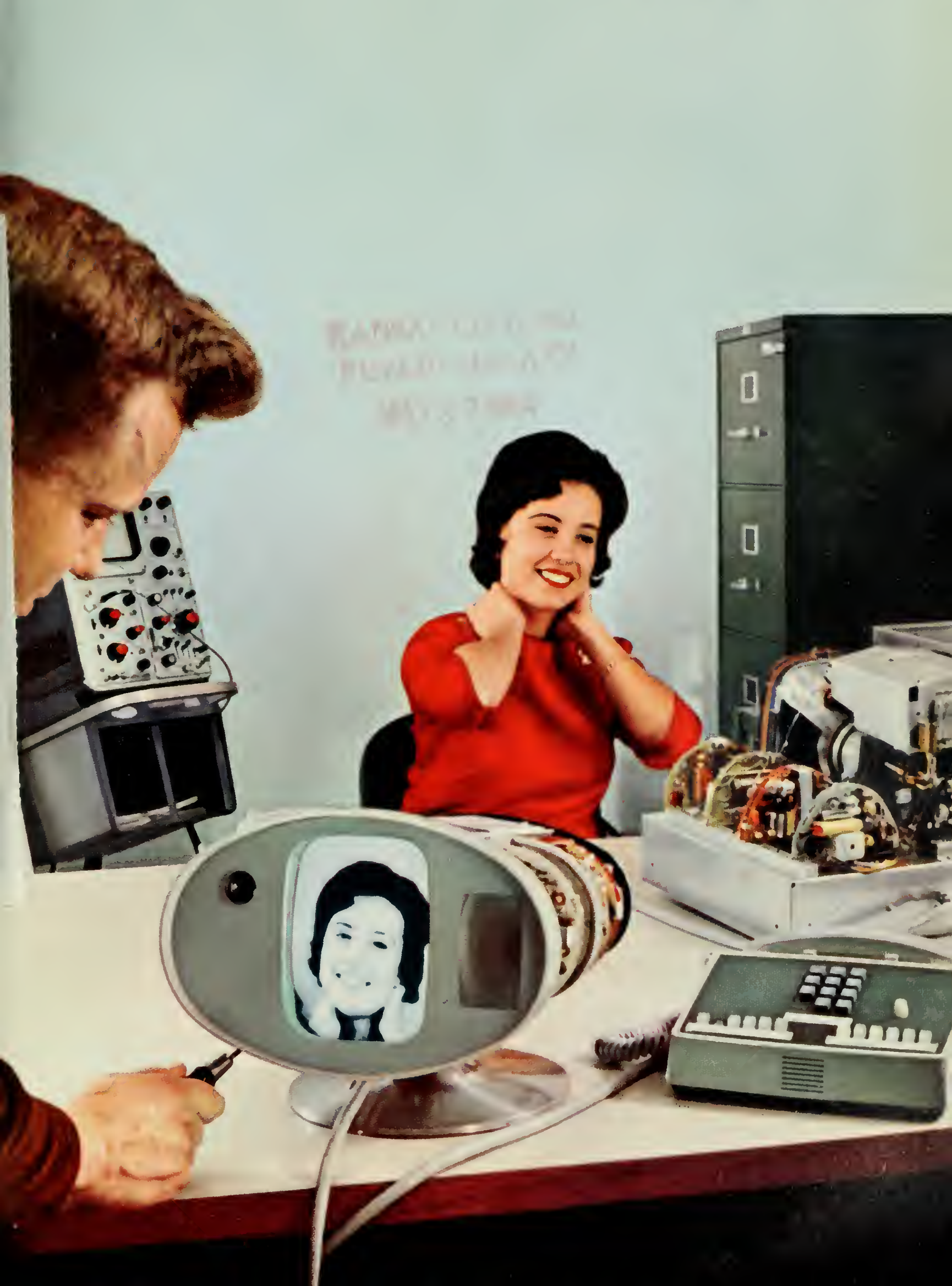
BELL TELEPHONE MAGAZINE

SPRING 1964



Experimenting with PICTUREPHONE

Board Chairman F. R. Kappel pauses to talk with a group of share owners after the 79th A. T. & T. annual meeting. At the meeting, held in New York City on April 15, Mr. Kappel told share owners that the business "is in a sound and healthy condition." He thanked them for "their splendid support of the new stock financing" which he said has brought more than $1.2 billion in new capital.

BELL TELEPHONE MAGAZINE

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A non technical review, published quarterly to give Bell System management people a broader view of the history, objectives, operations, and achievements of the business than they might attain in the course of their day-to-day occupations, and an added sense of participation in the problems and accomplishments of our nationwide public service.

Cover:

Photograph shows experimental testing of PICTUREPHONE set (left foreground) at Bell Telephone Laboratories. Set is being developed for PICTUREPHONE Service, subject of an article on page 14 of this issue. The first transcontinental PICTUREPHONE Service call was made April 20 from the New York World's Fair to Disneyland in California. Market trial of the new service is expected in the next few months, although service for private businesses and residences is still some distance in the future.

SOME REFLECTIONS ON COMPUTERS & HISTORY

Henry M. Boettinger, *Assistant Comptroller A.T.&T. Co.*

THERE IS AN INCIDENT in the last half of Tolstoy's great novel, *War and Peace*, which has deep meaning for those of us concerned with the application of computers and clerical procedures to our business.

Visualize the great Marshal of France, Louis Nicolas Davout, the military governor of Moscow, seated at a large table in the ballroom of a Russian noble's house. The table is covered with papers and two sentries stand near the door. Candles on the table furnish the only illumination. Suddenly, there's a commotion at the door, and the sentries cross bayonets to bar a stranger. This stranger is one of the heroes, Pierre Bezukov. His beard is frozen. He is ragged and dirty, yet demands to see the Marshal. The guards forbid it, but the Marshal, bored with the signing of large stacks of paper, allows them to admit him.

The Marshal asks his business and Bezukov replies that he is unjustly accused and his name is on one of those lists of papers before the Marshal. These are lists of persons who are to be executed for setting fires to Moscow. The Marshal, up to this point, has just been signing the lists on pieces of paper without any reflection on their human significance. On meeting Bezukov face-to-face, he can no longer do this. So the scene ends with Bezukov, the Marshal and his aide searching vigorously through the papers for the list with his name. On finding it, the Marshal boldly strikes out his name, dismisses him, and then sits down to sign all the rest of them!

What's the lesson here? That it is easy to make great errors or remove ourselves from reality if we manage affairs entirely by paper. This awareness is even more important in developments of today for we are in the process, in many cases, of removing even the paper.

In talking about the effects of automation and computers in the Bell System, I believe it is impossible to appreciate what it means without thinking in terms of the future. But, the future must be considered in the light of the past effects of social and technical movements in the history of the world.

Let me explain. One lesson which study of the history of technology drives home to me with great force, is the essential unpredictability of those *secondary* effects which technological developments have on the social structure of society, business, the nation, or any other institution.

To illustrate, an author and journalist, with long experience in the Middle East, was asked recently: "What has happened to the Arabs? In the last thousand years, we've heard little from them even though they once led the civilizations of the world. But suddenly, in the last ten or fifteen years, we see great things happening; they seem to have found a sense of destiny, nationhood and unity, and are creating a great deal of activity with which we are uncomfortably familiar. What's happened? What caused this? What factors are at work?" The journalist answered that the invention of the Japanese transistor radio was a very influential factor! He went on to explain that every camel driver, every oasis, every little village, now had Japanese transistor radios which tuned to the "Voice of the Arabs," the characteristic name for Radio Cairo which, incidentally, operates 24 hours a day and is the largest radio broadcasting complex outside Russia or China. Now these widely scattered people —many illiterate—are suddenly able to receive a message in their own tongues which calls them to power and glory. They listen and act.

Now let's go back to 1948 and imagine that you wandered through the halls of Bell Laboratories at Murray Hill, when you came across three shirt-sleeved individuals and you asked, "What are you working on, fellows?" And they said, "You're in luck today, because we've just invented the transistor." I believe that if you had casually observed: "That's wonderful, and won't that be a great force for the unity of the Arab World?", they probably would have looked at you with some amazement—if they didn't call the guards.

Yet, this a problem that faces anyone discussing the impact of technology, such as the trends in the apparatus of automation, on society or our business. All we can do is to point out some of the forces we work with and it will be the resolution of these forces, plus political, cultural, and economic forces which dictates what happens to our nation, its society and our business in the future. I can't predict exactly when or what will happen, but here I will use the "other-things-equal approach" and point out the kind of developments one might reasonably expect.

Take another example. In the case of Martin Luther, there isn't one item in the theses that Luther hammered to the door of the cathedral in Wittenberg, which was not known for hundreds of years or had not been stated long before by heretics ranging from Huss, Wyclif and all the others now known only to specialists.

What made Luther different? From the narrow point of view of technology, he enunciated and hammered these heresies on the door at the very time that printing was coming of age. It had only been in the European world a short time when he brought forth his thunderous message. His virile prose, carried by the invention of printing, altered world history.

If you had gone to Gutenberg and asked, "What effect do you think printing will have on Europe?", he might have replied: "I'm interested in getting out some books." Just as today, if you ask some Accounting people, "What effect will computers have?", they will tell you, "I'm interested in getting out some bills." We could multiply these examples interminably, but the only important point is that no one can predict precisely what the organizational and social implications of a particular change will be.

One thing I think we can say is that predictions found in Sunday supplements every now and then—the "gee-whiz" school of projection—are often sterile because they merely say that this invention or that particular piece of technique will mean that everything we are doing now will merely be done faster and in greater quantity.

These projections are of the kind you might expect from a foreman on the pyramids of Egypt, as you showed him a power crane. You might have asked, "Tell me, sir, what effect do you think this power crane will have on Egyptian society?" And being highly sophisticated in mechanical devices he would say, "Obviously what we can expect is that we will be able to build pyramids much higher and faster and perhaps every Egyptian will be able to have a pyramid of his own." We know, of course, that this isn't the the kind of thing which we are projecting. We often see projections of technical inventions which are shortsighted and do not take account of all the possible ramifications, but it is necessary for us to sense some of the changes in direction which will underly the response of society and of our business.

One way to look at the history of political, social or business organizations, is that their evolution has been influenced to a great extent by the control systems available to them. We can, of course, look at these from several points of view—economic, military, social, and so on. But here let's think in terms of the developments in world history as responses to the control systems which were available.

In prehistoric times, the cave men had to operate in essentially a "real-time" operation. There was no time to store food. Things had to be done quickly as problems presented themselves. And this approach, where the response to conditions takes place immediately, is really the natural mode for human beings. This is the way most of us operate every day in our own work.

In the formation of the Greek city-states the area of development of any particular city-state seems related to how far a man could go in a two-day journey; one day out and one day back. Almost none of the Greek city-states developed a geographical size larger than a two-day journey. This suggests that the time for decisions and problems—the delay one could tolerate in arriving at decisions—was limited by the communications system. It was also limited greatly by the diversity among the city-states, with no general agreement on what the desired goals of society were.

In the case of Rome, we see decentralization, only because certain technical inventions permitted the administration of a much larger area. The first of these was the legal system which is similar to our body of operating practices. These practices allow us to have a decentralized operation with uniform application. The Roman system of law was a great technical invention, and was coupled with the use of disciplined armies and the building of superb roads which allowed information including descriptions of major problems to be sent back to the capital for timely, yet far-reaching, decisions. This system overextended itself and, in its collapse, centralized decisions could not be maintained partly because the roads were destroyed by the barbarians, and the armies could not enforce the uniform legal code.

Think in terms of this, if you will, that capitalism was feasible only after we had the technical inventions of money and credit, a great deal of literacy, and in my own particular area, the invention of double entry bookkeeping. It is impossible to imagine capitalism and the building of modern nations without these controls and organization, the record keeping so essential to private property, and so on. So much, then, for this rapid excursion into control.

What has been the pattern of this history? It is one of growth to larger units over many years, but the growth is always limited to the control system of communication, awareness, and decision which has been available.

What do we mean by control? Control is a tricky word in English because it means, from one point of view, the control of crime, disease, behavior—i.e., restraint. But control also has the meaning of controlling an airplane, car, or battle. When we use the term control in "management control system," we mean a timely adjustment of forces inside a business to unforseen or impossible-to-plan-for changes in order to achieve a goal. It is not constraint, but adjustment to circumstances as they change the operating environment.

Now, what is the management ideal which we would like to attain? I think it is to give our customers service from initial demand through final supply, in the shortest possible time with the minimum required resources.

One of the best illustrations of this appears in the *Autobiography of Benvenuto Cellini* where he describes the casting of a great statue—his "Perseus." This is worthwhile reading because it illustrates what personal management, motivation and involvement can really accomplish under critical conditions of time and effort.

Cellini secured the funds, set up the shop, hired the men, and started something which all contemporary experts said was impossible. In the midst of his trials, they prepare for the casting. As he starts a furnace of his own design to melt the bronze, the shop catches on fire. He then has to supervise the fire fighting. Just as the fire is put under control, heavy rain pours into the shop and he suffers severe chills. He then retires to bed. While in bed with a fever, he gets frantic messages from his men that the

SOME REFLECTIONS ON COMPUTERS & HISTORY

molten bronze is caking up the furnace and that the entire project will be completely ruined. He dashes from bed shouting at his force. He arrives on the scene, throws in hundreds of pewter pots and dishes from the neighborhood, commandeers everyone's wood, and rekindles a roaring fire to the accompaniment of the cheers of his men. Just as the caking is reduced from the metal, the furnace explodes. At that point he sends everyone outside to pray! In the midst of confusion the men scratch a ditch in the floor which conducts the metal from the exploding furnace into the mold which rests in a large pit. They do this successfully, and we have as a result the great statue which stands serenely in Florence today.

I'm not suggesting, of course, that we can run the telephone business that way. However, I think the anecdote illustrates the objective—the total involvement of managers which comes from a sense of the actual things they are accomplishing; should this not always be in our mind in our dealing with motivation? How do we explain the great sensitivity that all of us have to the lapses in service from recounted experiences of our friends and acquaintances, and also from people inside the business? I submit that this springs from the irresistible impact of an experience in the real world, contrasted to the vicarious world of reports.

Today, computers—the present generation of computers—allow this kind of involvement in the operation of a business on a large scale. This is a significant fact for us today, together with the awareness that present machines possibly allow a rehumanizing of work in the future as contrasted to past mechanization systems.

In talking about service, we are usually talking about progress, for we most often plan for progress in service. I know that in many discussions and meetings, when one hears the word "progress," there seem to be differences in understanding. People split into two groups and, I submit, this is because progress in itself implies a certain relativity. One group thinks in terms of progress as improvement over last year, or last month, or last week. These are the relatively smaller differentials in gains which they have focused on and which are absolutely necessary. Their sense of progress is a brick-by-brick accomplishment. The other group is often more impatient. Its members see a certain goal, and measure their sense of progress not by distance away from where they were, but by how close they are getting to the ultimate goal. This relativistic attitude of progress is a healthy thing because we cannot get to our many goals without incremental departures and accomplishments, but we will not get to any goal unless we know where it is and what we are trying to accomplish. I believe that in improvement or progress in service *from the customer's point of view* we're going to have a diminishing return from improvements in instrumentalities which he uses.

The current sophistication of the American public makes them take technical advances for granted—almost as their right—and greet some of the greatest breakthroughs of the scientific world with a yawn. For instance, electronic switching. It is a tremendous advance, but many of the electronic switching features which can now be made available in mechanized systems, will be absorbed by the customers as "inevitable" progress to which they will not give a moment's thought. The fact that customers take their service for granted is our greatest accomplishment. But it creates a problem in that their awareness of its quality is often only realized when perfection is not experienced.

Transmission improvements—some of the greatest accomplishments that we've ever made—after a point are imperceptible to the customer. There was a day when people literally yelled to be heard over long distance circuits. Today normal conversational levels are adequate. Our

future efforts to eliminate noise and improve quality for exact reproduction of the talker's voice, while requiring great effort and technological progress, can be expected to produce little acclaim from our customers who already expect perfection. Since people *do* expect perfection in the mechanical aspects of our job, I believe that the greatest future opportunities for making the customer aware of service improvement lie in the personal contact area.

For instance, no amount of mechanical perfection in the daily "what-the-customer-expects" areas of the service will ever replace the warmth of repairing a telephone on a stormy night, at a vacation house. I know an economics professor who remembers just such an incident and it happened 25 years ago! Customers don't forget a perseverant operator in a family emergency, the straightening out of a complicated billing arrangement, or the skillful handling of a difficult information request. These are the areas where the essentials of humanity and personal interest are as old and effective as they were long before the telephone came into existence. If we can do something to make it easier for the people who handle unusual calls, orders and billing, repair service, intercept and information services, it will have a profound impact on the awareness of service improvement in the customers' minds.

Now, what are the prospects? As an example, a few weeks ago in Detroit, I saw an experiment. It was relatively crude, but all of the greatest journeys begin with one step and the implications here must be looked at from longer range perspectives.

First of all, the people who devised the experiment had joined an electric typewriter to a computer. (This terminal equipment will undoubtedly be changed and the opportunities for sophistication here are very great. The Teletype Corporation is intensely at work on such devices). This typewriter was connected to an ordinary telephone line using DATA-PHONE service, which was dialed to Poughkeepsie, N. Y., where a small computer had stored in it many, many facts about typical telephone operations. One girl sat at the typewriter; another simulated several customer contacts.

The girl at the typewriter had no pads or paper, no files of records, no pencil, no handbook, and she was not a fully experienced service representative. The customer came in on an intercept call and said, "I'm calling 555-2368." The girl with the typewriter said, "Thank you," and, as she was talking, typed on the typewriter, "555-2368." By the time she had finished "eight," back came the message on the typewriter in red (she had typed in black), "Changed to Chicago," this was followed by the new Area Code and seven digits all typed on the type-

writer. She gave the information to the customer who thanked her. The girl then hit one button on the typewriter and was ready for the next transaction.

She then took an order for new service, typing with one finger the customer's information as given to her. First she typed "I," and the computer wrote—"Name?" As it did this, she asked the name and typed it to the computer, then the computer asked for "Address" and so on, item by item. It also asked several sales questions, and she filled these in—extensions and so on. At the end of this, the machine came back, giving the new telephone number and installation times available.

The customer was asked "would after 3:00 tomorrow afternoon be fine?" She said, "I would prefer 9:00 the next morning." The girl typed that in, read the information back to the customer, gave her her new number, pushed one start button and all of the things she had typed in the contact with the customer, read back to her and verified, were immediately in the computer memory and constituted our new records. The cable was assigned, the number was assigned, and the girl was off the line.

Then we had another customer who called and said, "I want to disconnect my telephone." Typing "0" our girl typed in the telephone number with one finger, the computer came back with the customer's name, address, current balance on the bill, amount of equipment—all typed up within seconds, and the girl proceeded to carry on the contact with this information available to her. Then at the end, all things verified and correct, the girl asked if she wanted charges applied to the next bill, or would the customer rather have a final bill? As the customer said, "Final," and the representative typed "F," the computer asked, "Where send final bill?" She had forgotten that, so she said, "Where shall I send it?" The customer gave her new address and that ended the contact.

These are examples of what has come to be known in the computer art as "the conversational mode." It is a result of the real-time emphasis of the very recent past. The point here is that the technology is available today and we don't need any "breakthroughs." The question of economics is, of course, unresolved at this time, but in my opinion it is only a matter of time before such things become absolutely economically feasible.

Of what significance is all this? When you get the human quality of contacts that I observed, you can see the exciting potential impact that this could have for putting "fun" back into the job. The frustration of inaccessibility to records or "I'll have to call you back," or "I'll have to check with the Plant Department," or having to send a verification of directory slips—all the things of this kind which currently plague us and our service—could disappear.

It is significant that we are not suggesting removing people from the contacts. Humans will still talk to humans and be masters of the machines. The net effect will be to remove those delays and irritations which get in the way of good customer contacts, in order to really improve our service.

Don't think that the computer is going to dictate the contact and that you're going to have to synchronize yourself to it. The generation of computers that I'm speaking of—random access, real-time systems—have almost unlimited capacity for fact storage and flexibility. They will be servants, not rigid, demanding auditors. Many things remain to be worked out, but my point here is that the potential for this kind of operation exists.

Access on a random basis to all relevant information for customer contact and for management decision offers whole new areas for imaginative exploration. One aspect here is we could have a lot more ideas tried out as simulations, like airplane models in a wind tunnel. We could predict the probable impact of certain decisions and alternatives. We could do it by using *all* the data of an entire operating unit as a model.

For instance, as cities grow, certain areas and communities want to call others on flat rate charges and we never know with precision what the shifting patterns of costs and revenues will be. With present techniques, we don't do this very easily. We must use very elaborate statistical approaches, take samples of traffic and so on. But under newer computer techniques, we could take all of the traffic, literally *all* of it. Every bit of toll business for a week, a day, or a month and reprocess it under any number of new rate plans and study their effects. This is a good case of a job that just could not be done before, but which becomes possible because of automation, and leads to improvement in customer service.

We might also do dynamic network management. We sometimes describe our network, by comparing it to a spider web; if one piece breaks, the others take up the slack. However, a spider web experiences constant equilibrium—the strain caused by a break is automatically compensated and re-distributed. This is not completely the case in our switching network today, for it requires a high order of manual intervention on the part of network managers. The Long Lines Department has under way a great pioneering computer project for improvements in this area. But it need not be confined to the total intercompany network. With the kind of machines that are becoming available, it is conceptually possible that computer techniques could be used to constantly re-configure the network based on data secured directly from the actual traffic in real-time, i.e., as it is presented. Such a system could change the switching networks to respond instantly to varying traffic patterns according to prearranged strategies built into the computer programs by the Traffic engineers. These strategies could be altered readily whenever management criteria changed.

I think the time is coming when we will have a reduction in forms. Their reason for being is severely diminished in real time; if we don't have to process in batches, you don't need to fill out many forms and keep checking records to trace inquiries.

I also think that we can program questions as described in the Detroit experiment. If you want to change a training program, add or delete certain features, or start sales campaigns in certain areas or you want to modify a campaign in other areas, all this can be programed in these machines. We could train people differently in different areas, we could put specialists on certain kinds of transactions, combine and divert others and so on. In other words, we may have complete training flexibility based on local conditions. This could enhance the process of bringing people along to more responsible jobs. It is possible that we could have every kind of human contact—repair service, intercept, information, collections, new or disconnected service—handled by one contact person, if she gets the questions and knows how to enter the information. I should add that I don't think we are going to get there for many years —if ever—but the possibilities for organizational flexibility and job interest are intriguing.

Under the impact of computers, the criterion for advancement in the future may be less on a specific expertise (and that body of obsolete information which often hides behind the good name of experience), and more on the ability to keep learning in the face of continually obsoleted skills.

We work every day on destroying the monuments of individual's contributions in the past. In time, other people will be at work on our contributions and on the contributions of those who will supplant ours. This kind of world requires a much different orientation, for where do you get your feeling of contribution?

The ability to learn in the face of continually obsoleted skills, in the face of the knowledge that these skills must be obsoleted for progress, will call for deeper and newer knowledge of human motivation. The difference is that we will treasure people who really have 30 years experience, but be less than satisfied with those who have one year's experience repeated 30 times. As in the past, we will, of course, continue to retrain people in these newer skills.

Now, in all of this ferment there is never a lack of theories of organization. We hear all manner of ideas as to how things ought to be changed, and how we ought to be functional or multi-functional, and why we ought to have this unit in that department, and so on. I have heard these theories since my first week in this business and I have flip-flopped between the various schools of thought. These theories of organization generally have their origin in problems. Specific problems arise, weaknesses become apparent and we alter the organization to take them into account. Very rarely does an organizational change come as a result of an opportunity as such.

Many of these organizational theories are like heresies that floated about Europe before printing. But, just as printing came along and helped make some of the heresies that Luther selected the ones that prevailed in many parts of the world, I think today that computers can make certain of these organizational heresies more likely and possible than others. (Remember, "heresy" comes from the Greek word for "choice.") This is my own view, but happily many other people are thinking in this area.

One theory has been developed to some extent as an exercise. No one is seriously suggesting putting it into operation today or tomorrow, but there has been a lot of work done as to what approaches one might take. The exercise starts from the two points of what computers can do, and what the job of the business is. The functions fall into roughly three categories—aside from staff functions such as legal, public relations, personnel and so on. The categories are: those people who *process data;* those people who *do things for customers;* and those people who *plan things for the company and the customers.*

We then have processors, doers and planners, if you will, or to put it in another way, those people who deal with the *past*, those who are dealing with the *present*, and those people who are dealing with the *future*; or those who deal with customers as *data*, those who deal with customers as *individuals*, and those who deal with customers as *aggregate groups*. Notice that this organizational structure places people in groups based on their time relationship to the customers, and not on the type of facility or type of inventory one is controlling—"inventories" of skills and equipment.

The computer makes this sort of thing

possible but I'm not saying it makes it necessary. Some of us who have been thinking about this, and people who have been involved with similar problems in other businesses, see this as one logical solution. Now, it takes a lot of work, a lot of risk, to put such systems into operation. Shortages of talent and funds for investment, vested interest and human inertia will be delaying factors. My point here is that this is a system which makes logical sense in terms of operating with computers in a business geared to increasingly complex facilities and customer demands with little or no lead time tolerated.

For instance, in putting in a real-time system, a group in Ohio Bell has found that one of the greatest inhibitors to understanding and implementation is the organizational barriers between existing departments. This confirms the experience of many other businesses. We have also found in A.T.&T. that all of the real problems that one is dealing with in data processing are of a multi-departmental nature. The only cases that involve single departments are trivial. The organizational structure is going to alter subtly, perhaps like a glacier, because, in order to take advantage of these efficiencies, it is necessary that de facto changes (even if they are not made official) and methods of functioning interdependently take place. Organizational arrangements should always be designed to make it *easier* to do things *better*.

Now what do we really mean by an efficient organization? Generally only two things: it means that we do things faster, or that we do them with less resources, given a certain set of goals. These are the only two things which bear on the concept of efficiency.

If you want to do things with more speed or use fewer resources in the modern world, there are new techniques that can help. Operations analysis, program evaluation procedures, input-output analysis, critical path scheduling, linear programming and others are now becoming widespread. Even the Russians are beginning to use linear programming and input-output techniques for their economic planning improvement. Defense industries must submit, in most cases, with their bids or specifications, their method of job control and review. These methods are usually not possible without computers.

Some may say, "We don't have to go to this, it's not necessary; we'll hold off, wait till people prove these things in before we do it." There are two reasons why I don't think this will happen.

First of all, as a business we've always prided ourselves on being in the vanguard of progress. We could never tolerate the feeling that we were using backward methods.

Second and more tangible, is that right now in the Comptroller's Departments alone we have about 2,500 people—some of the brightest, brainiest people we have —who are engaged in electronic data processing staff work. Another 900 in other departments are doing the same kind of work. Everyone is trying to make contributions, each is in competition with all the others. Opposite them is an array of business machine manufacturers ready and eager to help with problems and to work toward solutions with them. Research and development is being advanced on a wide front by literally hundreds of manufacturers of great capacity and talent. These firms study their customers' problems and organize to implement solutions based on the new apparatus.

I would like to close on a story which I feel has pertinence to our present conditions: It seems that Destiny came from out of the sky one day several hundred years ago, to visit a tropical island, and talked to three men. He said, "Answer this question. What would you do if I told you that tomorrow, I'm going to have a large tidal wave wash over this island?"

The first was a Cynic, and he said, "I think we had best prepare a great feast, get all the drink and food we can together tonight and have a great party, for, after all, this is our last night on earth."

He then asked the Mystic, who said, "I think we should build an altar here, select our best animals for sacrifice to you, in hopes that we can alter your opinion of us, so that you will change your mind."

Meanwhile, the third man was hurrying off down the road. Destiny asked, "Where are you going?" This was a Man of Reason who answered, "I had better get down to the village as rapidly as possible, because I want to round up all those who know something about living under water."*

During this period of automation and computers which coincides with the expectation of continual rise in the level of living by all people, we're all going to have to "live under water" for some time. We in the telephone business, as well as in our nation and the world, are going to require such "Men of Reason" in increasing numbers.

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*Based on a passage in **Captain Newman, M.D.**, by Leo Rosten, published by Harper and Row, Publishers, Inc.

Note: This article has been adapted from a talk given by Mr. Boettinger before the Bell System Public Relations Vice Presidents' Conference, October, 1963.

What specific features will customers want most in a service that provides a new dimension in telephoning—the use of sight as well as sound? World's Fair visitors are helping Bell Laboratories engineers to find out

Developing PICTUREPHONE Service

Arthur D. Hall, *Head, Television Engineering Department, Bell Telephone Laboratories*

IMAGINE, IF YOU WILL, a service which permits you to have a face-to-face conversation with a person who may be many miles away—a telephone conversation in which you can see every expression of the distant person. Think for a moment what this might mean in terms of a "reunion" with a friend or relative in a faraway city. Consider the advantage of being able to show or be shown an object difficult to describe in words and consider, too, the possibility of a person with a hearing defect being able to read the lips of the person at the other end of the line.

These are just a few of the intriguing prospects of PICTUREPHONE service which was demonstrated for the first time on April 20 with a transcontinental call between Bell System exhibits at the New York World's Fair and Disneyland. Visitors to the Bell System exhibits at the New York World's Fair and at Disneyland are trying it out now. It features a simultaneous telephone conversation and picture, both of which are switched through conventional telephone central office equipment.

Those who try PICTUREPHONE service will have a novel personal experience. For the first time they will encounter a new dimension in telephoning—the ability to use the sense of sight as well as of hearing. But at the World's Fair, the PICTUREPHONE system is far more than a novelty. Its purpose is not entertainment alone. It is actually a part of a carefully planned experiment designed by Bell Laboratories' engineers to make this new concept as useful and valuable as possible to customers at the time when it can be offered commercially.

The basic idea is not new. Indeed, if you are a science fiction fan you may be somewhat surprised to learn that PICTUREPHONE service is just now an accomplished fact. As far as the pages of fiction are concerned it has been a familiar prop for some time. Certainly in the Bell Laboratories it has been a subject of experiments and development work for many years. From the technical point of view we know, today, how to provide such a service. Indeed, the present setup at the World's Fair is evidence that it is quite possible without going beyond today's technology.

What Will Customers Need and Want?

Nevertheless, before a complete system can be successfully designed and built there is much more that we need to know. All of the potential uses of the PICTUREPHONE service depend on which specific characteristics and capabilities are built into a system. Before we can determine these, we need to know what potential customers will need and want from such a system after the novelty has worn off.

Such information is basic of course. In fact, customers' needs largely determine the fundamental technical and economic requirements of any system. But in a service as new as PICTUREPHONE, an understanding of the customer's point of view is essential. What specific uses will a customer consider most important? What quality of picture will best serve these uses? Which features will he prefer and what controls will he need to activate them? How often would the typical customer use PICTUREPHONE service, at what times of day and for how long? We need detailed answers to such questions as these so that systems engineers can make realistic assumptions about what compromise a customer would make if he had to choose between a system's features, its performance, and its cost.

This kind of information is now being compiled in a program of studies and experiments. A vital part of this program consists of observing how people use and react to experimental systems complete

L. A. Meacham at his desk at Bell Laboratories talks with and views author A. D. Hall on experimental PICTUREPHONE *set. Both engineers helped develop the visual telephone system.*

with PICTUREPHONE sets, transmission and switching facilities.

Fortunately, many devices and techniques currently in use are readily adaptable to experimental PICTUREPHONE systems. Solid-state electronics makes possible PICTUREPHONE sets that are small and highly reliable; that operate on low power and that produce good pictures without studio lighting.

CHRONOLOGY OF VIDE

Related Research on Television Transmission Over Communications Lines

April 7, 1927—The first public demonstration in the United States of the transmission of television over telephone facilities took place at Bell Telephone Laboratories, New York City, between Walter S. Gifford, president of American Telephone and Telegraph Company, and Secretary of Commerce Herbert Hoover in Washington, D.C. At that time Mr. Gifford's remarks included the following: "The principles underlying television, which are related to the principles involved in electrical transmission of speech, have been known for a long time but today we shall demonstrate its successful achievement. The elaborateness of the equipment required by the very nature of the undertaking precludes any present possibility of television being available in homes and offices generally. What its practical use may be I shall leave to your imagination. I am confident, however, that in many ways and in due time it will be found to add substantially to human comfort and happiness.

1927. *First public demonstration of TV over telephone facilities took place.*

"It is our constant aim to furnish this country with the most complete telephone service possible. In connection with that aim, we endeavor to develop all forms of communication that might be supplemental to the telephone. With that in view, we shall continue our work on television, which although not directly a part of telephone communication, is closely allied to it."

Later, Mr. Gifford added, "As it is now, it is a giant mechanism which takes up nearly half a room.... Of course, it will be a long time before the ordinary telephones will be provided with devices for television. A great deal of work must be done on them to make it practicable to use them in our system. But we will some day, I have no doubt".

1929-1931—A similar system, the first two-way television transmission system, was set up and operated between the American Telephone and Telegraph Company headquarters at 195 Broadway and Bell Telephone Laboratories at 463 West Street, New York City. This system was in operation for

A Two-Part Experiment

Our experimental program has two parts. One system has been operating between Bell Laboratories' Murray Hill and Holmdel Laboratories for the past two months. A number of PICTUREPHONE sets, divided between the two locations, have been connected by ordinary unshielded pairs of conductors in telephone cables to switching centers. Trunks between the two locations use a microwave radio link and a baseband repeatered line. Bell Laboratories engineers taking part in the experiment have been using this system in their daily business.

The second system is the one in operation at the World's Fair. This consists of seven sets in individual booths and another set used by an attendant. All sets are con-

.EPHONE RESEARCH

two years and included the transmission of outdoor scenes, color television, and motion picture films.

Television-Telephone Research

1935-1938—A television-telephone service was operated by the German Post Office between video-telephone centers in four cities: Berlin, Leipsig, Nuremburg, and Hamburg. To make a video call, the public made appointments in advance to be at the centers at pre-arranged times. Operators made the connections manually with plug-in jacks. The picture sets were large. Signals were transmitted over coaxial cables.

1955—Kay Laboratories of San Diego, California and Pacific Telephone and Telegraph Company (Bell System) demonstrated a two-station video-telephone system over a distance of one mile.

1956-1963—Bell Laboratories devised a system plan, developed and tested an automatically switched, experimental system between two Bell Laboratories locations, 25 miles apart.

1963—Reports were received from Italy and Japan of slow-scan video-telephone experiments. Russia reported a public video-telephone service using regular TV network facilities during nonbroadcast hours.

1963—Pye Telecommunications, Ltd. exhibited a television telephone at the Business Efficiency Exhibition held in London. The set included a 19" screen, a loudspeaker and a miniature television camera. This was used with a desk unit incorporating a loudspeaking telephone. Up to ten extensions could be used in the system.

1964—PICTUREPHONE service demonstrated to the public at the New York World's Fair. The first transcontinental call is made April 20 by William L. Laurence (below) science consultant to the New York World's Fair from the Fair to Donald Shaffer managing editor of the Anaheim, Calif. **Bulletin** at Disneyland.

1964. *First transcontinental* PICTUREPHONE *call between World's Fair and Disneyland.*

nected to a switching system that permits a visitor to call an attendant or a visitor at another station.

We were faced with a very considerable problem in constructing these systems: how do you arrive at even temporary requirements that would reflect what customers might want in a PICTUREPHONE system before there is any experience to draw on? In other words, how do you anticipate the answers to the very questions the experiment is set up to help determine? The telephone was a known factor; the accompanying picture was not. We solved this problem in part through the design of a variable-parameter picture system that can develop millions of different sets of picture characteristics.

A TV Laboratory

This flexible system is used in a special laboratory set up to carry out subjective tests on television pictures. The laboratory consists of two television-viewing studios and a control room containing two variable-parameter systems. Each system has a camera, a control panel, transmission path filters and two television receivers. Each has a dual set of controls—called "red" and "green" parameters—which can be used to prepare two different sets of pictures.

A person taking part in the experiment can view the red pictures while a second set is being prepared with the green. By throwing a switch, the operator of the system can change immediately from one set of pictures to the other to facilitate pair comparison and make other subjective measurements.

The system is variable over a wide range of picture parameters (size, frame rate, bandwidth, etc.). Contrast, brightness and spot wobble (a technique for softening a picture that has too prominent a line structure) can also be varied over wide ranges. The viewing conditions of the studio can also be altered. For example, the lighting system can be used to produce a wide range of spatial and spectral effects. This flexibility has great value in studies of such problems as glare, picture tube surface treatment to reduce washout from ambient light and reflection from the background. Because the transmission paths of the systems are quite free of impairments, known amounts of signal impairments can be introduced in order to determine acceptable levels of noise, interference and echoes for various picture standards. A laboratory of this kind offers a wide range of possibilities. Experiments may range from quite simple and straightforward ones to the most complex.

The experimental PICTUREPHONE systems were developed around picture parameters tentatively selected on the basis of information gained with the variable-parameter system. Among the major parameters selected were a bandwidth of about 500 kc; a picture four-and-three-eighths inches wide and five-and-three-quarters high and a viewing distance of 36 inches. Of these, the most important is the bandwidth. Although it is much less than the four megacycles of commercial tele-

Small PICTUREPHONE unit held by J. A. Mazzeo of B.T.L. is made possible by use of transistors, other miniature components.

Visitors at New York World's Fair are now trying the experimental PICTUREPHONE *system installed there.*

vision, it provides a very acceptable head and shoulders view of a caller if the other parameters are carefully chosen. It also helps to achieve economy because it simplifies using baseband transmission over ordinary cable pairs. Another advantage is that this bandwidth is free of interference from the radio broadcast band of 550 to 1500 kc.

Design Objectives

The general objectives of the PICTUREPHONE design included an attractively styled set, that would be small enough to be used on a desk or table top and with as few controls as possible to make it easy to use. It also had to be low in power consumption and heat dissipation, reliable, and stable in its performance. These demands were satisfied through a design that uses solid-state devices exclusively except for the pick-up and display tubes.

The set consists of three equipment packages: a display unit, a control unit and a power supply. The first two are in reach of the user; the power supply is out of sight. The largest of the packages is the display unit which contains a picture tube, camera, the scanning, synchronization and other video circuits and a loudspeaker. The control unit has a telephone handset, a Speakerphone and a set of TOUCH-TONE telephone push buttons.

One objective of the experiment is to observe the relative use given to the telephone handset and the Speakerphone. The audio line connects through relays to the PICTUREPHONE switching system as well as to the standard telephone switching systems so that both conventional telephone and Speakerphone services are provided on the same instrument. The user controls the system with push buttons and makes calls by means of the TOUCH-TONE telephone set.

There are push buttons to select either of two modes of viewing: one-way video in which the user receives an incoming picture but does not transmit his own, and two-way video. Another push button controls a "self-view" feature that allows the user to see himself on his own viewing screen. This feature helps him to position himself with respect to the focus and field-of-view of the camera lens. A lamp is provided for use if room lighting is poor. It can be switched on and off manually or be set to light automatically when the set is turned on. Novel circuits used in it do make important contributions to economy.

Gathering Data

One of the methods used to gather data on the system is a telemetry connection between the PICTUREPHONE sets and the computation centers at the Murray Hill and Holmdel Laboratories. Extra contacts on the control unit relays in the sets are wired over cables to the computation center. Data over these lines causes cards in the computation center to be punched as a record of a change of status for any set. Cards are punched when:

- A telephone begins to ring or stops ringing.
- A PICTUREPHONE set begins to ring or stops ringing.
- The main telephone goes off-hook when it has been idle, or goes on-hook after completing a call.

The following modes of using the sets are also recorded by card punchings:

- Whether the call is a PICTUREPHONE call or a regular telephone call.
- Whether the Speakerphone or the handset is used.
- Whether two-way or one-way video is used.
- Whether or not the self-viewing feature is used.
- Whether the lamp is on or off or arranged to light automatically.

The punched cards record the date of any of these actions and the time of day to the nearest millisecond. This exact record will facilitate correlation of all the punched cards when the experiment is completed. By comparing cards from both locations, it will be possible to study the use of the service in detail.

Rounding out this part of the experimental program, a digital computer has been programmed to accept the cards from the telemetry system and to derive statistical information from them such as:

- The mean and standard deviation of the number of off-hooks a day.
- The mean and standard deviation of the number of uses of the various service features (self-view, one-way or two-way video, etc.).
- The mean and standard deviation of conversation time, ringing time, and signaling time.
- The mean and standard deviation of the per cent of off-hook time in which the Speakerphone is used.

The telemetry data will be analyzed weekly until the statistics become stabilized. It should then be possible to draw some conclusions as to how the users of the system have reacted to it. Various circuit options will be introduced during the experiment and pertinent statistics collected to assess how they are used. Interviews with the users will complement the telemetry analysis. When the data from the analysis and the interviews become stabilized, the sample of users being studied can be changed.

Getting Users' Reactions

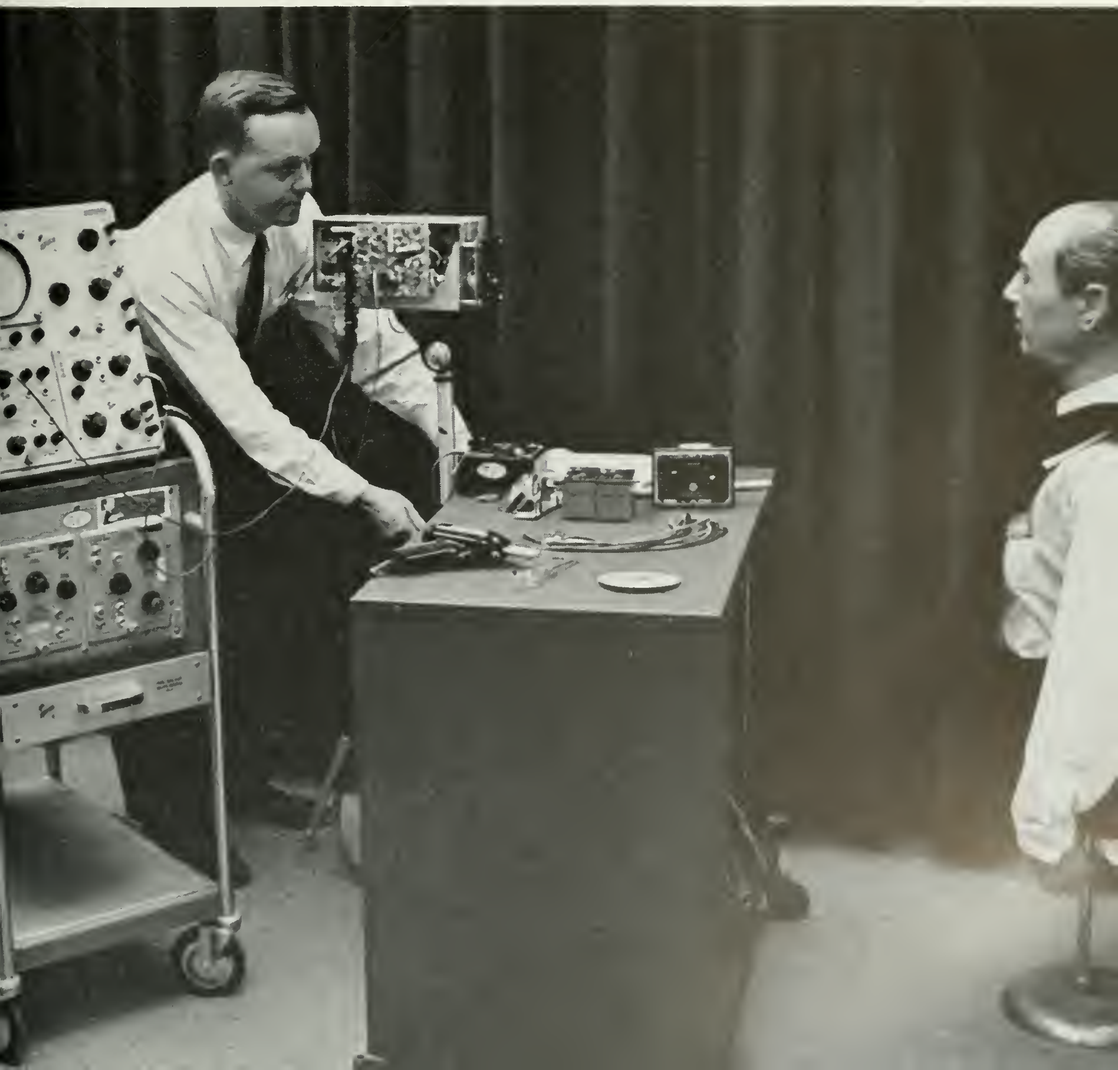
A sample of the World's Fair visitors who use the PICTUREPHONE system there will be asked for their initial reactions to the system. Because a large number of people will have an opportunity to use this system, differing attitudes after one expe-

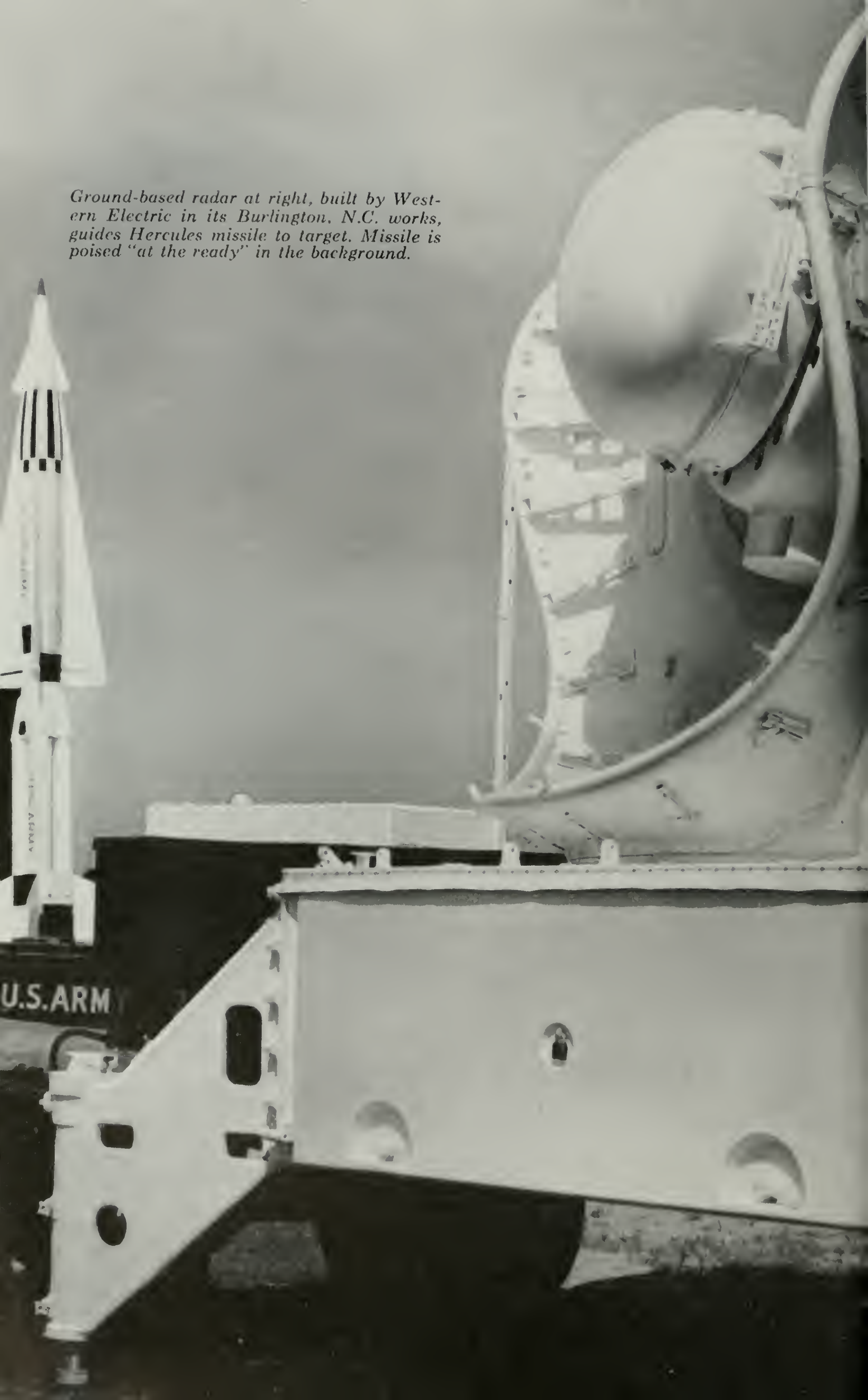
rience may be studied exhaustively. Viewing conditions may be changed to obtain an even wider range of first-use reactions.

Reactions to any communications system, however, will change markedly after a long period of daily use. This, of course, is a fact that motivated the Murray Hill-Holmdel system. Between information gathered on both experimental systems, it will be possible to assess the response of several samples of users. Thus, the data from both systems should complement each other effectively.

At this point it is still too early to predict when we will be able to offer PICTUREPHONE service to all our customers. Charles M. Mapes, assistant chief engineer of A.T.&T., explained to the press at the time of the first transcontinental PICTUREPHONE call that, "... Much further development work remains to be done before it will be possible to offer PICTUREPHONE service to the general public for residence and ordinary business use.... On the other hand ... a large company might find situations where communication by PICTUREPHONE might be attractive ... and you might visualize a situation ... where customers would come to a central location to make calls between family groups in distant cities. We are making studies of situations where PICTUREPHONE service might be justified ... and would expect to come up with some kind of a limited trial commercial offering ... within the next few months."

Dummy figure at right below is shown being used by Bell Laboratories Engineer Philip T. Porter in one of earlier experiments with the visual telephone system.





Ground-based radar at right, built by Western Electric in its Burlington, N.C. works, guides Hercules missile to target. Missile is poised "at the ready" in the background.

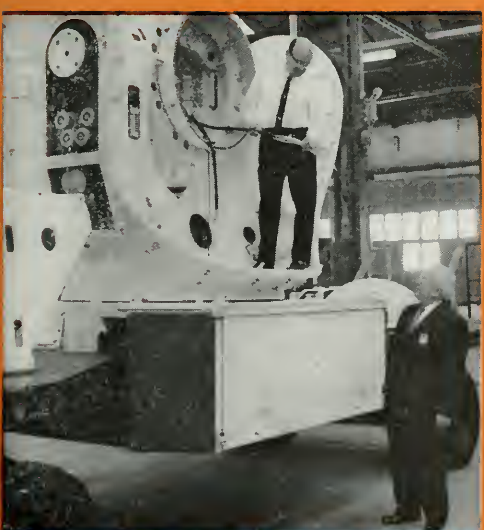
NIKE

The First Ten Years

When the first Nazi buzz-bomb screamed over London during World War II, the pattern of warfare changed radically almost overnight. That winged, rocket-propelled bomb foreshadowed the shape of things to come: supersonic aircraft, rockets and missiles that would make anti-aircraft artillery and searchlights as obsolete as a suit of armor.

In 1945, the Army asked the Bell Telephone Laboratories to explore the possibilities of a new defense system using proposed guided missiles. Later that same year, the Western Electric Company and the Laboratories were given full responsibility for execution of "Project Nike," named after the winged goddess of victory in Greek mythology. From that beginning have grown the Nike systems of defense—one answer to the threat of war as it is today.

Nike Ajax came first: an anti-aircraft missile system employing radars, a computer, ground equipment and a supersonic guided missile carrying a fragmentation-type, high explosive warhead. Just ten years ago, Ajax became operational with its first installation in Maryland. Next was Nike Hercules, whose larger missile was designed to carry a



W.E.'s S. C. Donnelly, right, a key man in production phase of Nike, with B. H. Terrell on radar tracking unit in Burlington, N.C. works.

"Family portrait" of Ajax, above, and Hercules, center, (not operational set-up).

Nike

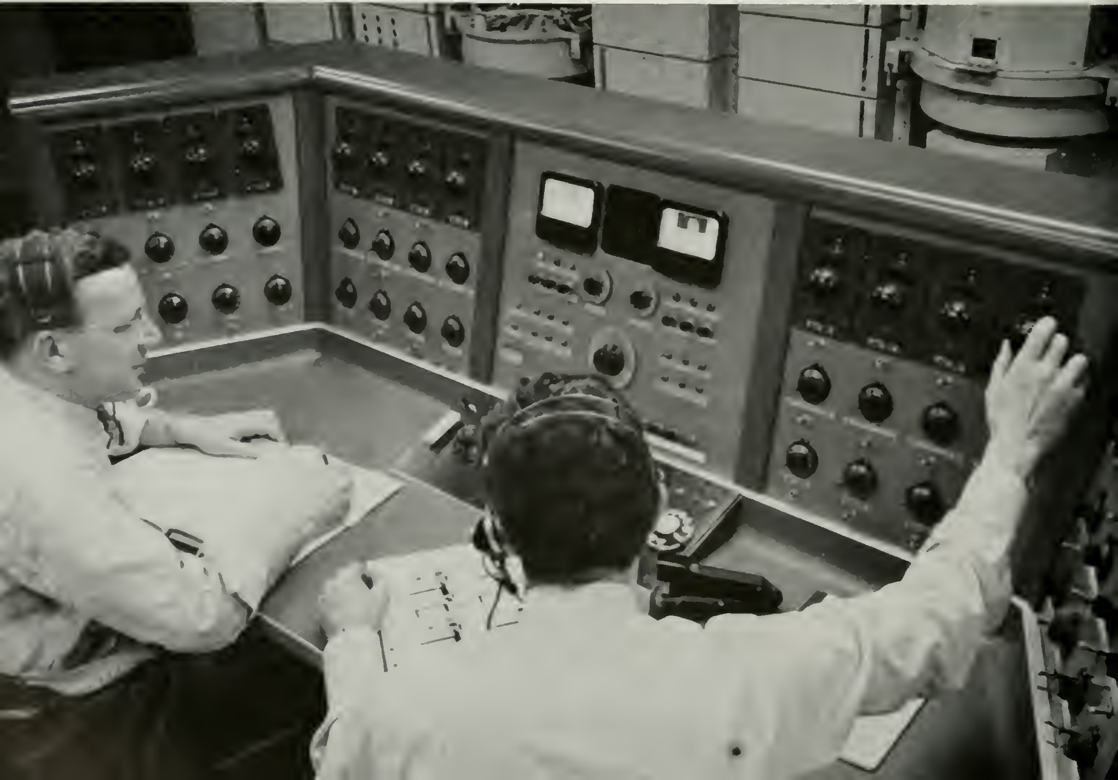
nuclear warhead capable of destroying entire formations of aircraft. It had greater range and speed than Ajax. Then came Improved Nike Hercules, utilizing more powerful radars and having the additional capability of destroying cruise-type and short-range tactical missiles.

The search for a defense against intercontinental ballistic missiles traveling faster than 15,000 miles per hour has led to much developmental work on Nike Zeus, now being reoriented toward the even more sophisticated Nike-X.

From the beginning, Bell Telephone Laboratories has handled research and development and Western Electric has served as prime contractor in producing all these complex modern weapons of defense. On these and following pages are shown some pictorial highlights from Nike's first ten years of operation in the defense of the nation.

Bell Laboratories engineer sets up simulated firing course, during developmental stage of Nike, by plotting course of missile and target.

The Simulator Master Control, special test equipment which enabled Bell Telephone Laboratories engineers to "fire" many hundreds of simulated missiles without the expense of using actual missiles on the range.



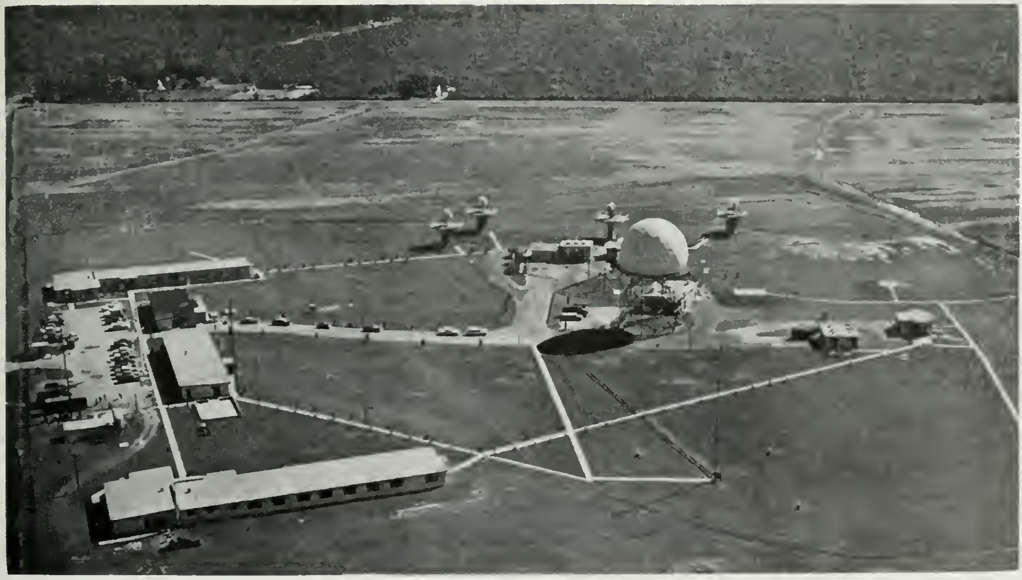
Ajax missile rises on elevator in underground storage area toward surface launching rack. Scene was at first operational NIKE installation in Maryland.

In early tests, Ajax missile roars skyward from proving ground. Proof of its lethal punch is shown by dramatic first intercept and destruction of drone B-17.

An Army sentry stands guard before acquisition radar installation at Improved Nike Hercules site.

Army missile-men check antenna of Improved Nike Hercules acquisition radar.

Nike Hercules stands guard at defense points across the U.S. and at many overseas bases.



Aerial view shows the layout of an improved Nike Hercules base in Maryland.

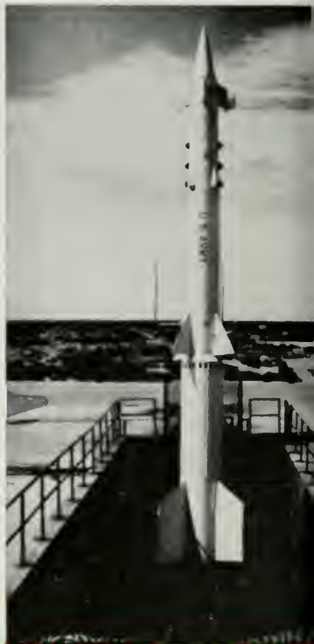
Nike

Hercules missile takes off to intercept another Hercules missile serving as target. The two approach each other at supersonic speed (right). On opposite page, the successful intercept.

Left to right, Col. M. Collins, then Chief, Research and Development, Army Rocket and Guided Missile Agency; L. W. Morrison, then Director, Guided Missile Development, Bell Telephone Laboratories; H. G. Och, then Director, Missile Systems Development for the Laboratories; and Gen. J. M. Colby, then Deputy Commanding General, U.S. Army Ordnance Missile Command. Occasion was a design and characteristics review to acquaint Army men with progress and status of the new weapon system.

High above the earth, missile intercepts missile in a cloud of destruction.

Nike Zeus and Nike-X

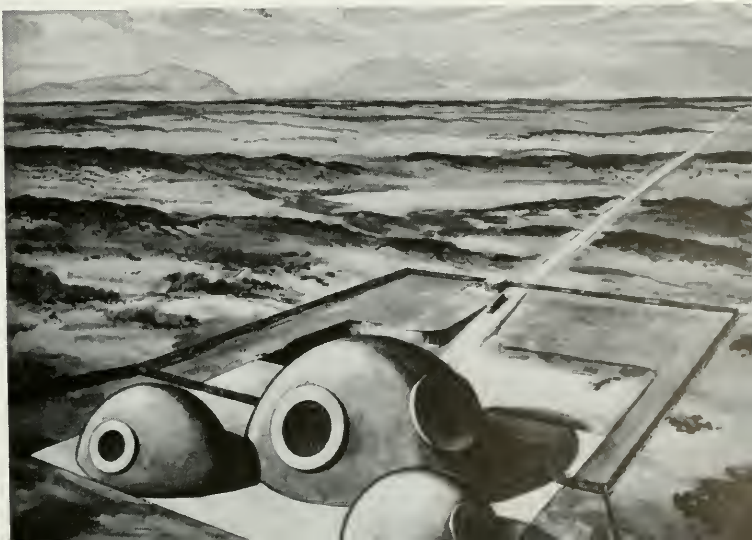


From top to bottom: Nike Zeus ready for flight; the fiery start of a test mission; the successful completion marked by a faint X near center of picture, where Zeus intercepted a Titan-boosted target vehicle. Bright flare is booster rocket case burning as it re-enters the earth's atmosphere.

Inspecting the front end of a Zeus missile are (from left) Maj. Gen. N. O. Ohman, Senior Air Force Member, Weapons System Evaluation Group (WSEG); J. W. Schaefer, in charge of Bell Laboratories installation at the tiny island of Kwajalein; Maj. E. A. Rudd, Pacific Field Office; Col. J. H. Swenson, U.S. Army, WSEG; W. T. Hunter, Douglas Aircraft Co.; and Maj. Gen. J. F. Ruggles, Senior Army Member, WSEG.

Discrimination Radar antenna, at left, on Kwajalein in South Pacific, used by Army in anti-missile-missile tests.

Target Tracking Radar on remote Ascension Island at lower end of the Atlantic Missile Range gathers data by tracking targets of opportunity launched from Cape Kennedy.



Artist's conception of a test version of the Multi-function Array Radar for the new Nike-X system.

Our Plant Department safety record is good but not good enough. Improving it is a primary objective of 1964 . . . here is the why and the how

THE NEW SAFETY ASSURANCE PLAN

Robert B. Stecker, *Assistant Vice President —Plant, Operations Department, A.T.&T. Co.*

The leaves rustle in the cool summer breeze while the mid-morning sun glints on the power lines overhead. Below, a telephone company line crew is in the process of placing underground cable and at this very moment is about to change cable reels with the aid of a derrick. Now the foreman arrives on the scene. Abruptly, he *completely stops* the work operation! Getting his men together, he points overhead to the 7200 volt power line and talks with them about the hazards of working so near the line. Indeed, that derrick was only a few feet—but several lives—away from those lines and their lethal volts. He then takes the time to instruct the crew and remind them of the necessary precautions to be taken—and stays to observe while they lower the derrick away from the power line.

After assuring himself that the remainder of the job can be completed in a safe manner, the foreman prepares a safety report outlining the unsafe condition he observed and the action which he took to correct it. His report is forwarded to his supervisor. Because of the potential seriousness of this accident-that-might-have-happened, this job operation is reviewed the next morning with all craftsmen who perform this type of work—with particular attention to illustrating the serious hazards involved and to demonstrating the proper and safe method of completing the work. A week later, at the monthly management safety meeting, this foreman's report and safety reports from other foremen are reviewed. The meeting focuses attention on unsafe habits that seem to be developing as well as pointing out individuals who have been observed working in an unsafe manner. A course of action is initiated and follow-up observations are scheduled in order to correct these unsafe habits and eliminate accident hazards.

What, you may ask, is going on here? Briefly, it is a new Bell System safety plan—the Safety Assurance Plan—in action. This plan is new and perhaps unique in industry. It has been designed to answer the continuing and increasing need for accident prevention and is now being put into effect by all the Bell System Operating Companies. In their Plant Departments, strict adherence to safety practices is particularly important because of the nature of the work—such as climbing poles or working in manholes, where accident possibilities are greater than in many other telephone jobs. Therefore this plan is being augmented by field visits by A.T.&T. Plant staff people.

The Record

For a number of years—12 years, in fact, since the Bell System joined the

THE NEW SAFETY ASSURANCE PLAN

National Safety Council—we have had a top safety record, a record unparalleled not only in the communications industry, but throughout industry in general. In 1962, for instance, for the 41 industries reporting results to the National Safety Council, the lowest lost time work injury rate was .98 per million hours worked for the communications industry as a whole; the average rate for all industries was 6.19. The 1962 rate for the Bell System was .67.

This rate, to coin a phrase, was no accident. Safety was first introduced on an organized basis in the Bell System Plant Departments (to which we will limit our discussion here) shortly after World War I. While considerable improvement in the lost time injury rates were made by a few of the Bell Companies during the early 20's, it was not until after 1930 that the effects of the movement were actually felt throughout the System. During the five year period 1926-1930, 229 Plant men were killed in accidents on the job—an average of 46 per year. During the period 1930-1956, aggressive attention to accident prevention contributed to a reduction of 78 per cent in fatalities, with the saving of over 1,000 lives. Bringing this comparison down to the present: in 1933 we had 23 fatalities on the job; in 1963, thirty years later, with about double the number of employees, we had eleven plant fatalities. Lost time injury frequency rates for Plant men also have been reduced from an average annual rate of 8.58 per million hours for the period 1926-1930 to .70 for 1963.

The Problem

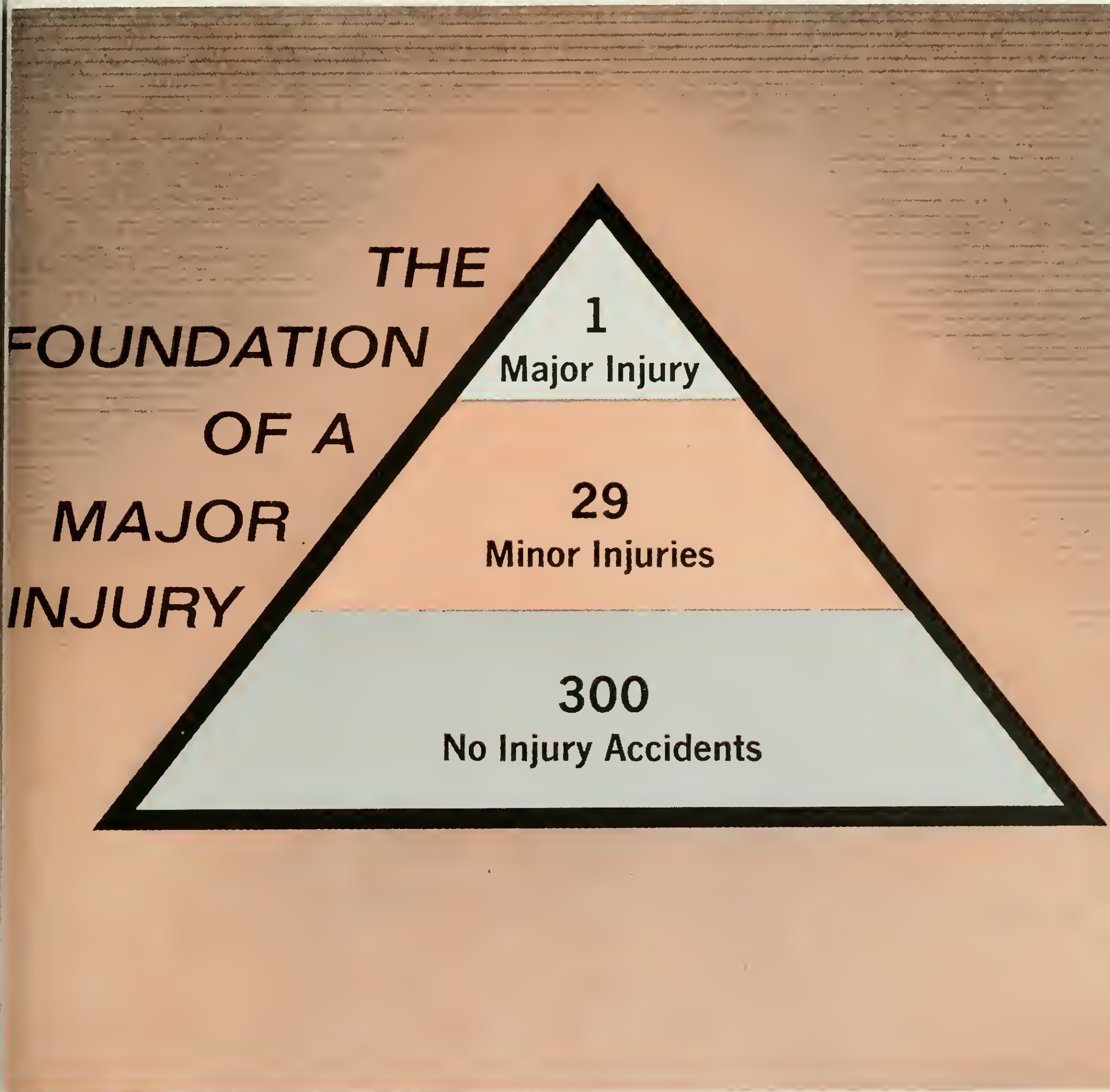
Why then, with such significant improvement, are we putting a new plan into operation? First and most apparent, because the battle against accidents is never completely won—the aim is always *no* accidents; in this battle there is always room for innovation and improvement. Secondly, over the last three years, while the Bell System safety record is still the best, the number of lost time work injuries has begun to rise. In the Plant Departments this increase has been particularly noticeable, especially among those working with poles and ladders, in areas of possible electric shock (such as the line crew above) and in manholes. Indeed, the 1963 Plant lost time work injury rate of .70 was 4.5 per cent worse than the rate in 1962. In short, the problem we face has become one of how to *keep* a top safety record—and improve it!

The over-all Plant Department safety program, as it has existed for a number of years, has many different facets. It includes posters, films, several publications, regional safety conferences and reviews of all Bell System practices for safety features. Despite the demonstrated success of this program, it became obvious, in the light of recent statistics, that something more—both in kind and degree—had to done.

Theory Behind the Plan

The years in which this program has been in effect have also produced a body of knowledge about the nature of accidents and accident prevention on which to base any new program.

Accidents, in nearly all cases, are preventable, but there is a chain of cause and effect that is always with us. For a given number of unsafe acts such as improper use of tools, lifting too heavy objects or poor housekeeping, we can predict fairly closely the number of minor injuries that will occur. Obviously, more unsafe acts result in more minor injuries, and so on up the line: more minor injuries result in more injuries requiring medical treatment; more medical treatment injuries result in more lost time injuries, and more lost time injuries result in more fatalities. This ratio of accidents to unsafe acts is fairly predictable (see illustration, page 35). Whatever new



The major lost time injury that could result in a fatality theoretically has been determined sometime before. From available data concerning the frequency of potential injury accidents, it is estimated that in a unit group of 330 accidents of the same kind and involving the same person, 300 result in no injuries, 29 in minor injuries and one in a major injury. This indicates that 90.9 per cent of all accidents produce no injuries, 8.8 per cent produce minor injuries and 0.3 per cent are a major lost time injury. Obviously the major injury may result from the very first accident or from any other in the group of 330.

(Based on material in **Industrial Accident Prevention** by H. W. Heinrich, published by McGraw-Hill Book Company, Inc.)

THE NEW SAFETY ASSURANCE PLAN

plan was to be initiated must get to the root of the problem—by eliminating unsafe acts. These acts may seem like small failures at the time, but knowing the deadly nature of these small failures has proved to be important knowledge to us. It takes very fine nets to catch such small fish. Yet they must be caught. Somehow we had to construct a finer safety net—a net that would catch the hazardous condition or act *before* an accident occurs.

But the program must include more than recognition of an unsafe situation; preventing accidents, after all, goes beyond observation—it requires immediate, appropriate *action*. For, if the cause is eliminated *promptly*, the accident won't happen—as was the case with the line crew and their alert foreman in the opening example. Procrastination, in this case, is not only the thief of time—it is also a barrier to effective accident prevention. It became obvious that a plan which would eliminate procrastination and promote immediate action when an unsafe situation is observed could make great progress in preventing accidents.

A trial program of such a plan was initiated in the suburban area of the Illinois Bell Telephone Company. During this trial, the Illinois Bell safety people developed the idea of having a special staff member as a safety supervisor or inspector to perform a follow-up and audit function. This plan was then discussed in the regional safety conferences in 1962.

The Plan Itself

Thus was born the Safety Assurance Plan—a combination of action and audit—which was originally initiated in the spring of 1963 and started getting going on a System-wide basis late in that year. Here is what the first few paragraphs of the booklet describing this plan have to say:

"This plan is designed to prevent accidents.

"Every person, management or non-management has a prime responsibility for his or her own personal safety.

"In addition management people particularly have a responsibility to prevent others from having accidents. Preventable accidents are caused by the failure of one or more persons to recognize an unsafe situation and take appropriate action to eliminate or avoid that situation. Preventing accidents requires going beyond observation. It requires immediate, appropriate action.

"The primary responsibility of management under this plan is to develop a constant awareness of unsafe conduct or conditions and to act effectively and promptly to prevent potential accidents. All levels of management have this responsibility. The appropriate action may be to delay a work operation pending action of others, to instruct an employee in safe work habits, to correct or to avoid a known hazard, etc."

The basic steps of this plan are simple and effective:

- Observe—Be aware of conditions and employee conduct;
- Judge—Recognize safety violations and hazards;
- Act—Take effective and prompt action to prevent potential accidents; make report;
- Follow-up — Use safety inspectors; Pin-point and act on repeat cases.

Observation is the obvious first step. In this respect, the plan is a mandate to look for trouble, for accident-causing conduct or conditions, and then to act to remedy them. All unsafe acts thus observed by a supervisor are then constructively discussed with the employees at the time of the incident. Instruction in the correct procedure, if required, is given. It is this part of the plan which our line crew foreman was carrying out and which caused him to stop the work operation. All unsafe conditions are corrected immediately; thus, he had the crew promptly move the derrick away from that potentially fatal power line. If any delay had been necessary, arrangements would have been made to protect both the employees and the public until the condition was corrected.

The Safety Action Report

In our example, it was noted that the foreman filled out a report of the incident. This report, termed the Safety Action Report, is the basic tool of the plan. Prepared in concise narrative form on the day the incident occurred, it includes a description of the unsafe conduct or condition observed, the action taken to correct the unsafe act or eliminate the unsafe condition and a recommendation for any further action. We also noted that his report was forwarded to his supervisor and thereafter discussed at a monthly meeting, along with other such reports.

It is then included in a Safety Action Reports Summary where it may, among other things, help to establish patterns that permit the stressing of safety efforts toward specific hazards. Thus, the report serves the multiple purpose of recording the unsafe act or condition and the corrective action taken, informing upper levels of management so that periodic appraisals can be made of safety activities, and providing a factual basis for effective safety programming, revised training, work practice changes or equipment modifications to eliminate hazards.

Follow-up Inspections

The final step in the plan is the follow-up. Trained safety inspectors make observations on a scheduled basis. These inspectors have a good practical knowledge of the work operations being inspected. They observe all phases of work operations as well as the condition of tools being used. The results of these observations and any corrective actions taken are reviewed with the appropriate line supervisors. These activities, which are a follow-up of the line supervisor's observations, thus aid and reinforce the supervisor's safety responsibility and help evaluate his safety program among the craftsmen.

We have seen one example of how the Safety Assurance Plan can work; a few others will help to indicate the scope of the plan—and of the problems it must solve.

In a small central office, the entire building was equipped with grounded electrical outlets, but none of the power equipment had three conductor cords. After the safety inspector pointed these conditions out, *immediate* steps were taken to equip all of the power equipment with three conductor cords.

In one area gas explosive meters, used to test the atmosphere prior to working in a manhole, were checked by using gasoline vapors from the tanks of the trucks. This can be dangerous due to the low explosive point of gasoline; it also ruins the meters. When this practice was observed, a demonstration of a standard test kit was arranged and immediate orders were issued to discontinue this method of testing meters.

In one area of another Company, the safety inspector noted that climbers were generally very dull. It was discovered that the craftsmen and supervisors were sharpening their own climbers. The proper method of testing climbers was demonstrated, and everyone was instructed to return their climbers to Western Electric for machine sharpening when they did not meet the requirements of the test (machine sharpening is the only way to

Demonstration of standard gas test kit used to check meters prior to working in manhole.

THE NEW SAFETY ASSURANCE PLAN

assure the correct—that is, the safest—angle and degree of sharpness).

Each of the above examples is a very good illustration of the way in which the Safety Assurance Plan promotes positive action in determining and correcting unsafe conditions and of how the plan helps place safety in its proper perspective in the minds of craftsmen and management alike. It should be pointed out here that this plan applies to all the Operating Departments in the Bell Companies and to any unsafe condition, be it improper handling of cords at a switchboard, defective office furniture, poor housekeeping in storage areas, even to an open desk or file drawer.

"Plane test"—demonstration of proper method of testing climber's sharpness, and angle.

More Action Necessary

In the Plant Departments, the rising trend in injury rates over the past three years has led to an increased emphasis on safety. Starting in January, 1964, the A.T.&T. Plant staff people, in what is essentially an extension of the Safety Assurance Plan, are visiting each Company and assisting the field forces in making safety observations. This program of visits is, and will be, on a continuing basis.

Some of the cases of unsafe conditions revealed during these visits were:

- Climbers that would not pass the test for proper sharpness.
- Equipment, used to test for possibly dangerous voltage on poles, metal sided buildings and street light fixtures mounted in the telephone working area, which was not kept in good working condition.
- Employees who failed to test manhole atmosphere for presence of explosive gases.
- Manhole areas which were not properly guarded to protect workmen from oncoming traffic.
- Gloves that are used for protection when working where high voltages are encountered which were outdated and not properly tested at specified intervals.
- Small hand tools, such as screwdrivers, drill bits and pliers which were in an unsafe condition.
- Seat belts provided in Company vehicles which were not being used.

These cases were the exception rather than the rule, but all the more need to correct them *now*—before they could become more widespread.

Some of these conditions were the result of a lack of knowledge of the proper procedure, some stemmed from carelessness or any one of a host of other reasons. Whatever the cause, immediate action was taken in each situation to correct the unsafe condition and instruction was given on the proper procedure or care of equipment. After each of these inspections is completed, the results are reviewed with the upper management of the area. It is pointed out that local supervisory people should also be finding and correcting these unsafe conditions. It is also pointed out that, in each of these cases, conscientious use of the Safety Assurance Plan should now be able to detect such unsafe acts and conditions and insure that immediate action

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(1) Climber gaffs—point at right shows proper sharpness and angle; one in middle is too sharp and tends to break while one at left is curved wrong direction and will not hold in pole; (2) voltage test; (3) manhole test; (4) properly guarded manhole; (5) glove showing dates at which it was tested; and (6) tools are checked by safety inspector.

will correct them. Follow-up action by safety inspectors and supervisors should then reduce all accidents and thus minimize the possibility of a major injury.

Most certainly, that is our aim.

Looking Ahead

Over all, the present situation in the field of safety in the Bell System is one of progress and improvement, largely through the continued application of techniques and knowledge slowly and painfully acquired through the years. Yet, despite our outstanding record, there are always problems still to be solved.

The total job ahead is at least as great a one as the job already accomplished—and it may well be more difficult, for among the unsolved problems are, of course, a large number which, though studied carefully, have stubbornly resisted solution. As A. T. & T. President Eugene J. McNeely said in his address at the President's Conference on Occupational Safety in March, 1962: "The safety battle is something like our international struggle—a protracted effort, a long-term struggle that requires the continuing endeavors of many knowledgeable and dedicated people to preserve our lives and values." The resources of the safety movement in the Bell System are great and strong—an impressive body of knowledge, a corps of able and experienced safety people, a tradition that "No job is so important and no service is so urgent that we cannot take time to perform our work safely"—and these very resources, aided and augmented by the Safety Assurance Plan, insure that this ultimately important struggle must—and will—continue.

In a single transaction at AT&
headquarters is the essence
millions done by mail, by phon
and in person during the large
stock offering in our histor

"Largest Operation Of Its Kind..."

"The American Telephone and Telegraph Company on May 20, 1924 offered for subscription new stock to its stockholders of record on June 10, 1924 in the proportion of one share for each five shares then held. ... It was the twenty-second offer so made by the Company and its predecessors and its successful completion on August 1st establishes another milestone in Bell System finance. So far as we know this was the largest operation of its kind ever carried out by any corporation..."

Just 40 years ago that paragraph led off an article in what was then the *Bell Telephone Quarterly*. By changing the dates and a few figures, we could almost reprint the article today to tell the story of A.T.&T.'s latest stock offering. We can still say that this was the largest operation of its kind ever carried out by any American corporation. We can still say that only a tiny fraction—less than one per cent—of the rights issued to stockholders were not used in some fashion: exercised (or augmented) to buy stock on a one-for-twenty basis, transferred to another party or sold on the market.

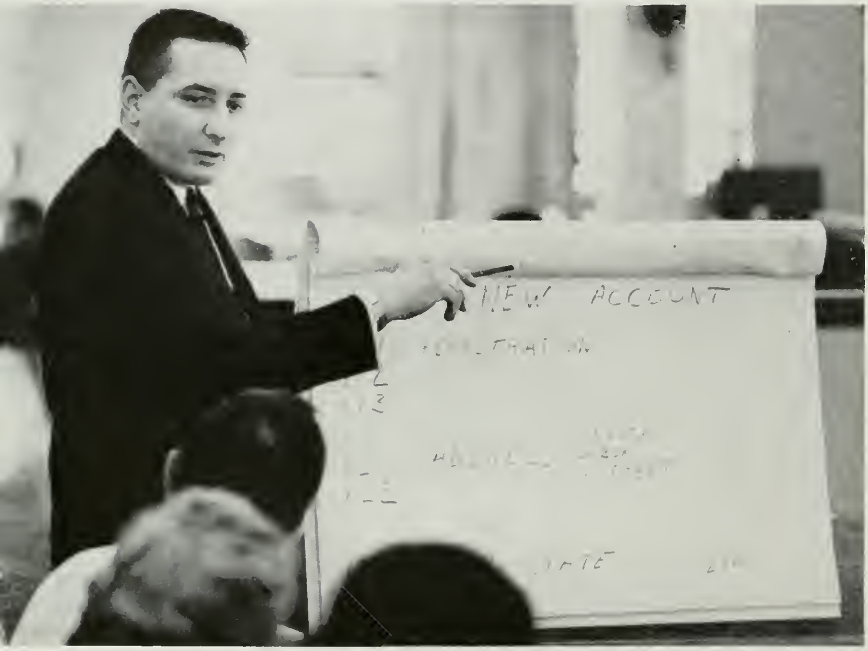
Although the story we're telling today is basically the same, the size of the present undertaking alone makes it unique in the annals of American finance.

In 1924 there were about 316,000 A.T.&T. stockholders. In March of 1964, rights to purchase stock were mailed to more than 2,250,000 stockholders. The rights left A.T.&T. headquarters in New York in 1,500 mail sacks weighing 52 tons. A previous mailing, containing prospectuses and announcement letters, went out in 3,200 mail sacks weighing over 100 tons.

What does it take to handle such a mountain of paper, to answer telephone inquiries, to complete warrants, to mail out checks, bills and stock certificates? In this case, it took a small army of more than 2,000 temporary employees, working with a cadre of some 200 Bell System management people brought in from all over the country, plus a nucleus of veteran A.T.&T. stock and bond people. Most of the temporary employees, after thorough training, formed a task force located in rented quarters in the 20-story Remington Rand building on Park Avenue South. About 135 of them worked behind counters set up in the lobby of 195 Broadway to help stockholders in face-to-face transactions. On the first day about 5,500 persons streamed into the marble-pillared halls, with the average on succeeding days running from 2,500 to 3,000.

The pictures on these and following pages give you a glimpse behind the scenes of the biggest financial undertaking in the history of any American corporation—an undertaking that, when completed, had raised about one-and-a-quarter billion dollars toward a record program of construction, modernization and improvement of Bell System facilities and services in 1964.

1



2

3

4

Preparations for the stock offering got under way as, in (1), (2) and (3), temporary employees were trained at Park Avenue South for work in an acceptance unit handling incoming warrants. In (4), the decks are cleared in the Company's Varick Street building for activity ahead; and in (5) members of a group extract cases for special handling.

5

1 2

Miles of computer tape (1) carried information processed from warrants; (2) technicians maintain one of seven computers temporarily installed for the offering. In (3), an IBM 7074 produces output tapes for checks for rights sold, bills for rights purchased, and stock certificates. On the opposite page, the enclosing room at Varick Street handled tons of prospectuses, letters and warrants.

3


ENCUÉNTRELO
EN LAS
PÁGINAS AMARILLAS
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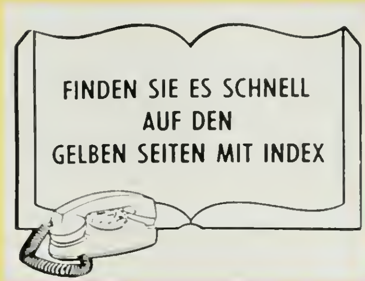
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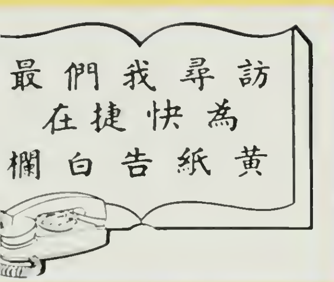
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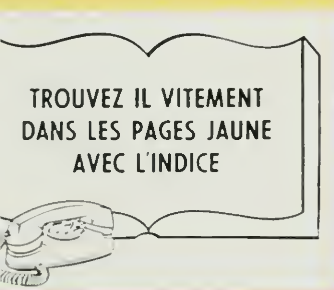
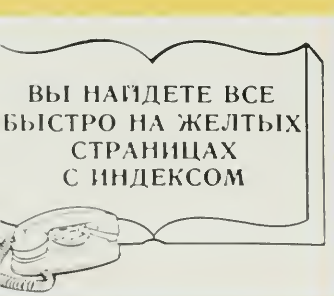
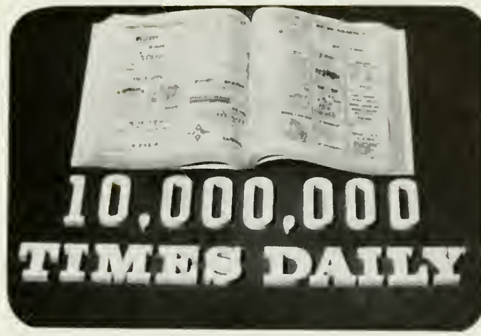
Yellow Pages


TROUVEZ IL VITEMENT
DANS LES PAGES JAUNE
AVEC L'INDICE


ВЫ НАЙДЕТЕ ВСЕ
БЫСТРО НА ЖЕЛТЫХ
СТРАНИЦАХ
С ИНДЕКСОМ


Find Us Fast
In The
Yellow Pages


Najszybciej Nas Znajdzieci
W
Żółtej Książce
Telefonicznej



ational Usage Study

Russel T. King, *Directory Operations Administrator*
Marketing Department, A.T.&T. Co.
and
Arthur H. Walsh, *Advertising Manager—Printed Media*
Public Relations Department, A.T.&T. Co.

The most comprehensive media study ever undertaken in a single advertising medium has just been completed. It is the first detailed examination of how many, how often and why people use the Yellow Pages. For the first time we get closer to being able to tell the advertiser using a particular medium what consumers did as a result of being exposed to his advertising.

The Bell System and the Independent telephone companies sponsored it. Audits & Surveys Company, Inc., one of the nation's largest independent research firms, conducted it.

In all, 19,737 adults 20 years and older were interviewed during the month of June, 1963 for periods up to 45 minutes each. What they told 909 interviewers about their use of the Yellow Pages during the preceding twelve months fills 21 huge volumes weighing more than 100 pounds and full of statistics.

After some 160,000 punch cards containing the data from these interviews were fed into the most advanced computer available, these facts came out on top:

- 83,522,000 persons—73.6 per cent of the adult population over 20—used the Yellow Pages to locate a product or service in the 12 months studied;
- These users turned to the Yellow Pages 3.6 *billion* times (about 10 million times a day)—for an average of 43.9 times per person in the 12 months studied;

- 93.2 per cent followed up their reference with a personal visit, telephone call or letter;
- 58 per cent of all references were for personal needs; 42 per cent were for work or business;
- More women (44 million) use the Yellow Pages than do men (39.5 million). But the men turn to it more often, averaging 52.5 uses a year to 36.1 by women.

That's twelve facts already. The other 400,000-plus get into every nook and cranny of Yellow Pages usage not only nationally, but within 20 geographical subdivisions of the U.S. that correspond basically to the operating territories of the Bell companies. They show how many adults were actively in the market for each of 53 different categories of products and services, and tell what proportion of these adults looked in the Yellow Pages for sources of supply. They break these data down according to 27 subgroups of adults, classified by sex, age, family income, city size, family size, residential mobility and home ownership. They report the reasons, personal or business, for users' references. And they tell how many of these references were followed by action—a personal visit, telephone call or letter.

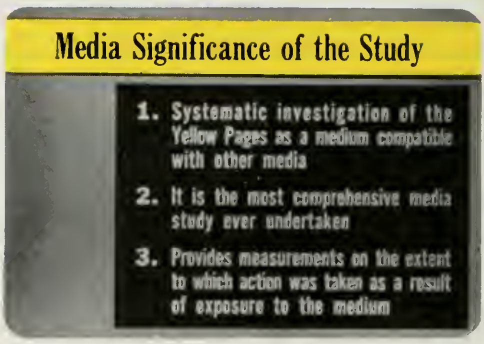
Why go to all this trouble? Because telephone customers who advertise in the Yellow Pages asked the Bell System to do it, and, as usual, the customer was right.

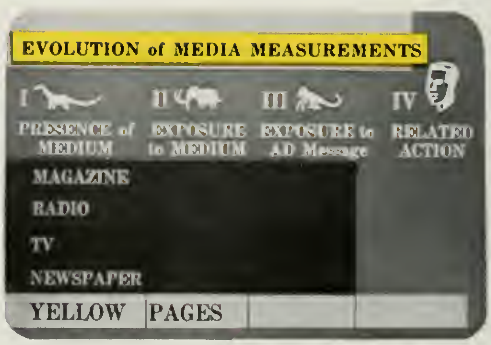
Of course, this is not the first time Yellow Pages usage has been studied. Research has been conducted by and for telephone companies throughout the country. But these studies were largely local in nature. The figures they developed were not comparable and so could not reliably be projected for the entire nation.

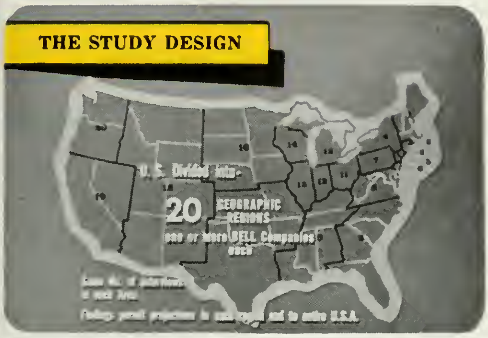
In the early days of the Yellow Pages, these studies sufficed. Directory advertising was overwhelmingly local. All that local businessmen wanted to know was whether their ad money brought in the customers. Sales figures were the ones that mattered.

But since World War II the nature of the Yellow Pages has changed enormously. National advertisers began to take more and more brand name and trade mark advertising. Then they began to order display space.

Today, over ten per cent of all Yellow Pages revenues stems from national advertising. That figure is growing rapidly, spurred by the establishment in 1960 of the National Yellow Pages Service, an industry-wide system of placing advertising in any of more than 4,000 tele-







phone books through a single Yellow Pages representative.

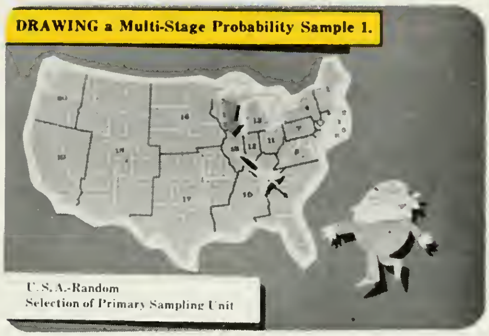
To focus their messages, national advertisers asked for factual, documented, validated data on markets and usage. Advertising agencies, also called for facts that would enable them to measure the Yellow Pages against other media. Even the small businessman, besieged by an increasing number of local advertising media, began to ask for positive proof.

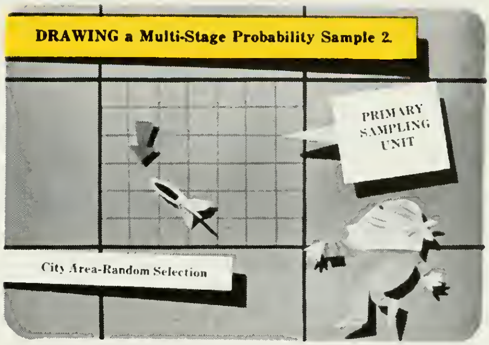
The studies conducted by and for the telephone companies were too often written off as having been done by "insiders," rather than by objective specialists.

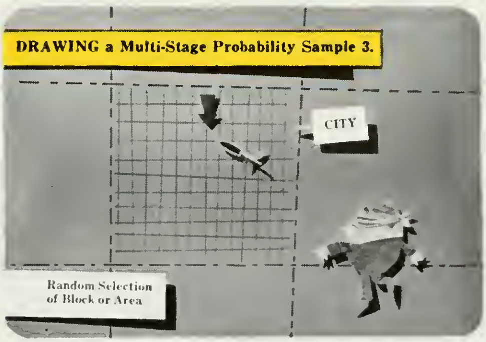
The Yellow Pages National Usage Study actually was three years in the making. It began when its basic technique and design were laid out by Cunningham & Walsh, Inc., advertising agency on the Yellow Pages account.

The resulting study devised by Audits & Surveys was based on proven research methods. Some of them had been pioneered by A&S executive vice president Lester R. Frankel when he was with the U.S. Census Bureau in the late 1930's.

Because the study aimed at getting data for each of 20 geographical regions of the United States, probability samples





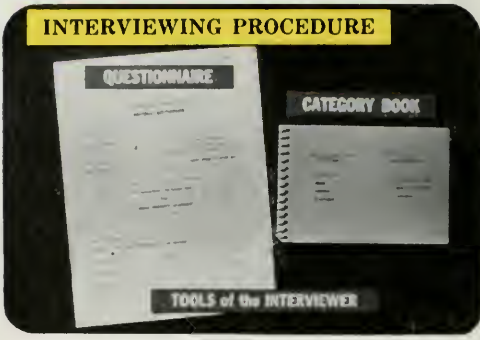


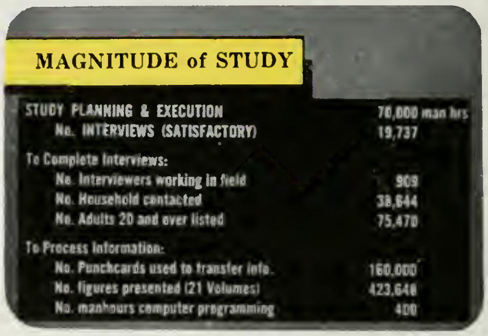
of about 1,000 people were drawn from the adult population of each region. These samples were large enough to make the data they provided meaningful and valid for all adults in each region. What was learned about the total of nearly 20,000 people in the 20 regions could then be projected to the entire United States.

In form, it was a recall study. Interviewers asked respondents if they had used the Yellow Pages during the past 12 months to locate sources of specific products and services and what action they had taken after they had made their references. Because recall studies depend on the respondent's memory, the data collected were conservative. Odds are, many of the respondents remembered references to the Yellow Pages after the interview ended, despite interview techniques which aided recall by asking specific memory-jogging questions on each category covered.

One of the unique aspects of the study is that it reports the share of the active market reached by the Yellow Pages for each of 53 different categories of products and services. Before these "shares of market" figures were developed, it was necessary to determine the size of the total market. Even the exceedingly thorough U.S. Department of Commerce had never compiled these figures.

The solution was simple and direct. The interviewee was asked if he had used the Yellow Pages one or more times to find a source of supply for a particular product or service. If the answer was yes, he obviously had been in the "active market." If he said no, he was asked if he nonetheless had sought the product or service in some other way. If he then said he had, he was also listed as having been in the active market. Figuring the proportion of people who used the Yellow Pages in the total active market was a matter of simple arithmetic.





Before the study was conducted nationally, its techniques were pretested with hundreds of consumers. Then, in the fall of 1962, these pretests were incorporated into a pilot study among 429 respondents in eight key cities. The results of this test led to further refinements in techniques.

For instance, Audits & Surveys found that respondents would grow weary and bored in the course of half an hour or more of interviewing, especially since the same battery of questions was asked for each of the 53 products or services. This problem was solved by giving the respondents booklets containing the same categories and questions as those used by the interviewers. When a respondent had something to do during the interview, fatigue was reduced.

To get an idea of the magnitude of the study, consider these figures:

Planning and execution of the study required some 70,000 manhours (2,000 35-hour weeks).

The Study Demonstrates:

That the Yellow Pages cannot be ignored as part of media planning

The unique character of the Yellow Pages as an advertising medium

That Yellow Pages advertising exposure is not accidental

Before narrowing down to those actually interviewed, the interviewers contacted 38,644 households and listed 75,470 adults 20 and older.

A few years ago it would have taken two to three years to analyze the data collected. Thanks to the most sophisticated computer now available, it actually took three weeks from programming to completion.

The major findings of the study simply document what we have long known through observation: that most people go to the Yellow Pages not by accident but because they are ready to buy. Unlike other media, in which advertising is surrounded by entertainment or information, exposure to advertising in the Yellow Pages is not incidental. The directory and its ads are tools used by people who are actively in the market.

But besides confirming the obvious, the study turned up countless fascinating and—in the hands of advertisers—important facts. Such as these:

The five products or services referred to by most users were medical, florists, travel, television and radio, and home building and repair.

But the quantities of people who use the Yellow Pages were not necessarily the most significant figures. It was found that those classifications used by relatively few people had been consulted most often. Buyers of industrial materials averaged 26.9 references a year; heavy machinery buyers, 21 times a year; and heavy farm machinery, 18 times a year. It turned out further, that of 9.2 million people who purchased or inquired about industrial materials, 4.3 million of them had consulted the industrial materials headings of the Yellow Pages. Their references added up to an astounding 115.5 million.

By way of contrast, some 25.4 million people had used the Yellow Pages to locate florists. Six times the number who had consulted industrial materials headings. But they averaged 3.8 references each, for a total of 95.3 million—more than 20 million fewer than the seemingly low-traffic industrial materials headings, but still enormous in terms of cash-register action.

Other breakdowns were similarly revealing:

Adults in the 20-29 and 30-39-year age groups had the highest percentages of Yellow Pages usage (83 and 82 per cent). But those in the 30-39 and 40-49 age groups consulted them most often: an average of 53.2 times a year. Lowest frequency of use was reported by the 60-and-older group: 21.2 times a year.

Frequency of use rose with family income, ranging from 24.7 times a year for those under $3,000 to 65.5 times a year for those making $10,000 or more.

People who live in metropolitan areas of 50,000 to 500,000 also were heavy users, averaging 60.4 references a year. In small towns of 2,500 or less, 27.4 uses a year was the norm.

Impressive and interesting as these and other figures contained in the study may be, they are not necessarily the most important ones to national, regional and local advertisers. What's in it for them?

Yellow Pages

Imagine for a moment that you are the advertising manager of a firm that manufactures automobile parts and supplies. Industry sources have never been able to provide you with a clear picture of your market, but along comes the Yellow Pages National Usage Study and here is what you learn:

In the 12-month period studied, nearly 52 million of the nation's 113.3 million adults 20 and older were actively in the market for auto parts and supplies. Sixty-four per cent were men, 36 per cent were women. That means that 18.6 million women were in what is normally considered a predominantly male market.

One-third of this total active market, 17.8 million people, have family incomes in the middle range—$5,000 to $7,500 a year. And more than 13.5 million had moved within the past two years. The advertiser of automotive parts and supplies learns much, much more about the nature of his market from the data, but his major concern is how to reach it with his selling messages.

His strategy certainly should include the Yellow Pages, for the study shows that in a 12-month period 14.4 million people in the active market turn to the auto parts and supplies headings when they're ready to buy. That's 28 per cent of his total market. And they do so repeatedly, averaging 11.1 references each. That means that a national representation in the Yellow Pages will expose his name and message to more than one-fourth of the total market 160 million times.

The national figures on Yellow Pages usage give more than 250 such facts in this particular category. But there are special situations an advertiser must face. For instance, in some regions he may have good distribution, but poor sales, in others the distribution set-up may be spotty. Perhaps he can devise a Yellow Pages advertising program that will take these factors into account. But to make logical grassroots decisions, he needs facts.

The Yellow Pages National Usage Study has them. It tells the size of the active market in each of 20 regions of the United States, tells what proportion of that market can be reached by the Yellow Pages, and in most instances can give a profile of prospects by sex, age, income, residence and other important demographic factors.

Now, let's look in at the local level, where the owner of an auto parts and supplies business is explaining to a Yellow Pages sales representative for the fifth time in five years why he does not want to advertise in the Yellow Pages.

"I don't need the Yellow Pages. My customers know my name. They can find me in the white pages."

He's right. Most of them do know his name. But at last the Yellow Pages man has an answer for him.

First, he shows the proprietor a usage study figure showing that 53 per cent of all references to auto parts and supplies headings in the Yellow Pages are made by people who knew the name of an auto parts and supplies outfit, and who could have found it in the white pages, but nonetheless chose to use the Yellow Pages.

If they look there and don't find you, they may be lured by the ads of your competitors, he advises the dealer.

Then, he shows him that of the more than 28 million people who move within a two-year period, one in six refer to the Yellow Pages to find dealers in auto parts and supplies. These are people who couldn't possibly know his name, his store, or his reputation.

What is more, the salesman points out, 96 per cent of all references were followed by consumer action.

Similar scenes are taking place simul-

Study Objectives

1. **MEASURE YELLOW PAGES USAGE in TERMS of:**
   Incidence and frequency of usage by adults in past year
   Extent consumers "ready-to-buy" turned to YELLOW PAGES
   Extent consumers used YELLOW PAGES for: personal, business
   Percent of ACTION vs USAGE - telephone, letters, visits

2. **DETERMINE CHARACTERISTICS of YELLOW PAGES USERS (ADULTS 20 or over) IN TERMS OF:**
   Sex, Family Size, Income, City Size, Residential Mobility, Type of Home Ownership

3. **TO ASCERTAIN the LEVEL of YELLOW PAGES USAGE:**
   on an overall basis for the whole YELLOW PAGES directory
   on an individual basis for 53 SELECTED PRODUCT or SERVICE CATEGORIES

4. **TO ASCERTAIN the LEVEL of YELLOW PAGES USAGE:**
   on the NATIONAL LEVEL - projectable to total U.S. population and its population subgroups

   On the REGIONAL LEVEL - projectable to the total population and population subgroups in each of the 20 regions

taneously in the offices and shops and advertising agencies of national, regional and local businessmen throughout the United States.

The Yellow Pages men at the center of these scenes are well-trained to interpret the data, well-equipped with materials to leave behind, and well-heralded by a program of national and regional advertising and promotion.

Early last month, two two-day meetings—one in the East and one in the West—were held to educate men from each of the Bell companies who will train representatives. They were shown how the study can be made meaningful to advertisers.

These men returned to their companies and, in turn, taught the local and regional Yellow Pages representatives. Equipped with 150 sets of training slides and related materials, they explained the method and meaning of the study, the uses of visual aids and sales materials in presenting it to advertisers, and the ways in which study data should be interpreted.

In making their calls on advertisers and agencies, Yellow Pages representatives collectively will be armed with 93 tons of sales materials, give or take a pound. These include 1,800,000 national and regional fact sheets for each of the 53 product and service categories covered (1,134 different sheets in all), and 1,600,000 brochures that quickly give the gist of the Yellow Pages story to each of the 53 trade classifications. Also available for the salesmen's use are copies of the usage study basic data book, an eight-pound, 676-page compendium of national and regional facts derived from the study.

For the most part, the salesmen will talk to local, regional and national advertisers and their agencies. These have been alerted to the study and its importance as authoritative and unbiased proof of the selling power of the Yellow Pages through a national program of advertising, promotion and publicity.

in this issue...

■ Henry M. Boettinger whose "Some Reflections on Computers and History" appears on page 2, has been associated with electronic computer applications in the Bell System since 1955. A graduate of Johns Hopkins University in Electrical Engineering, Mr. Boettinger joined The Chesapeake and Potomac Telephone Company of Maryland in 1948 as a traffic assistant. Since then he has held positions in the Accounting, Plant, and Traffic Departments of the Chesapeake and Potomac Telephone Company of Maryland, the Treasury Department of A.T.&T. as general financial supervisor and stock transfer manager, and in 1959 was elected vice president and comptroller of the Michigan Bell Telephone Company. He returned to A.T.&T. in 1960 as assistant vice president-Planning and in December, 1962 moved to his present position as assistant comptroller in the Operations Division which includes responsibility for EDP planning.

■ Arthur D. Hall, author of "Developing PICTUREPHONE Service," page 14, is head of the Television Engineering Department at Bell Telephone Laboratories. He joined the Laboratories' technical staff in 1950, immediately after receiving the B.S. in Engineering degree from Princeton University. He has specialized in various phases of systems engineering work throughout his Laboratories career and for the past eight years has had, as one of his responsibilities, supervision of long-range studies of the potential of PICTUREPHONE service.

A graduate of the Laboratories' three-year Communications Development Training Program for graduate engineers, Mr. Hall designed the Program's systems en-

Henry M. Boettinger

Arthur D. Hall

Robert B. Stecker

gineering course and wrote the textbook used by the students. He is also the author of a book, *A Methodology for Systems Engineering*, published in 1962 by D. Van Nostrand.

He has also been associated with systems engineering work on Automatic Message Accounting and long-range planning of future long-distance transmission systems, including waveguide systems and high speed PCM coaxial cable systems. In his present post he is in charge of systems engineering in the television field, including PICTUREPHONE service, Educational Television, and TV systems for the broadcasting industry.

■ Robert B. Stecker, author of "The New Safety Assurance Plan," on page 32 is uniquely qualified to speak on the subject of safety as he has been personally engaged in the current all-out Bell System effort to keep and improve our safety record and, as part of this effort, to introduce the new Safety Assurance Plan. As a result of this experience, Mr. Stecker stresses the importance of constant vigilance at all levels of management: "Sustained management interest and personal emphasis is the only way to improve safety performance."

H. Walsh

Russel T. King

Mr. Stecker's Bell System career began in 1942 with the Illinois Bell Telephone Company, after which he held various positions in the Long Lines Department of A.T.&T. and Western Electric. He was general plant manager for the Northwestern Bell Telephone Company when he came to his present position as assistant vice president-Plant, in the Operations Department of A.T.&T. in December of 1961.

■ It would scarcely be possible to find more appropriate authors for "The Yellow Pages National Usage Study" which appears on page 46 than Arthur H. Walsh and Russel T. King. Both saw the need for such a study and were personally involved in nurturing it as an idea and getting it launched in the first place. Since its very beginning both have been closely identified with it every step of the way.

Mr. Walsh began his Bell System career as an economic statistician with the Southern New England Telephone Company in 1937. Later he went into the Public Relations Department of that company and was public information manager when he came to A.T.&T. as community relations supervisor in 1956. He assumed his present post of advertising manager—printed media in 1961.

Because of his enthusiasm for the Yellow Pages as a spectacularly effective advertising medium, Mr. King is often called "Mr. Yellow Pages." His interest in this medium goes back more than 25 years to the time when he became directory sales manager for the Bell Telephone Company of Pennsylvania at Pittsburgh. In 1943 he joined A.T.&T. as trade mark engineer. After World War II he assisted in transferring trade mark selling activities from 195 to the companies. In 1960 these selling units in the companies joined hands to offer advertisers a complete national Yellow Pages service. Mr. King became directory operations administrator in 1956.

in the news...

G. E. Network

World-Wide Calling Agreement

Science Teachers Award

TAT-IV

Japan-France TELSTAR Broadcast

New Caribbean Network

Earthquake Causes Heavy Telephone Traffic

New 'Switched Service' Network for General Electric

A Bell System first: a 'switched service' network for the General Electric Company went into service throughout the country on March 2. The new system provides desk-to-desk dialing between some 100,000 extension telephones located in General Electric factories, offices and laboratories in some 240 locations throughout the United States and Canada.

General Electric is the first major customer network to use the Bell System's new Common Control Switching Arrangement which is now being offered to large business customers who have extensive requirements for private line communications within their business. In the past, many businesses have had private phone systems linking key locations, but this is the first time a firm with nationwide offices has had all its telephones joined by direct dialing. Formerly, systems of such scope have been used only by defense and administrative agencies of the U.S. government.

The network utilizes regular private line facilities between customer locations and shared switching in telephone company switching centers. In addition to station-to-station dialing, it also offers a uniform numbering plan, automatic alternate routing, and improved administrative and accounting servicing techniques.

Recent advancements in technology and the development of Direct Distance Dialing make possible the 'switched service' network such as that serving General Electric. The Long Lines Department of A.T. & T., which coordinated the project, reports that the General Electric system is equal in size to the entire Bell System private line voice network of 1951.

In order to insure a probability of completing all GE calls on their first attempt, there are 15 "location" zones, each with a switching center. The 15 centers are linked with some 890 interconnecting trunks with 2300 access lines feeding into the system. An initial digit of "8" connects the caller to an access line. After receiving the second dial tone, the user then dials a three-digit "location-code," followed by the extension number of the called party. By reducing the number of dialed digits and the operator services previously needed to handle great numbers of long distance calls, the GE system is both speedy and economical.

World-wide Calling Agreement

Decisions concerning future long-term arrangements for operator and customer dialing of world-wide telephone calls were made during the meeting of the Plan Committee of the International Telecommunication Union in Rome in early February. There were 22 U.S. representatives in attendance, coming from government, telephone and telegraph carriers, Comsat, manufacturers and research institutes.

In principle, the world-wide plan follows the arrangement in use in North America. Agreement was reached on the tentative locations of seven world switching centers of highest rank. Ultimately, centers of this type will be completely interconnected.

For numbering purposes, the world was divided into eight zones. World-wide telephone numbers are to consist of a maximum of twelve digits—these to comprise 1, 2 and 3 digit country codes, followed by the national number of the station. This scheme provides numbers for use beyond the year 2,000.

The special telephone network serving 400 locations of General Electric in 213 cities.

To implement the world-wide dialing network, international agreement has been reached on an international signaling and switching system known as CCITT No. 5 System. This may be applied on submarine cables (with or without TASI), terrestrial land lines (including microwave relay), and satellite relay systems.

The Long Lines Department of A.T. & T., which has the Bell System responsibility for handling overseas telephone service, already provides operator dialing with Australia, Belgium, France, Switzerland, the Netherlands, the United Kingdom and West Germany.

Science Teachers Honor Bell System

The Bell System has received the 1964 National Science Teachers Association award for outstanding excellence in the field of science education assistance. The award, announced in Chicago on March 23 by the Business-Industry section of the national association, cited the Company for its program of teaching aids for high school science classes and outstanding students.

During the last three years, the Bell System has made six science units available (see **BTM,** Summer 1963). These include classroom demonstrations and other materials that delve into the similarities of wave motion in mechanics, sound and electricity; a basic approach to the study of magnetism; and a study of the physics and biology of speech and hearing.

Special aids for individual students include a kit for creating a solar-powered, transistorized audio-oscillator; a unit for turning silicon slabs into working solar cells and an experiment in electronic speech production.

James W. Cook, A.T. & T. Public Relations vice president, accepted the award at the ceremonies held in Chicago. He said the Bell System Aid To High School Science programs was developed to offer the American educational system "concrete assistance in areas where educators welcome our particular competence."

James W. Cook, center, AT&T public relations vice president accepts N.S.T.A. award.

The Bell System program aims to provide material that helps narrow the wide gap between research laboratory and classroom, bolster weak spots in school texts, and help teachers raise their own level of teaching competence.

This is the sixth year in which the Business-Industry Award has been presented. Previous recipients were The National Broadcasting Company, Bausch & Lomb Optical Company, Shell Companies Foundation, Manufacturing Chemists' Association and The American Gas Association.

Detailed information about the Bell System Aid to High School Science programs can be obtained from local Bell telephone offices and many independent telephone company offices.

TAT-IV

The Federal Communications Commission has authorized a fourth transatlantic telephone cable of the design proposed by A.T. & T. last fall. At the same time it denied a Company request to permit it to offer private line alternate voice and non-voice service to all customers. However, it granted the Company's request to provide facilities to the international telegraph carriers for the same purpose.

Since, in the opinion of the FCC, the telephone cable between California and Hawaii provides interstate service, the Federal authority permitted A.T. & T. to offer private line services over it—the same services it now furnishes within the continental United States. The Company is also allowed to continue providing private line services to the U.S. defense agencies in all its cables under existing contracts. However, if they are terminated, the Company must leave that form of business to the other international telegraph carriers.

The plan for TAT-IV calls for a 3,800 nautical mile cable between Tuckerton, N. J., and St. Hilaire on the western coast of France. The $50 million project, which will provide 128 two-way voice grade channels, is expected to be ready for service in 1965. The present facilities, which the Company owns in conjunction with foreign communications administrations, provide a total of 290 circuits which, with the installation of TASI equipment now on order, will be increased to 364 circuits.

Previously, A.T. & T. had stated that it has no desire to enter the field of international telegraph communication. Historically, this has been the domain of the other carriers while the Company has concentrated on overseas telephone business. However, today there is a customer requirement for a new and totally different kind of overseas service—a mixture of both voice and non-voice use of the same channel.

"We are disappointed," stated a Company spokesman, "that the Commission would deny us the right to compete in the furnishing of a new international service that is part voice and part record. A.T. & T. developed the facilities which make this private line service possible and proposed that all international carriers be allowed to offer it. The public should have the right to choose between carriers in obtaining this service.

"This FCC decision on the voice-record matter involves vital aspects of public interest, including national defense, that should be given further examination."

Chief opponent of A.T. & T.'s position was Mackay Radio & Telegraph Co., a subsidiary of American Cable and Radio Corp., which in turn is owned by International Telephone & Telegraph Corp.

Japan-to-France Via TELSTAR® II

The Bell System's TELSTAR II experimental communications satellite relayed a live television broadcast—described as "excellent" and "fantastic"—from Japan to France on April 16. This was the first Japan-to-Europe transmission by communications satellite. The transmission via TELSTAR traveled more than 17,000 miles to bridge the 6,000 mile land and sea gap separating the two countries.

The program originated in Tokyo at 10:06 p.m. Paris time as the Bell System satellite —on its 2,209 orbit of the earth—cruised above the border between Communist China and Soviet Russia. TELSTAR II beamed the program to the French satellite communications station at Pleumeur-Bodou, on the north coast of Brittany, where it was "fed" into the French TV network for viewing in France and for distribution over Eurovision, Europe's inter-country television network.

Japanese authorities delivered a 15-minute video-audio report on preparations for the 1964 Olympic games, scheduled to begin in Tokyo on October 10, 1964, and a capsule tour of Japan. TELSTAR II, which was launched May 7, 1963, will not be usable for similar transmission while the games are in progress. Mutual visibility between the satellite and ground stations in both Europe and the United States reaches a maximum this summer and ends before the Olympics start. However, other communications satellites now in orbit may be in position to handle Olympic broadcasts from Japan.

Expansion of Caribbean Network

The Long Lines Department of A.T.&T. has announced plans for an important telephone cable in the expanding underseas network in the Caribbean. The cable will stretch 1,200 nautical miles between St. Thomas in the Virgin Islands and a point near Vero Beach, Fla. According to present plans, it will be laid by the C. S. **Long Lines**, the Bell System's 17,000-ton cable ship.

The $20,000,000 system is a joint project of A.T. & T.; its subsidiary, Transoceanic Communications, Inc.; and ITT Communications, Inc.-Virgin Islands.

Telephone service between Continental U.S. and the Virgin Islands is now furnished via Puerto Rico—over cable and radio circuits. Telephone traffic with the Virgin Islands and Puerto Rico has tripled in the past three years and is expected to continue to grow.

The new cable, scheduled for service in early 1965, will provide 128 voice circuits. It will be the main artery for calls to the U.S. Virgin Islands and points beyond. In addition, it will connect through Puerto Rico by a microwave route to provide additional circuits for Puerto Rico mainland calls.

Extension of the proposed system to Antigua, St. Lucia, Barbados, Trinidad and from St. Thomas to Caracas, Venezuela, are planned in the next year or so. The growing web of Caribbean cables now links the mainland with Cuba, Puerto Rico, Jamaica and the Panama Canal Zone.

Heavy Traffic Loads Due To Earthquake

The Anchorage earthquake of Friday, March 27, caused very heavy telephone traffic into Seattle over the weekend and early into the following week. Less than 12 hours after the earthquake, more calls were being made to Alaska than facilities could handle, necessitating control action—by circuit rearrangements and recorded announcements—to move traffic out of Alaska through Seattle and to permit handling emergency priority calls to Anchorage. Traffic to other Alaska locations was handled normally.

Service to Alaska is presently provided through Seattle with operator dialing only. Customers cannot yet dial their own Alaska calls.

On Saturday, March 28, operators who were unable to reach Anchorage and other Alaska numbers by direct dialing because of the no-circuit conditions, generated 10,000 calls at the Seattle Inward Switchboard (normal volume of calls for a Saturday is about

200). Seattle Inward operators were accepting emergency calls only.

By Tuesday, March 31, traffic had sufficiently tapered off to permit reduced control measures throughout most of the day, and Inward call volumes at Seattle were close to normal.

There was no damage to Bell System plant as a result of the earthquake, but a number of Bell System private line services were interrupted due to destruction in Anchorage and troubles at other locations in Alaska. In addition, a 12-foot tidal wave caused damage to Independent company plant in Crescent City, California, and the "Compac" (Commonwealth-Pacific) cable from Canada to Hawaii was out of service until Sunday, April 5. Failure of this cable interrupted three select circuits and four overseas governments circuits which were routed over the Bell System cable with minor delays.

Bell System Companies offered assistance wherever possible — the Pacific Telephone & Telegraph Company to the Independent company at Crescent City, and the Pacific Northwest Bell Telephone Company to Alaskan telephone people.

Broadcast Pioneers Honor Bell System

The Broadcast Pioneers, a national organization of early leaders in the field of radio and television broadcasting, has cited the Bell System for fostering the growth of broadcasting in America through its research, technical skill and service. A.T. & T. Board Chairman F. R. Kappel accepted the citation for the Bell System at ceremonies in Chicago and expressed appreciation "on behalf of the hundreds, in fact thousands, of Bell System people whose efforts have won your recognition."

The citation to the Bell System by the Broadcast Pioneers reads: "In deep appreciation for the more than 40 years of research, technical skill, foresight and dedicated service with which it (the Bell System) has fostered the growth of broadcasting in America —from the earliest remotes and station hookups to the incredible complexities of transmitting audio-visual information around the world.

"We honor the company and individuals who eliminated the boundaries of sight, sound and time, making the past limitations of broadcasting virtually nonexistent."

Five More Bell Companies Sign "Plan For Progress" Statements

Five more Bell System Companies have signed "Plan For Progress" statements reaffirming their companies' objectives of employment and promotion based on merit. This brings to 21 the number of Bell System Companies participating in the Plan.

In a special White House ceremony, on April 9, 1964, representatives of these companies met with President Lyndon B. Johnson to acknowledge their signatures on the statements for the Plan For Progress program. The companies signing were: Indiana Bell Telephone Company, The Chesapeake and Potomac Telephone Company of Maryland, Mountain States Telephone and Telegraph Company, The Chesapeake and Potomac Telephone Company of West Virginia, and The Cincinnati and Suburban Bell Telephone Company.

Basically, the statements reaffirm the objectives of these companies to recruit, hire and assign on the basis of merit, without discrimination because of race, creed, color or national origin. The companies pledged in the statements to continue to insure that all employees are treated equally and that no distinctions are made in compensation and in opportunities for advancement because of an employee's color, religion or nationality.

Long roll of printed circuits heading for an acid bath is part of a major breakthrough in the production of flexible printed wiring: a continuous, semi-automatic manufacturing process designed by Western Electric engineers. Flexible wiring is intended to serve the same functions as conventional wiring, but is lighter, requires less space, has a greater electrical conducting capacity, can be made to fit almost any shape and costs less than half as much to produce. Its use will permit development of many new communications products and significant reductions in the size of products already in existence.

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BELL TELEPHONE MAGAZINE

SUMMER 1964

The future becomes present: PICTUREPHONE service is now here on a commercial basis between New York, Chicago and Washington, D. C. On the inaugural day of the service, June 24, the first call was made from the National Geographic Society Building in Washington, D. C., by Mrs. Lyndon B. Johnson to Dr. Elizabeth A. Wood, a scientist at Bell Telephone Laboratories and former president of the American Crystallographic Association, in New York's Grand Central Terminal. Above, one of the more striking benefits of the new service was demonstrated on opening day when Laura Rabinowitz, a 15-year-old deaf student at New York's Lexington School for the Deaf, and Howard Mann, 14, (on screen), communicated by lip reading during the first PICTUREPHONE call from the Prudential Building in Chicago to Grand Central Terminal in New York.

BELL TELEPHONE MAGAZINE

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VOLUME XLIII ■ NUMBER TWO ■ SUMMER 1964

A non-technical review, published quarterly to give Bell System management people a broader view of the history, objectives, operations, and achievements of this business than they might attain in the course of their day-to-day occupations, and an added sense of participation in the problems and accomplishments of our nation-wide public service.

Cover:

Original drawing by David Stone Martin, artist and illustrator famed for his superb design and high sensitivity of mood, depicts with moving style and bold excitement the assembly of an emergency microwave tower, one of the activities covered in the article "Microwave Today and Tomorrow" which appears on page 14 of this issue.

Opening of the U.S.-Japan cable is an important step toward world-wide telephone service

Historic call between Premier Ikeda of Japan and President Johnson opened U. S.-Japan cable. A.T.&T. President Eugene J. McNeely was master of ceremonies at Washington, D. C. end of call.

この歴史的な
よろこばしい機会に

'A Historic and Happy Occasion'

THE WORDS above, which spanned 10,000 miles of land and sea with the clarity of a call across town, are those of President Lyndon B. Johnson. The occasion, the telephone call between the President and Premier Hayato Ikeda of Japan on June 18 which formally inaugurated the first telephone cable between America and Japan. In his remarks, President Johnson said the event was "another welcome step toward transforming the Pacific from a barrier to a bridge between Asia and America." Premier Ikeda said the new cable would "enable our peoples to deepen (their) mutual understanding."

The new cable is a joint endeavor of A.T.&T., Kokusai Denshin Denwa Co., Ltd. (KDD) of Japan, the Hawaiian Telephone Company and RCA Communications, Inc. The cable has a capacity of 128 voice channels and was laid by the Bell System's cable ship, C. S. *Long Lines.*

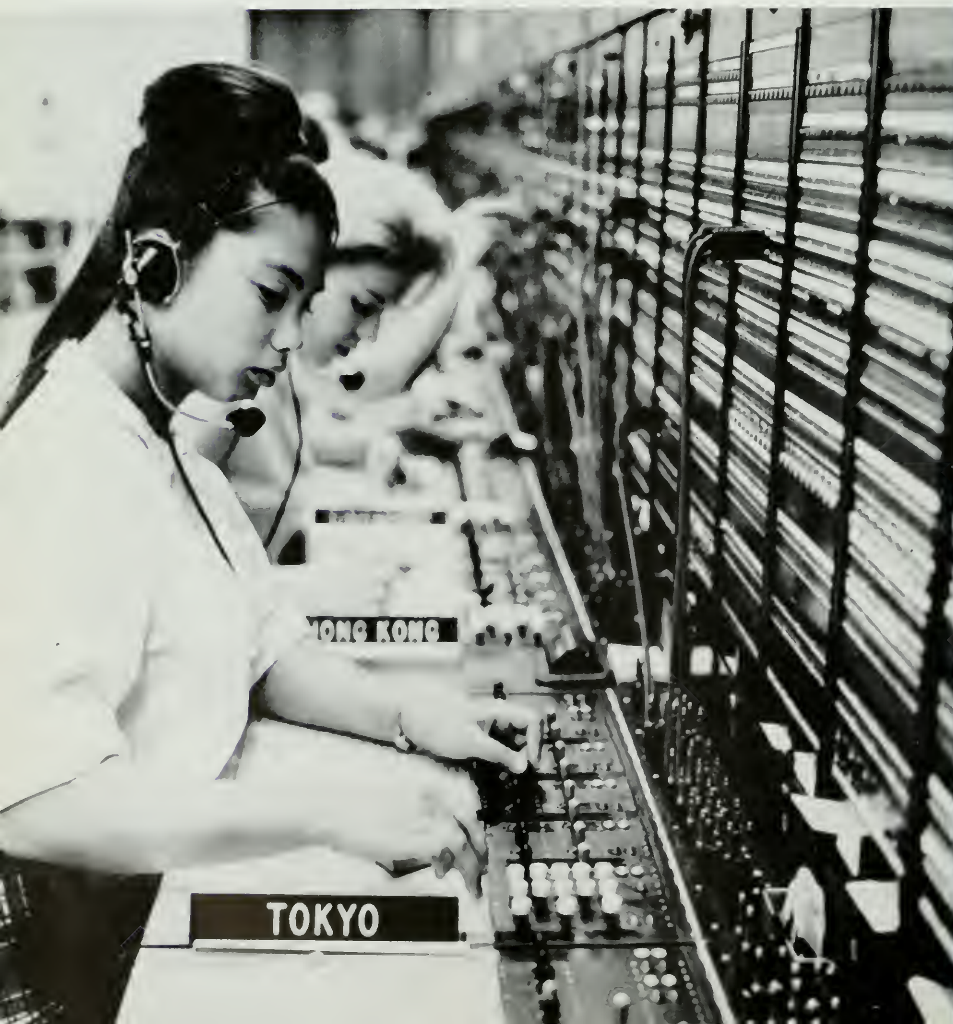
During the opening ceremonies, dignitaries in Washington, Tokyo, Honolulu and London exchanged greetings and congratulations. When the ceremonies began

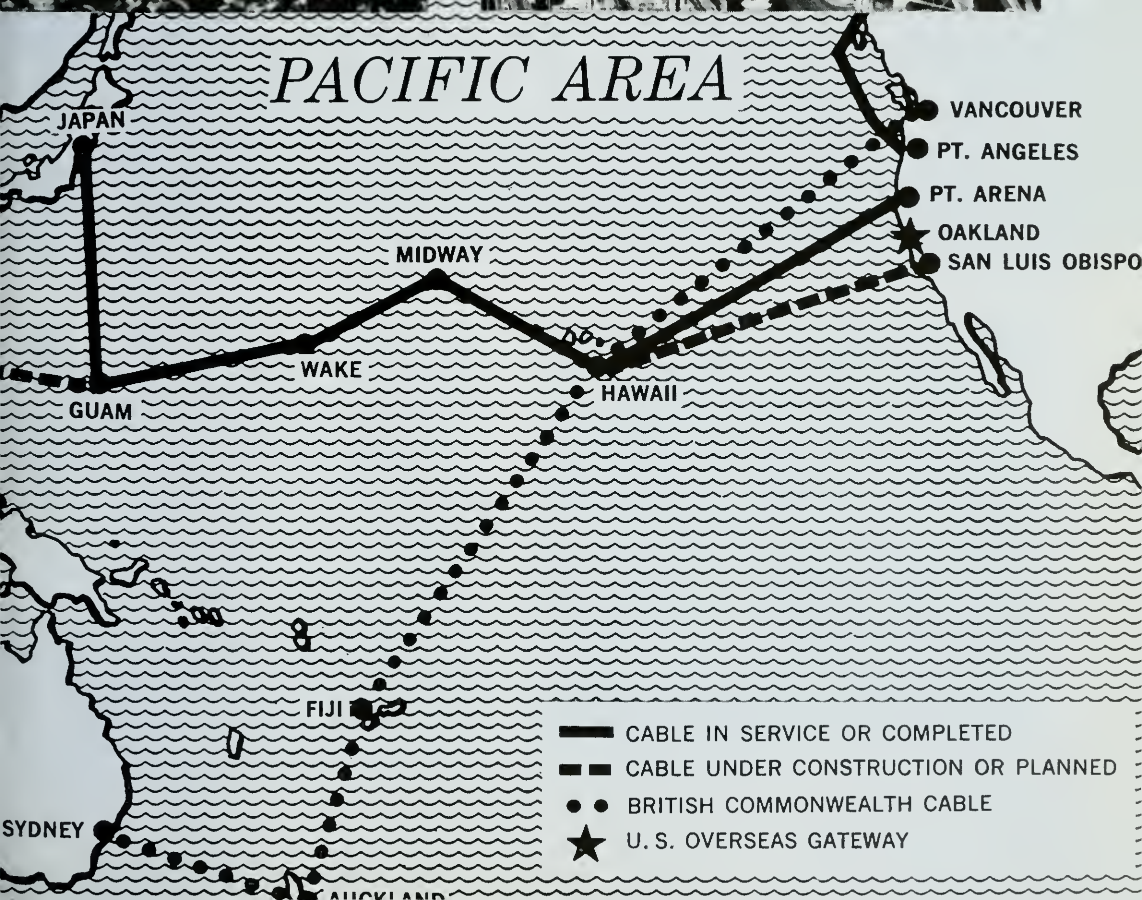
Left. With A. T. & T. Cable Ship Long Lines *in background, sea and shore ends of cable are spliced on Japanese coast.*

it was 11 a.m. Friday in Tokyo, 3 a.m. Friday in London, 10 p.m. (EDT) Thursday in Washington and 4 p.m. Thursday in Honolulu.

From London A.T.&T. Board Chairman Frederick R. Kappel had a three-way conversation over a 16,000 mile circuit across the Atlantic, North America and the Pacific with Katsuzo Ohno, president of KDD and Douglas Guild, president of the Hawaiian Telephone Company. In his closing remarks, Mr. Kappel said: "Tonight we have seen two great countries move closer to each other. My thanks to everyone who has made this possible. I now declare the cable officially open for service."

Right (opposite page): Laying of 5,300-mile Hawaii-Japan link of cable began off Oahu, Hawaii. Left (opposite page): Japanese terminal for cable near Ninomiya, Japan. Below, overseas operator in Oakland, Cal., can call directly any telephone in Japan. Similarly, overseas operators in Tokyo can call any telephone in North America or on island of Oahu.




PACIFIC AREA
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PT. ANGELES
PT. ARENA
OAKLAND
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HAWAII
FIJI
SYDNEY
CABLE IN SERVICE OR COMPLETED
CABLE UNDER CONSTRUCTION OR PLANNED
BRITISH COMMONWEALTH CABLE
U. S. OVERSEAS GATEWAY

Today's manager needs to know and act upon facts as they are in present time, not as they were yesterday or last week. Data communications combined with data processing can build business information systems which give him his facts where and when he needs them

KEYING THE EXECUTIVE TO REAL TIME CONCEPTS

Edgar C. Gentle, Jr.,
Data Communications Planning Administrator
Marketing Department, A.T.&T. Co.

MUCH HAS been documented in the field of real time concepts. Much material has been devoted to definitions of this approach, which at the moment appears to be the ultimate in sophistication of data processing systems. In this instance the words "data processing" are used in the context of the generally accepted term when we speak of business information systems as contrasted to the scientific application of high speed electronic computing devices.

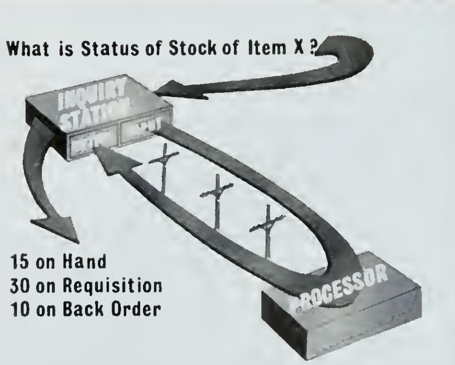
Let us look at the field of data processing and information handling, and particularly at its relationship with a communications system such as the Bell System is capable of providing in this rapidly advancing and developing field.

Before embarking on a discussion of our efforts in the Bell System perhaps I should first explain our position in the business world in the realm of machine-oriented communications. Logically, a question might be raised—what part can be played by the telephone company? An answer to this question can be found in the comments of communications industry executives in a recent issue of *U. S. News and World Report.*

Frederick R. Kappel, chairman of the

board of A.T.&T., commented that, "Our ability to send information in so many forms, so fast and for so many purposes, testifies that a new era in communications is upon us."

Herbert Trotter, Jr., chairman of the board of General Telephone and Electronics Laboratories, stated, "The traditional idea of telephone service is giving way to the much broader concept of total communications. Our whole industry is thinking in terms of getting the right information to the right place at the right time—regardless of whether the information is a spoken message, data on



Real time system: handling data for speed, location, accuracy—where and when needed.

punched cards or tape or video signals."

So the telephone company is in fact a communications company. Today, because of the wide variety of services used by both business and residence customers, we find our established network carrying many more forms of information than voice telephone service. The requirement for voice and data communications has come of age and now we have the term—data communications. Combine data communications with data processing and you have the unique ability to process data and to place it where and when you need it—and are these not basically the broad parameters we associate with a real time system?

Information—time, place and form—combining these takes on a special significance. They indicate the need for speed, location and accuracy. It follows, therefore, that some method of binding these requirements together in an orderly, flexible and economical array must be an inherent part of any real time system. Can we use a network which is presently being used for telephone conversation? The answer is yes!

The field of data communications is one of apparently endless possibilities. There are innumerable codes, questions of compatibility, urgency, accuracy, etc. We have summarized these into what we refer to as the Seven Criteria of Communications in an information system.

Function—What the communications system has to do for the business; specifically the types of messages it has to move, from point to point.

Distribution: The number of places involved in the moving of the information.

Volume—The total amount or bulk of information to be moved in a given period of time.

Urgency—The requirements for delivery can also be referred to as speed requirements.

Language—The physical nature of the message such as handwriting, coded tape, etc.

Accuracy—Tolerable error performance that will still provide desired results.

Cost—The justifiable limit for the system. The cost will always be dependent upon the other criteria and in proportion to their weighting in the design of any system.

These ingredients, properly considered and combined to meet a specific application, will result in a flexible, completely integrated computer and communications complex. This, again, is another definition of a real time system.

The next point is: What is the Bell System doing and what has it done to meet this challenge?

Fundamentally, our approach is twofold: first, relations with our customers and second, consideration of the ability of our people to design, sell and service acceptable new communications systems compatibile with an ever-increasing field of electronic processors. We believe we must recognize the total system requirement from the start of the exploration of an idea with a customer through the formative stage and on into implementation and the employment of particular operating techniques.

We consider these two areas as fundamental guides in developing our programs. We must inform our customers of those areas which we as a communications company recognize as being fundamental to the successful implementation of a total system. In most instances our customers are also the customers of business equipment manufacturers who also have a vital role in these real time systems. Consequently, our responsibilities are to both groups. Internally, our programs involve educating and training our people to realize our capability and meet our responsibility in implementing the communications portion of a real time system.

The main entrance of the Otesage Hotel in Cooperstown, N. Y., where the Bell System's Data Communications Training Program is located.

Laboratories at Cooperstown include a variety of business machines to give students a practical understanding of their operation.

In the Fall of 1961 the Bell System established at Cooperstown, New York, a Data Communications Training Program. Its job is to prepare selected men for the job of planning and implementing data communications systems.

Our intent is to present to these men a heavily concentrated curriculum designed to educate as well as to stimulate a continuing interest in this new field. From this program the graduate returns to his home telephone company and from there expands his knowledge by practical application and further study.

The formal course itself at Cooperstown is 12 weeks long on a live-in basis. Classes are arranged in groups of 24 and the present school population is 48 engineers, 72 marketing salesmen and 24 plant operating managers. During the school term from September through June, we graduate three groups of 144. The main areas of instruction in the marketing curriculum are:

- *Capabilities of the Plant*

  Fundamentals of Data and Transmisssion

  The Switching Plant

KEYING THE EXECUTIVE

Teletypewriter, Business Machine and DATA-PHONE Principles

- *Understanding of Computers and Their Use in Systems*
  Business Systems Analysis
  Computer Principles
- *Data Selling Techniques*
  Marketing and Sales Principles
- *Practical Application of Course Material*
  Case Study Work

In the last third of the course for each of the three schools, practical applications involving sales, engineering and operating forces are combined into a well-knit system approach in order to develop team capabilities. This team aspect is invaluable, of course, in actual field operations.

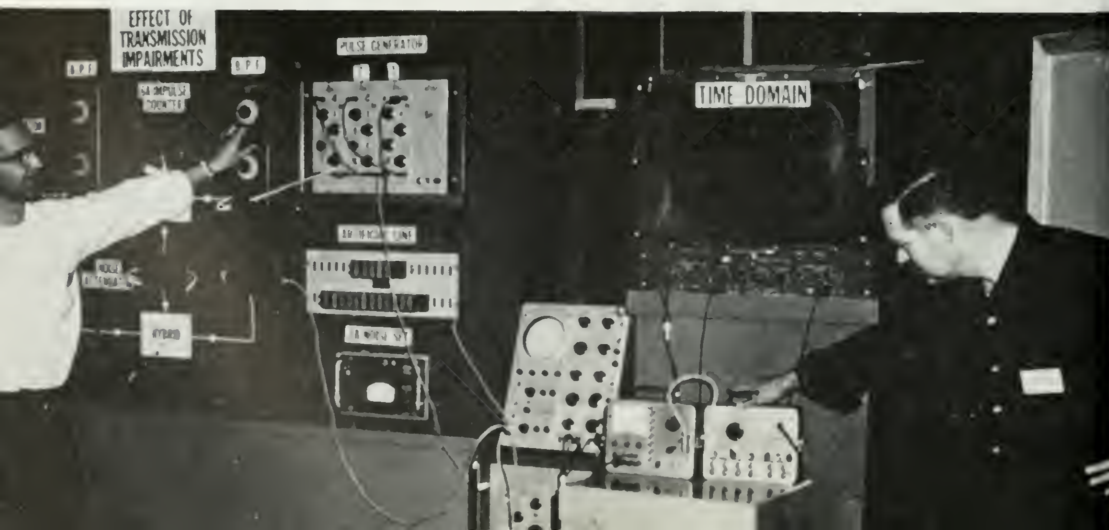
Laboratory equipment provides the student with a large array of business machines and two small general purpose computers, as well as with most of the Bell System data sets and with a whole range of Bell System working test and transmission facilities.

■ You may wonder how an organization such as the Bell System gives personal attention to a data communications sub-system which is tailored to fit into a total system for a particular real time application. Actually, we have learned quite a bit about how to do this in the recent past.

The TWX laboratory at Cooperstown features all types of teletypewriter equipment.

To accomplish rapid and good results in this area, we have developed an Intercompany Service Coordination plan. This is now in existence throughout the Bell System. I.S.C., as we call it, utilizes modern communications to coordinate efforts among the Bell System Operating Companies. This plan brings into play the combined services of each company to implement multi-point interstate systems—the kind most often associated

A special demonstration board is used to explain transmission characteristics.



Instructor in the Data Communications Training Program explains to a class of students the importance of the Data Test Center.

with a data communications project.

A single knowledgeable contact for the customer is made available by this plan. This individual, specially trained and ready and able to move in a hurry, can see that uniform, excellent service is provided for any particular communications system which is part of any customer's total information system.

■ I have covered briefly some of our internal efforts as we go forward in the data communications field. Let us now look at some aspects of the external programs which we have and are developing—for we know these are equally important to our total effort.

In this age of the "information explosion" when the executive frequently finds himself fighting to digest mountains of statistics, there is probably no other single element in the province of the systems analyst more important than communications. Today's manager needs to manage by fact and not by guess, and he needs news, not history.

There is plenty of information—literature, discussion papers, brochures, etc.—available today concerned with all types of new equipment which can be used to implement management's requirements for accurate, economically attainable, timely information. But perhaps until recently this has not been matched with comprehensive information for managers on how to integrate communications into a total system environment.

It was against this background that we designed the program of continuous Business Communications Seminars which are now being conducted in Chicago. The Communications Seminar sessions, which began in the Summer and Fall of 1963 (*BTM*, Summer 1963) are of three different types. Each one differs from the others in that a specific approach is used in each type of session to meet the needs of the particular group in attendance.

The first type is a one-day session geared to the interests of top corporate officers. Corporate officers of most organizations, whether the organization is a relatively small regional operation or a large national one, have many interests in common. Consequently, a comprehensible conceptual approach is the tenor of the program prepared for these top level evecutives.

The second type of session, covering two days, held for business equipment company salesmen and sales managers, is in more detail and stresses coordination and the role of the processor as well as that of the communicator.

The third type of Seminar, conducted over a three-day period, emphasizes overall total systems design and is geared to a pace which allows plenty of time for discussion of whatever details are pertinent to that group. This three-day Seminar is presented to communications managers and systems and procedures managers from customers' organizations, as well as to systems consultants from consulting firms.

The latter two programs, as already mentioned, cover the material in greater detail and speak directly to the complexities of communications techniques combined with the interplay between communications and data processing in a total system.

About 25 persons attend each session of all three types of Seminars, and this number provides for free participation and discussion.

The techniques used in the presentation of the material in Chicago cover a wide spectrum. These include discussions, slides, films, demonstrations of working equipment and case studies, all combined to give a solid continuity to the program. Much information is covered in relatively little time.

Since the sessions are continuous, it would be impossible to have a really stimulating and authoritative panel of experts present at every session. A film of a lively panel discussion on management information systems is therefore used as a way of bringing a truly interesting investigation by authorities into every meeting. The filmed discussion is moderated by Edward C. Bursk, editor of the *Harvard Business Review*, and includes Dr. Willis J. Winn, dean, Wharton School of Finance; Richard Neuschel, vice president of McKinsey & Co.; John

F. Magee, Arthur D. Little, Inc.; Robert M. Trueblood of Touche, Ross, Bailey & Smart; Henry M. Boettinger, assistant comptroller, A.T.&T., and Dr. V. M. Wolontis, associate executive director, Data Systems-Engineering Division of Bell Laboratories.

During their filmed discussion, this panel examines the problem of the businessman trying to come to grips with information in the electronic age. The film makes a point that even though we may expect many improvements in data processing equipment, further progress will come from more sophisticated use of equipment than from faster equipment. The seven criteria for estimating communications needs are examined in some detail. The interplay of all seven criteria is discussed in the light of their application to varying situations.

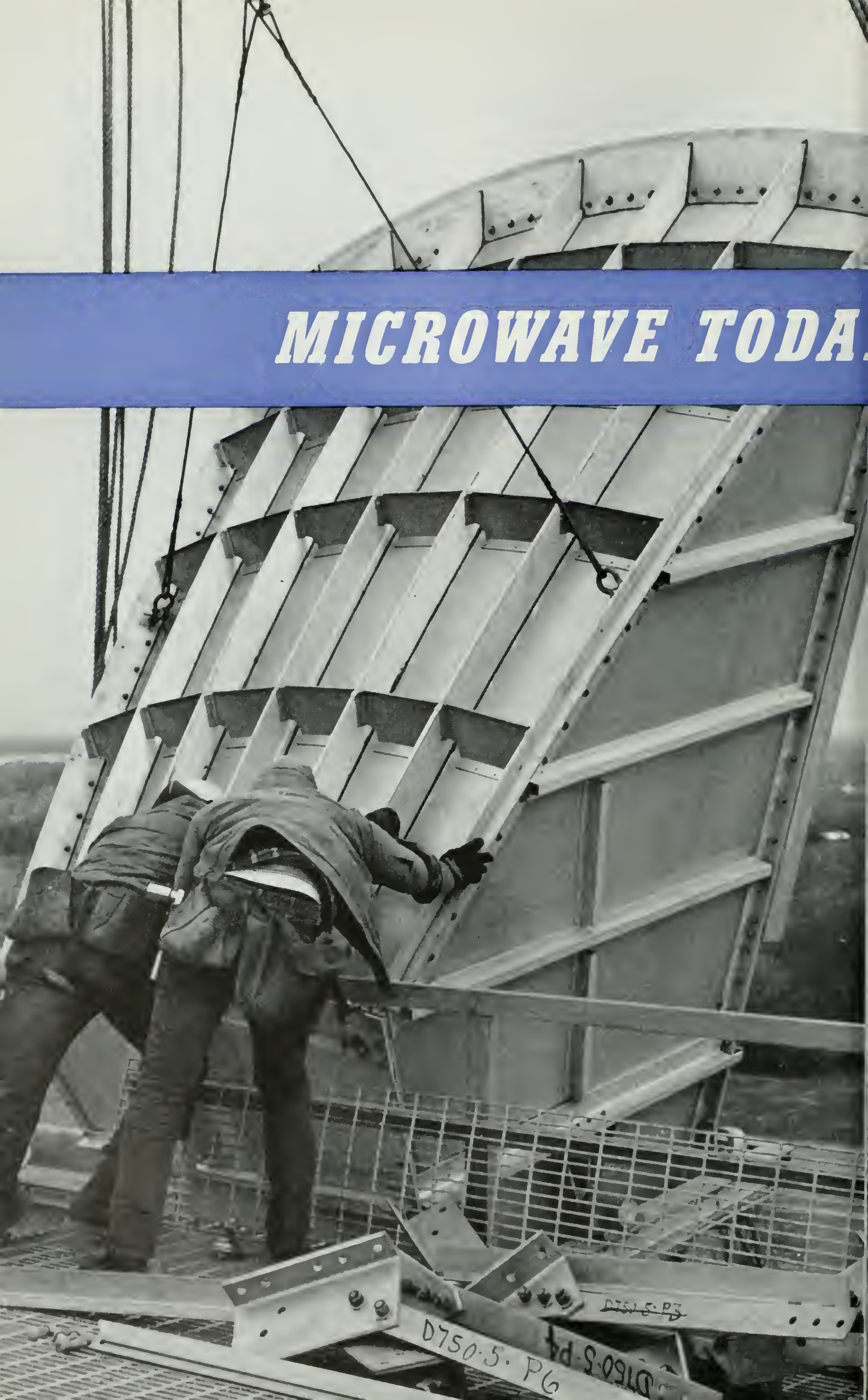
Throughout the Seminar the conferee is made aware that a fully successful information system must rely first on planning and then on the integration of information processing and communications. It is pointed out to him that mutual understanding and full utilization of the capabilities of system planners, business equipment men and communciations people will result in more effectively meeting the full needs of a business.

■ Fast-changing technology requires continuous effort both in development and in implementation. However, equally important is a continuous program for educating people who need this technology. We are using an integrated approach for both internal and external aspects. It is our hope that this systematic effort will be helpful to all of us in making maximum use of the capabilities available to industry today.

Today's electronic age is a period of trial and error for American business as each company searches for the right business information system to meet its needs. However, this search can be made easier and more fruitful if the knowledge at hand is wisely applied. To many this will spell success in the years ahead.

"Information Explosion" film (below) at the Bell System Business Communications Seminar demonstrates that the paperwork needed to build a jet bomber outweighs the airplane itself.

MICROWAVE TODA



Microwave has grown mightily in both quantity and quality since the first route was opened in 1947. Its future promises to be even more startling

ND TOMORROW

Herbert H. Goetschius,
Plant Operating Engineer, Long Lines Department, A.T.&T. Co.

It was only 17 years ago that the Bell System inaugurated a chain of radio relay stations that beamed communications between New York and Boston. A mere four years later, the country was linked from coast to coast by such a route. Today, the Bell System uses over 54,000 miles of microwave routes in a network that encompasses the nation. This valuable communications workhorse is marked for even more significant use in the years ahead.

Microwave channels are not only growing in mileage, they are also handling an increasing volume of new and more sophisticated forms of traffic. With them, more and more long distance calls are relayed to their destinations; almost all television programs are sped from city to city, and an impressive volume of data messages are transmitted as well. Today, about half of the communications facilities of the A.T.&T. Long Lines Department use the microwave medium. It shares the bulk of Bell System long distance traffic with another well-known medium, coaxial cable, which has many important applications and advantages in its own right.

In essence, microwave systems send signals in the high frequency range, amplify them at intermediate stations, and retransmit them until they reach their destinations. Microwaves (which are electromagnetic) are between one and three inches long. Like light waves, they travel in straight lines and do not follow the curvature of the earth. They are focused sharply and aimed from point to point. Less than one watt of power—about the amount needed to light a pocket flashlight bulb—is sufficient to

Left: horn antenna being positioned on top of TD-2 microwave radio relay tower.

Microwave system installed by Bell System for oil company. It transmits high speed data between computers at refinery above and those at the company's headquarters.

send them on their way between stations on a radio relay route.

Variety of Systems

In 1949, the Federal Communications Commission allocated three bands of frequencies—about 4,000, 6,000, and 11,000 megacycles—to be used by common carriers for commercial communications. Microwave systems have wide frequency bands that can be divided into many different communication channels. In turn, each of these channels is usually capable of being sliced up to furnish from 480 to 1800 telephone circuits or one television path.

When the Bell System opened its first microwave route in 1947, it made use of the 4,000 mc band. This experimental service was the forerunner of the basic system, called TD-2. This provides six radio channels—five working channels and another channel for protection, to ensure continuity of service in the event of interruptions. The length of the microwaves in this system is about two and one-half inches.

Added Capacity

More recently, advances in technology have made it possible to derive twelve broad band channels from the 4,000 mc frequency band. (These dozen channels divide into ten working, two protection.) Although the capacity of each channel of the TD-2 system was originally only 480 voice paths, this was later increased to 600. Thus, the 2,400 circuits once obtained with this system have been increased to 6,000.

Of late, the Bell Laboratories has also undertaken to further increase the capacity of the TD-2 system in a development that will make use of transistors and other solid state devices. This miniaturized equipment requires less power and also less space for performance.

As the amount of business being handled in the 4,000 mc band of frequencies grew rapidly, the Bell Laboratories turned to developing a long-haul system which could operate in the second block of frequencies assigned—the 6,000 mc band. This system—called TH—has eight rather than the six broad channels of the earlier system. By the time the TH system was evolved, advances in the communication art had made it possible to transmit 1,800 voice paths on each of its broadband channels. Hence, with six working radio channels on a TH route (two others are for protection) the capacity of this system is now 10,800 circuits. In addition to the eight broadband channels that can be operated along a route, the TH system also furnishes a pair of two-way, narrow-band auxiliary channels for control and alarm purposes.

Since the TD-2 and TH systems employ frequency bands that are well separated from each other, both can be used on the same routes without interference. As common sites, towers, antennas, access roads, and power connections can be used, TH systems may be introduced with great economy. Even existing buildings can be utilized, although enlargements may be needed.

With both types of systems being used, a route can have a total capacity at present of 16,800 circuits. Thus far, the existing TD-2 route between New York and Salt Lake City, with branches to Chicago and Denver, has been equipped with the TH system as well.

In 1966 the Bell System expects to have new equipment which will double the capacity of the TD-2 system. Coded TD-3, the new system will carry 1,200 circuits on each channel, using the 4,000 mc frequency band. By adding the 10,800 circuits of the TH systems transmitted in the 6,000 band, a combined total of almost 23,000 telephone circuits will be secured. This is a far cry from the first radio relay system introduced in 1947.

T-1 microwave repeater at Chink's Peak, Idaho. One of first installations of this system.

Short Haul Service

The third block of radio frequencies made available for common carrier operation—the 11,000 mc band—is more suitable to short rather than long-haul transmission. This is because the microwaves in this band are extremely short—slightly over one inch—and therefore transmission may be impaired during heavy rain storms when energy is absorbed by rain drops. Nonetheless, the Bell Laboratories has developed systems—called TJ and TL—which can employ the microwaves in this band for short-haul service in parts of the country where the annual rainfall is light.

The TJ system has a capacity of 600 channels that can be maintained with a normal level of reliability. In areas where rain is heavy, it is possible to transmit up to 100 miles with about ten intermediate stations, but where it is relatively dry, it is possible to span some 200 miles with the same number. The TL system introduced is a transistorized form of this system for short-haul transmission.

Finally, an effort has been made to develop a microwave system for short-haul use that can utilize the 6,000 mc band, previously used only for long-haul traffic. In this band, microwaves are not affected by raindrops as they are in the 11,000 mc band. This new system—labelled TM—has a capacity of 600 circuits and is expected to be available for installation ths summer.

Elements of a System

About 1,700 towers—situated some 30 miles apart, rising above the fields, perched on mountain sides, soaring into the sky above the plains—identify the growing Bell System radio relay network. The towers range in height from 40 to 350 feet. However, at many cities along the route, existing telephone buildings are used to house the microwave equipment and support its antennas atop their roofs.

Each system requires essentially the same elements—a transmitter, a transmitting antenna which will radiate and direct the energy produced, a receiving antenna that will intercept a maximum of this energy after its transmission through space, and a receiver.

Radio relay stations on a route are not placed in a straight line but zigzag somewhat. With this arrangement, it is possible to prevent interference which might be caused if the frequency transmitted overshot its immediate mark and was received at a station farther along the route. (This phenomenon is referred to as "over reach."

A scheme of alternate frequency assignments is employed at intermediate stations to secure further isolation of the microwaves. Thus, the signal comes in to a station on one frequency and is sent out on another, while at the next intermediate station the frequencies assigned are reversed. As a consequence, the same frequencies can be used over and over with no waste of spectrum space. Highly directive antennas are used to transmit the microwaves and this helps to confine the energy in a narrow beam.

At terminal stations the signal is converted from the microwave frequencies transmitted through space between stations to the lower and more manageable ones used in long distance cable and wire communication. Most intermediate stations are arranged only to receive, amplify and retransmit the radio waves, although at some of them equipment is provided for diverting channels from the main routes to side or branch legs.

Two-way communication requires that a pair of paths transmitting in opposite directions must be established between stations on a radio relay route. Hence, at terminal stations there is usually an antenna for transmitting and another for receiving. At intermediate stations there are two pairs to keep in touch with two neighboring stations.

Microwave site on Buckhorn Mountain, Col
is one of Bell System's highest. Below: i
breakers are assembled to protect wave gui
equipment on a mountain top microwave tow

Although the electron tubes used on the TD-2 system are remarkable in design and compactness, their power output is limited. A more modern tube capable of greater power output has been developed and this is utilized with the TH and TD-3 systems. Called the traveling wave tube, it operates on a principle quite different from that of the conventional electron tube. In the traveling wave tube the signal passes through a spiral conductor in the presence of a strong electron stream. Energy from this stream combines with the signal to increase its amplitude, much as the wind blowing over the surface of the sea increases the size of the waves.

Periodic inspection ensures that the equipment at each station is operating at peak efficiency. But, should maintenance or restoration work be called for unexpectedly at locations that are unattended, an ingenious alarm system gives instant notice of the nature of any difficulty to a control office where telephone people are ready to take the necessary action. This may involve sending craftsmen to the station or merely operating a switch which will handle the problem by remote control.

At the receiving terminal station the energy sent along the route must be demodulated—that is, the original information, whether telephone conversations, data messages, or television programs must be retrieved from the carrier radio wave. This involves a process of electrical conversion; the world of super-high frequencies is left behind as the microwaves are stepped down in stages by converters to the lower frequencies used by regular telephone equipment or by television stations. Electrical filters sort out each particular telephone or data message for its ultimate destination. In the case of television, only one demodulation step is necessary because this signal occupies an entire transmission band, and it is sent on to the broadcasting station intact.

Traveling wave tube used in TH and TD-3 systems has a far greater power output than electron tubes used previously.

For Emergencies

Transmission by means of microwaves offers problems as well as advantages. Occasionally, for example, the signal fades, as irregularities in the atmosphere prevent all or part of it from reaching the receiving antenna. Again, the microwave equipment is also subject to such difficulties as the failure of a component. Consequently, at least one channel on a radio relay route is usually assigned to serve as a standby. Ordinarily, on multichannel routes, sections of protection channels are automatically substituted for sections of any working channels that have become disabled. Substitutions can also be made by push-button remote control.

In the six-channel TD-2 system, it will be recalled, a protection channel was set aside to act as a substitute in the event of the failure of any of the five working channels. Again, on a route with twelve channels, two protection channels are available to ensure a performance of normal reliability. However, if such a pair of protection channels were to be substituted for any of the ten working channels, it turns out that the reliability of this route would actually be increased some seven times. As a consequence, the Bell Laboratories has developed an improved switching system to make such substitutions almost instantaneously, and the system has recently undergone a successful field trial.

Restoration

Strategically spotted throughout the country by the Bell System, a number of mobile restoration units provide ready replacement in the event of the destruction of a station on one of the System's radio relay routes. Each unit used by the Long Lines Department, for instance, is self-sufficient and contains equipment to restore six microwave channels in each direction of transmission. In all, each unit is made up of three trailers and includes a 300-foot sectional tower, with associated waveguide and antennas, and two emergency engine alternators.

While all this equipment is mounted in van units, it can also be removed readily should transportation by air carrier be desirable because a particular site is inaccessible by other means. To furnish adequate housing under such circumstances, each restoration unit also contains a portable structure.

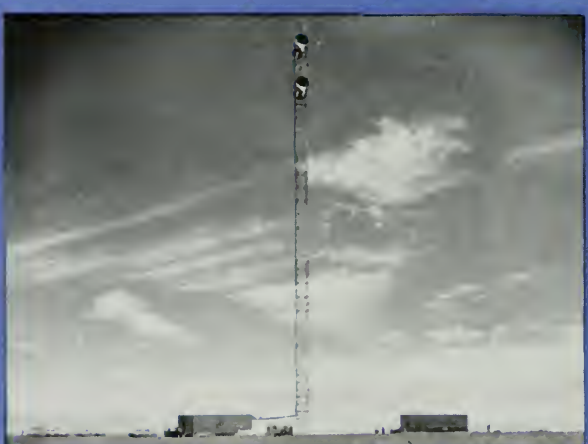
Pre-plans have been prepared for the restoration of each radio relay location, using these restoration units. These pre-plans cover the physical location of a replacement tower, a list of contractors who could be utilized in construction work, and many other pertinent details essential for quick restoration—even to showing where the guy wires for the towers should be placed.

A pre-designated force has also been assigned various responsibilities involved in carrying out a restoration job efficiently. This force consists of a site restoration crew and another group located at a restoration headquarters.

The restoration of a single repeater station can usually be accomplished in about 18 to 20 hours. However, this interval will be somewhat less if the existing antenna structure can be re-used and only repeater equipment is required.

It is a long way—in investment, time, and technical advance—from the early days of microwave to the present systems and the efforts toward future improvement in radio relay communication. Each stage in these developments, however, has had the same goal—a further contribution to better service.

Mobile emergency units are stored at strategic points. Towers can be set up and in operation in a few hours.



A Plan For Preventing Fraud

Fraud is a costly drain on every business. Only by an alert management and a carefully planned prevention program can it be kept under control. Here are some basic rules for prevention that have proved successful in the Bell System

Donald F. MacEachern,
Chief Accountant
Comptroller's Department, A.T.&T. Co.

All businesses are faced with fraud on the part of some of their employees, customers, suppliers and others outside the business. The telephone business is no exception. Fraud is a costly proposition. In many lines of business, dishonesty may be adding as much as 15 percent to consumer prices. The FBI reports that losses from fraud are three times as great as the combined losses from all the burglaries, robberies, car thefts and bank hold-ups in this country. Known losses from bank embezzlement in 1962 exceeded nine million dollars whereas bank hold-ups resulted in losses of about two-and-a-quarter million dollars.

Certainly fraud is now big business. It is no longer restricted to kiting, forging or simple cash manipulations. It often involves extremely sophisticated falsification of large volumes of records with the result that the records themselves cannot be relied upon as a means of uncovering fraud. These broad facts are cited to show that our attention must be turned toward preventing fraud if the assets and revenues of our businesses are to be protected against the damaging effects of these deceitful acts. Against this background it becomes clear that positive fraud prevention should be a part of every company's policy.

Management's Responsibilities

It is a fundamental managerial concept that the primary responsibility for safeguarding assets rests with the managers of the business. Managers in all levels of authority throughout all departments must be constantly aware of this responsibility and strive to conduct their operations in a manner that makes the perpetration of fraud virtually impossible. Each operating routine should be developed with built-in control features that will enable management to maintain adequate control. Also, each manager must personally evaluate his operations in the light of these controls to guard against fraud. If this responsibility is carried out energetically, it has an immediate and long-lasting effect on every employee. Also, once this attitude of everyday supervisory control permeates the organization, every person in the business quickly realizes that the company is going to exercise specific controls to see that dishonesty does not occur. There is no other form of control that can ever match the effect of alert management.

Identifying Fraud

The internal auditing organization should have the primary responsibility for determining whether fraud exists. Who is better equipped for this responsibility than the auditing organization? Here we have an independent group of highly competent management staff representatives with a company-wide point of view. Moreover, they are the only ones who have the authority and responsibility for reviewing and appraising all company operations.

Employee fraud prevention is essentially a problem in human relations. If nobody seems to care, you can bet that employee theft will increase. It's unfortunate, but true, that the company must identify honesty as a condition of employment. There have been cases where an employee dismissed for a dishonest act was reinstated by an arbitrator on the grounds that the company had not explicitly forbidden the dishonesty. To be effective, the stimulus for honesty in the business should come from top management, and it should be made clear that what is said is meant.

In our business there is no question about this. Frederick R. Kappel, chairman of the board of A.T.&T., has said the following about honesty in the business, and he has left no doubt that he means it:

> "Those who manage have a special responsibility. Through their own personal conduct and through supervisory action, they must impress upon employees under their leadership the need for the highest ethical standards. We cannot tolerate any practices which compromise the principles of honest business conduct."

This then is the first important step in fraud prevention: A clear statement to all employees that the company will not tolerate fraud in any form.

Each of the Bell Companies has taken this step. A booklet on the subject of honesty in the business is given to every employee and is reviewed periodically with him by his immediate supervisor. The booklet covers thefts of services as well as goods, other dishonest acts, secrecy of communications and the legal penalties prescribed for falsification of reports and records. There is a record in each employee's personnel file showing that he has been informed of this policy.

A second important deterrent to fraud on the part of employees is the blanket fidelity bond. Although the deterrent effect is its primary purpose, such a bond also provides important financial benefits to the Companies in case of major fraud. Under such a bond, each dishonest act of an employee, whether committed on the job or off the job, is reportable to the bonding company. The report must be made in all cases, whether or not a claim is made. If the employee is retained, specific application must be made to the bonding company to have him reinstated under the bond. The bonding company, of course, may refuse reinstatement, in which case company management must take this condition into consideration in job assignment.

A most important aspect of bonding is that each employee be informed that he is bonded, even though he is not required to make specific application for coverage under the bond. Unless he knows he is covered and knows what this means, there will be little or no deterrent effect. Each employee should also have a clear understanding of the reasons for bonding and what the company's contractual responsibilities are under the terms of the bond, particularly the reporting requirement. The "Honesty in the Business" booklets previously referred to are generally the means used to inform all employees that they are bonded.

Need for a Security Group

A third suggestion for fraud prevention is to have an outstanding security group closely associated with the internal auditing function. A security group is not a company police force, and it is not even primarily an investigating group, although various aspects of investigation are part of the group's responsibility. It is primarily engaged in determining how to prevent losses of assets and revenues. Formal security groups have been established by the Bell Operating Companies, principally during the past three years, although the security problem was dealt with in various ways previously.

In most instances, the general internal auditor and the general security supervisor report to the same person, namely an assistant comptroller. This assistant comptroller's sole responsibility (or in some cases his primary responsibility) is auditing and security. He in turn reports to the vice president and comptroller. Although the security group and the auditing group each has certain independent responsibilities, each often requires the assistance of the other.

A close working relationship between the groups is especially necessary when an audit turns up a suspicion of employee fraud or theft of assets, revenues or services. In these cases, a security representative and an auditor decide upon the action to be taken. Each group then carries out its assignments until there is a positive indication of whether theft or fraud exists.

These cases may involve giving or providing free telephone service; the unauthorized use or installation of service; theft of material, supplies, equipment or tools; sale of confidential information; or collusion with contractors and suppliers. The auditing and security groups generally are not content merely to apprehend the wrongdoer. Since they are primarily interested in prevention, they seek economic ways to make such frauds difficult or impossible.

Here are a few examples of how the Bell Companies' security groups are combatting fraud in the communications field.

Public Telephones

Coin telephones represent one area of operations in which there are major losses of revenues and plant assets. These losses occur either as a result of lock picking or through strong-arm methods. The Operating Company security organizations are charged with the assignment of eliminating these losses. They approach the problem by seeking the assistance of other representatives of the Operating Telephone Companies, of the Western Electric Company, and of Bell Telephone Laboratories.

These are a few of the things that have resulted from their study of the security aspects of the public telephone side of our business, which brings in many millions of dollars a year:

- The use of silent alarm systems which result in the immediate notification of police.
- Numerous design changes providing greater physical security.
- The use of more secure locks.
- The use of armored cords to deter theft of telephone handsets and to prevent other abuses.
- The use of special back boards, security studs and through-bolt devices to deter loss and destruction of equipment and money through strong-arm methods.

This is typical of the approach to the job of deterring fraud. We are making real headway in this area. Many of the defrauders have been convicted and imprisoned and losses are down. Major redesigns of coin telephone equipment are now in the manufacturing stage and are expected to reduce losses still further. We are determined, in this and other areas subject to losses in our operations, to see that company assets and revenues are properly and adequately safeguarded.

Credit Cards

Another significant area of loss is the fraudulent use of credit cards. The company security supervisors have, in effect, set up a nationwide clearing house for the accumulation and investigation of credit card fraud. This area of loss is still large but is being brought under control.

The practices for the use of credit cards have been so arranged that a minimum amount of information is required, thus making their use as convenient as possible. This convenience stimulates usage and we want to keep it that way. However, there are always chiselers who take advantage of such a public convenience to try to get something for nothing—in this case free telephone service. That's an outright theft.

Protection by Legislation

Until a few years ago, the communications industry was faced with an unusual legal void. In general, theft of communications service, by whatever means, was not a crime. Legislative groups were interested in hearing about this—and in doing something about it. Now, in all of the states in which we operate, legislation has been enacted to classify thefts of communication services as criminal acts.

Other 'Outside' Fraud

There are numerous other ways of defrauding the communications business, including the use of a variety of electronic devices. This equipment, when located, is turned over to our Laboratories where its capabilities are studied and where methods are devised for making its use ineffective.

A fourth means for deterring fraud is the introduction of operational auditing. Our approach to operational auditing, which is called the "transaction approach," serves to limit the scope of an audit to a single type of transaction or to a group of closely related types of transactions.

This approach is in contrast with the "office" or "departmental" approach. It involves the identification of individual operations within the business which, for want of a better term, are referred to as transactions. There need be no precise definition of a transaction as long as the scope of the resulting audit is quite well defined. Here are a few examples of the application of this approach, with particular reference to fraud detection.

In auditing supplier's bills, for example, we no longer take the mass approach and try to cover all kinds of bills at one time. Nor do we restrict our review and appraisal to such things as the propriety of approvals and accuracy of arithmetic and accounting classification. Instead, we subdivide the mass of charges from outside contractors for goods and services into their numerous and rather logical categories such as right of way clearance and maintenance, house service supplies and services, building maintenance, motor vehicle expenses, trucking, printing, etc.

What we want to know about these company expenditures is:

- Were these goods and services actually received by the company, were they used for company purposes and were they completely satisfactory?
- Were charges billed in accordance with a contract and if not, why not? Otherwise, were the charges determined to be reasonable and proper?
- What specific controls exist in the line administration of the job to assure the propriety of such company expenditures?

Each audit, no matter what the transaction, is started at the point of origin of business data and continued step by step through the various districts, divisions and departments until such data reach their final resting place; usually a company report involving costs, quality or productivity, customers' bills, employee pay drafts and the like. In many instances the auditor, accompanied by a competent departmental representative, will actually inspect the work to find out exactly what was done. We place considerable emphasis in our audit procedures on the need to get out of the Comptroller's Department and into the Operating Departments to find out by first hand inspection and review, with the assistance of experts in the particular field, just exactly what control we have against loose practices which can so easily develop into waste and sometimes conflict of interest.

The internal auditors' interest goes far beyond suppliers' bills and vouchers. Here are two more examples of the transaction approach to internal auditing. In these cases, fraud detection is also one of the objectives of the audits, but as you will see, it is an entirely different kind of fraud and also of vital interest to the business.

All of us realize the importance of the work performed by plant craftsmen in offices, plants and homes. We need to know that these telephone installation jobs are being done in a completely satisfactory way from the customers' point of view and from the company's. As a check, our auditors make premise visits to a scientifically selected sample of locations within a few days after the completion of each job. The auditor is there to make these determinations:

- Was the customer completely satisfied from the first contact with the business office to and including the work performed?
- Does the actual workmanship conform with Bell System standards? The auditor is not interested in minor deviations dictated by good judgment, but is vitally interested in any deviation which might affect service—improper grounding, for example.
- Are there any hazards from the standpoint of the customer's safety as well as from the standpoint of equipment maintenance?
- How does the total amount of time reported for the job compare with the amount of time which would

be normal for that job, giving consideration to actual conditions under which the work was performed?

- How does the assignment of time compare with the assignment which would be normal for that particular kind of job?
- Were the statistical data properly reported? If this was an installation job, was it properly identified as a new installation, a reinstallation or a reconnection? Were the work units properly counted and coded?

We also realize the importance of the work performed by plant craftsmen in the construction, replacement, maintenance and removal of outside telephone plant. We need to know that such work is being performed in a completely satisfactory manner from the public's and from the telephone company's points of view. As a check, our auditors also make on-the-spot inspections of samples of outside plant construction work as soon as possible after the work has been done. The following determinations are made:

- Was the job carefully and properly engineered?
- Does the plant conform with all specifications and governmental regulations covering safety, especially with respect to clearances over highways and from power company plant?
- Was the plant constructed in accordance with prescribed specifications covering both materials and workmanship?
- Was a good cleanup job performed including the removal and recovery of all excess material and scrap?
- Was the total time reported for the job reasonable?
- Was the time assigned to each field account code for the job consistent with that which would normally be required, giving consideration to the classes of plant worked on and the nature of the work performed?
- Do the quantities of major items of material and supplies actually added to, or removed, agree with the quantities reported to the accounting department?

It is absolutely vital that management reports of cost, quality and productivity be devoid of the effect of bias or irregularity. We are not nearly so concerned with the individual error as we are with any tendency toward bias or distortion in basic business data. We must be able to support the accounting classification of payrolls to the accounts prescribed by regulatory agencies. We cannot condone any attempt to improve measurements of cost, quality or productivity through distorted field reporting. Our output, in the form of bills to customers, paydrafts for employees and administrative reports, will be only as good as our input.

The suggestions for deterring fraud against a business can be summarized this way:

- Clearly and formally establish "honesty in the business" as not only the best policy but the only policy. Be consistently fair and firm in its enforcement at all levels in the business.
- Bond every employee and make certain that each knows he is bonded
- Establish a security organization and take a positive preventive approach to all possible sources of fraud against the business.
- Introduce operational auditing since this is an excellent means of testing the validity of basic business data.

These four suggestions constitute a plan for prevention which really works, at least for the Bell System. The impression that fraud can be licked by apprehending the defrauders has been carefully avoided. Certainly apprehension is necessary and has a strong deterrent effect. But apprehension should also serve to identify conditions which, if eliminated, would make such fraud difficult or impossible. Whatever the causes for a dangerous increase in dishonest manipulations, thefts, falsification of records, and other forms of fraud, the resulting threat to business is heightened if management fails or refuses to recognize the danger.

An Obligation

We all know that there is no magic by which fraud from within or from without a business can be completely overcome. But we cannot assume that we are free of fraud just because is has not been brought to our attention. Management has a financial obligation to its customers, owners and employees and a social responsibility to see that it is not being defrauded. It is essential that company management know positively and on a continuing basis whether the business is being defrauded. This may be an anomaly, but it seems to be necessary to have positive indications of fraud before sufficient interest can be aroused in taking preventive measures. Management complacency can be dangerous and might stand in the way of preventive measures. Our top management people, who are ultimately responsible for the success of our business, accept this obligation to take whatever action seems appropriate and necessary.

Accounting officers have a big responsibility to see to it that top management is kept constantly informed of the status of fraud and of any important weaknesses in internal control within the business through an effective information system. We are working hard to fulfill this responsibility.

(This article has been adapted from a talk given by Mr. MacEachern to the Accounting Conference of the United States Independent Telephone Association at their 66th Annual Convention.)

New ways are rapidly shouldering out the old ways in Thailand and Nigeria—two tropical countries on the other side of the world. Both are on the way to more modern communications with the help of consultants from Western Electric

TELECOMMUNICATIONS *in the tropics*

David Younger, *Manager, Advance Engineering and Costs Defense Activities Division, Western Electric Co.*

THREE YEARS ago, in 1961, the Bell System had two requests which gave it a new opportunity to be of service. One came from the Agency for International Development of the State Department (AID) then the International Cooperation Administration, and the other from Senator Jacob Javits of New York. Both asked that we concern ourselves with communications in foreign countries in connection with the foreign assistance program. H. I. Romnes, then president of Western Electric, wrote Senator Javits to concur with his suggestions and to say that the Bell System would be glad to play a part in that program.

As a result, pursuant to a contract between Western and the International Cooperation Administration, two Bell System engineers found themselves in

A 280-foot microwave tower rises over rice paddies and banana trees in Thailand. It is part of a new network built by Collins Radio and recommended by Western Electric consultants.

This modern building, in the heart of Bangkok, houses Thailand's national toll telephone center, and is now serving the country's newly-expanded communications system.

Thailand in the fall of 1961 to determine the type of long distance communication system best suited to that Southeast Asian country. Their findings called for the preparation of a telecommunications systems plan which would meet the current circuit requirements, military priorities and transmission objectives of Thailand in accordance with a practicable schedule. At the request of AID, Western sent a group to Thailand for several weeks to work out such a plan and prepare specifications for the implementation phase, with the understanding that Western would not participate in the bidding.

The contract was awarded by the Government of Thailand to a team headed by the Collins Radio Company of Dallas, Texas. Again, the United States Government called on the Bell System, this time to send people back to Thailand to assist in monitoring and evaluating performance under the specifications. Eleven Western Electric men are finishing up their stint there and the project will probably come to an end this December. But in the three years from 1961 to 1964, a complete modern long distance communications system has been built in the northern regions of Thailand with the help of these men from the Bell System.

In March, 1963, another such request came from the Agency for International Development. Would we carry out a telecommunications survey in Nigeria? A West African country between the Sahara Desert and the equator, Nigeria is almost as large as Texas and New Mexico combined. It has a population of 42 million people, the largest of any African country, the thirteenth largest in the world. Western's contract with the Agency called for an economic and feasibility study to show how a modern communication system would affect the Nigerian economy. The report was to include a five-year plan, for immediate implementation, for improvement and expansion of Nigeria's telecommunications.

Again, two Bell System engineers found themselves in a far-away country, making a quick survey to gain an appreciation of its terrain, resources, industry and commerce. Meanwhile, in New York, a survey group of 20 engineers and economists was being formed, consisting of men drawn from Western Electric and various Bell Telephone Companies. By mid-June, 1963, a group had not only been formed, but it had become familiar with the geography and economic statistics of Nigeria.

On arriving in Lagos, Nigeria's capital,

the group was pleased to find that summer in this handsome modern city on the edge of the equator was more agreeable than one in New York City. Because the summer includes the rainy season, the skies there are usually filled with clouds which screen the hot summer sun. Actually the rain is not especially troublesome, particularly to one accustomed to going into a New York subway entrance at five o'clock during a downpour.

The survey group was a balanced team comprising specialists in Commercial, Traffic, Plant extension, transmission and switching engineering. They came from 12 Bell System companies and their average age was over 50. They were the type of group that only a large organization can assemble. They were thoroughly grounded in the principles of communication, they knew what could be done, and how much it would cost to do it. Their primary function was to utilize that knowledge and experience to prepare a five-year plan which would reflect the industry, economy and terrain of Nigeria.

After a week spent in becoming familiar with local customs and getting acquainted with some of the people in Lagos, the group split up into small teams and made on-the-spot analyses of local telecommunication needs in 60 cities, interviewing 300 business and government leaders in those cities, and inspecting the existing telephone system.

While this was going on, two economists determined trade patterns and business trends. The group got together again late in July and exchanged information and experiences. The meeting showed a

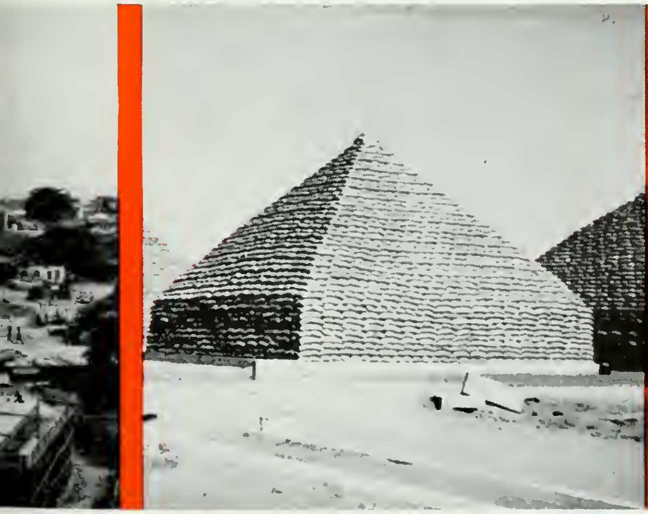
Nigeria is a land of contrasts: the walled city of Kano in the north at the Sahara Desert's edge is at least 1,000 years old; in the south lies modern Lagos, Africa's busiest seaport.

In Lagos new luxury hotels and business buildings rise around the old residential quarters.

need for further survey information, and for the first time there were indications as to what form the report might take.

The survey team found that the economy of the country was being stifled by the lack of suitable telecommunications. Practically every city, town and village had a waiting list for telephone service. In fact, the service in 1963 was even more inadequate, relative to the needs of the country, than it had been ten years previously. A delay of four hours in completing a long distance call was not uncommon. Frequently, because of the demand, calls that did get through were limited to six minutes. Many businessmen reported that they could not expand their operations because they lacked communications. For example, many of the towns in Nigeria have branch banks whose headquarters are located in Lagos. Authority of the branches to make loans and carry out other business is necessarily limited. As a result, business operations were often delayed several days until a message could be sent by the branch to its headquarters in Lagos and the necessary authority granted.

Upon their return to New York in September, the 20-man group refined its findings and prepared a two volume report totaling 170 pages, sumarizing them and outlining steps to be taken which would assist Nigeria in the development of an expanded and improved telecommunications system. The report was accepted in November by the Agency for International Development, which asked that it be presented to the Government of Nigeria for their consideration. This was done during the same month at a formal



Modern communications will help move 50-foot pyramids of peanuts in 100-pound bags, piled up for lack of contact with market.

Three officials of the Posts & Telegraph, Nigeria's communications system, before telephone headquarters building at Kaduna.

presentation in Lagos. U.S. Ambassador Joseph Palmer, II made a brief speech, and Communications Minister Olu Akinfosile then thanked him "for the speed and efficiency with which this excellent document on our national telecommunication network has been prepared." He added that "the report opens a new phase not only for our national telecommunication development but also for the commercial, industrial and social development of the entire nation."

In February of this year, Western Electric entered into a new contract with AID calling for the preparation of specifications for the equipment needed to implement the recommended five-year plan. As in the case of our work in Thailand, it was understood that Western would not participate in the bidding. A 68-page specification for the first of four steps of the plan was prepared and was issued in June of this year to 27 companies in eight countries. The bidders conference held at Lagos on the first of July was attended by 70 representatives of those companies. The conference was followed by trips to possible radio relay and switching installations to acquaint the bidders with the problems they might encounter. Specifications for the second step are in progress for a similar bidders conference scheduled for the fall of this year. Nigeria has asked Western to continue its assistance and has asked that we have people in Nigeria to make inspections and assist in evaluation of performance by the implementation contractors under the specifications. Arrangements for this additional assistance are now being worked out.

As in the case of Thailand, Western Electric has excluded itself from the bidding. However, proposals prepared by the bidding companies will be sent to Western for evaluation. AID is pleased with the whole arrangement because it

Old and new in industry: indigo dye pots
trast with modern Guiness brewery be

helps the development of Nigeria. The Republic of Nigeria is, of course, pleased.

As more overseas cables are placed and when communications satellites become common, communications between the United States and other countries will become more and more frequent. The day is approaching when direct dialing to Thailand and Nigeria will be commonplace, and this will happen with a minimum of difficulty if these countries have adequate domestic communications systems of good quality. These projects are important to the United States as shown by AID's interest in them. When we are asked to assist in these public communications projects because of our competence in this field, we, as good citizens do our best to comply.

Training class of Nigerian outside plant engineers, aided in up-to-date techniques by Western Electric consultants.

Nigerian plant men work on a telephone pole in the Eastern Region.

Typical operating room at Kaduna in the Northern Region.

THE SERVICE REPRESENTATIVE

Lee C. Tait, *Assistant Vice President*
Operations Department, A.T.&T. Co.

> ## WANTED:
>
> Girls for job in Telephone Company business office; must be able to handle customer contacts intelligently, capably, humanly, and must be able to handle important clerical work efficiently, promptly, accurately. Good judgment and amiability essential, also must be understanding, alert, responsive, tactful, resourceful and have initiative.

WHAT IS THIS JOB which requires such a list of desirable qualities? Just what kind of a job is it, that it can be so demanding? It is that of the Service Representative, a job that is almost unique in industry. And in terms of personal service to the individual customer, it is one of the important jobs in the Bell System today.

The service representative is an important link between the telephone company and the customer; her job is a focal point in providing the best possible service to each customer at all times. Her work centers around customers in a number of different ways: talking with them on the telephone or, in some offices, in person; answering letters; collecting bills; preparing many kinds of forms and records; offering appropriate suggestions for additional telephone service.

The job is demanding. It requires constant tactfulness and the ability to change pace on an instant's notice—the ring of the telephone may mean a customer with a request or a problem and, in all likelihood, entirely different from the call that preceded it: a request for an extension, a question about a bill, getting service turned off for the duration of a vacation, a question about a directory listing, new telephone service for a business, a request for service at a new address. Each entirely different from the other and each must be handled knowledgeably, accurately and efficiently, in a friendly and helpful manner—in such a way that the customer will have confidence in the service representative and the company. She must represent the company to the customer and the customer to the company, for she is usually the link between the customer and the other telephone company departments.

Paper Work

In addition, about half of the service representative's job is paper work, not only records to be noted and files to be kept, but work on bills, including posting payments and collecting. That the latter requires tact and judgment hardly needs to be noted; the collection of an unpaid bill can be a challenging task in itself, to do it without offending the customer is even more so, yet that is what is required. She must negotiate and issue service orders, a job that requires great accuracy. From her handwritten order will come the company's permanent records. From these the Plant Department installs the equipment and establishes its own records; the Accounting Department issues the bills; the Traffic Department arranges a listing on Information records, and

Directory lists the customer's name in the local directory. Understandably, any error—however slight—can have innumerable and varied consequences, not the least of which is loss of customer confidence. Even after the service order is issued, the service representative's job is by no means completed; she still remains the customer's representative and is responsible to him.

Promoting Service

Enthusiastic promotion of telephone service, while not entirely new to the Bell System, has in recent years taken on new significance in the business office and is another of the many and varied activities of the service representative. Telephone service is a considerably broader concept today than ever before. The wide variety of services available in custom-tailored combinations means better service to the customer. The service representative plays a key role in making this concept known to Bell System customers throughout the country. Whenever appropriate, and she must use her own good judgment and sensitivity to the customer's point of view in determining when that is, she is expected to inform the customer of the services the company has to offer, discussing with him the benefits of adequate and complete telephone service.

An important job? Undeniably. And its importance is growing. The approximately 25,000 service representatives in the Bell System handle about 10 million customer contacts per month, and each one offers the potential for affecting customers' attitudes, for good or for bad. It is this aspect of her job, her contact with the customer and the potential it represents, that is becoming an increasingly important factor.

A Nation on the Move

Great changes have taken place in the telephone business in the past two decades. Once their telephone service is installed, customers today have much less need to contact the telephone company

THE SERVICE REPRESENTATIVE

than in years past. For example, as a result of Direct Distance Dialing, about three-quarters of our customers now dial most of their long distance calls unassisted. Advances in technology and engineering are leading to further reductions of the already small number of repair calls. Contrast this, if you will, with a nation on the move, more and more people moving or being transferred from one city or area to another, or moving from one house or apartment to another within an area, customers talking more frequently by telephone over greater distances and for longer periods of time, demands of a changing population for better and better telephone service.

The consequent move orders, requests for new and additional services, questions about bills or services, are channeled to the business office and directed to the service representative. With the lessening of other points of contact with the customer, the contacts which come to the service representative gain increased importance. The way in which she performs her job, the way in which she gives service to the customer, are of increasing consequence. The obvious corollary here is that the way in which we are recruiting and training for the service representative job has become much more important also.

Finding The Right Girl

Undeniably, the service representative's job is demanding and the skills needed are many. And it is equally undeniable that finding qualified applicants for this job is a difficult task at best. Employment offices all over the Bell System are seeking service representative applicants with just such qualities. Certainly intelligence and educational background are important, but equally important are the qualities of understanding and good judgment. Add to this an ability and desire to do the essential paper work promptly and accurately (as one service representative put it, "you really have to like to do clerical work, as well as talk to people, in this job"). Such a combination seems to be in short supply these days; over the past decade only about one in 100 of the applicants who come to the employment offices measure up to these requirements. To enlarge this market has become a major challenge.

Qualified applicants for the service representative's job come from several sources. They are recruited from a wide range of age groups and educational backgrounds: high school graduates with one or more years' business experience; some come directly from high school; others have a year or two of college—either junior college or those who have had to drop out of four-year colleges, perhaps for financial reasons. Some are graduates of four-year colleges. One especially productive source is found in

Service representative trainee receives on-the-job training with help from her instructor.

promotion from within the company and through interdepartmental transfers. In addition, increasing attention has been paid recently to attracting older women to the job, former service representatives or others perhaps whose children are grown and who are now looking for jobs.

The task of recruiting is two-fold; one, to find the qualified applicants and, two, to make sure the applicant is suited to the job. The job has challenge and variety, but most certainly it is not easy—the pace is fast; there is a lot of work;

Rapid pace of job is graphically shown by blurred speed of service representative's hands as she looks for customer's records.

Instructor makes point to trainees on use of handbook, containing essential day-to-day reference material, in classroom training.

THE SERVICE REPRESENTATIVE

the standards are high. To help meet the second half of the recruiting task, a new slide-film, titled "The Service Representative," presents a profile of the job in an interesting manner without "gilding the lily." Plans call for the film to be used partly to encourage interest in the job, but mainly to give the prospective applicant an opportunity to personally evaluate it, its variety and pace, in terms of her own personal desires. Applicants who qualify are also encouraged to "sit in" with experienced service representatives for at least a half day to see the work performed under actual on-the-job conditions.

It may seem that there is a surprising amount of emphasis here, considering the difficulty of finding qualified applicants in the first place, on making sure that this is the job the girl wants. It is for a very good reason. Once a girl is accepted for the job, she goes through a period of intensive training at considerable cost. Indeed, by the time each girl has completed her training, she represents an investment of approximately 2,000 dollars to the company. It is quite obvious then why an applicant should be encouraged to make her evaluation and decision before going through the training course.

Because this job requires considerable knowledge and skill, the training of a service representative takes on considerable significance. There is a lot to learn.

The initial training period lasts several weeks, usually from four to six. Before she takes over a desk to provide customer service, the new service representative has received both classroom and on-the-job training. And, once she is on the job, her training does not end; there is more formalized "continuation" training ahead of her as well as advice, observation and some additional training from her immediate supervisor.

The classroom preparation covers a multitude of subjects with which the service representative must be completely familiar, from the fairly simple "how to handle a request for information about an item on a bill," to the more complex "how to negotiate, prepare and issue an order for new service." She is equipped to recall literally hundreds of bits of information and, in addition, to know how and precisely where to find prompt answers to many questions. The initial training not only prepares the new representative to be familiar with rates, but, through repeated exposure, provides her with a knowledge of the equipment and services available and of how they will contribute to office efficiency or add comfort and convenience to home management. As noted before, she must learn how to apply this knowledge to the needs of the individual customer and how to exercise judgment and consideration in doing so.

She must become familiar with company practices and procedures, but must learn to use good judgment here also. The practices and policies are established to serve the average customer best. But, while the guides are uniform, all of our customers' needs are not. The new service representative must learn that deviations from "the book" are sometimes required and justified in the interests of good service, and she must gain confidence in herself to use flexibility in meeting these situations. This comes with the training both in the classroom and on the job.

As training progresses, she gets more and more on-the-job practice. She has an opportunity to handle simulated calls from customers in class and actual calls in the office as she becomes increasingly familiar with the job. By the time she is ready for her job, perhaps the most important thing she has been taught is to *apply* what she has learned at the right time in the right way with each individual customer. She must now know how to meet calmly, pleasantly and intelligently any problem that any customer in any mood might present.

The list might go on, but what has been indicated here should be enough to demonstrate that this is quite a bill to fill—as to the job, as to the person who can do it successfully, and as to the job of training that goes behind it. And, as we have seen, filling that bill has and will continue to become more and more important. Technical and scientific advancements have led the way to new achievements, new services, yet the primary concern of the customer is, as it should be, the personal telephone problems of his own home or business. When he wants to discuss these problems, he wants, without delay or difficulty, to talk with someone who will be responsive and helpful, who will answer his questions and solve his problems with understanding and good judgment. This is the service representative's role; increasingly she is the focal point of service to the customers. Increasingly the need for really good people in this job is growing. The problem of finding and training these people is a challenge we must meet.

Amid the fast-paced activity of the business office, a business office supervisor (right foreground)—usually a former service representative herself—discusses a customer's problem with a representative. Generally 6 to 8 representatives are under her supervision.

This valuable communications technique, which brings the speaker to far-flung audiences via regular telephone lines, began in the colleges. Today, new uses are being found for it in industry and the professions. It is spreading into government and politics, too

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Michel Beilis, *Staff Representative, Sales Marketing Department, A.T.&T. Co.*

Two terms heard with increasing frequency these days are "population explosion" and "information explosion." Like many expressions of pervading truths which we encapsule in easy brevity, these say much in a few words. What they say for the communications industry can be seen in construction programs that grow year by year and in a steadily proliferating line of new products and services.

One among many of these new services is Tele-Lecture. From its origins as a conference-call arrangement among colleges a few years ago (*B.T.M.*, Autumn, 1962), it has grown rapidly to a full-fledged member of the telephone family. Essentially, this new technique brings the lecturer—or any speaker—to his audience via regular telephone lines. His voice is amplified through loudspeakers, and people in the audience can talk directly with him in the give-and-take of question and answer. In the last year alone, some 250 universities have programed Tele-Lecture service to bring teachers, scholars, writers, artists and many others to classes that might otherwise never have the chance to hear such speakers in person.

For example, Professor Hadley Cantril, of Princeton's Institute of Social Research, spoke recently to an audience of 500 people from the University of Vermont. About three-quarters of the listeners—teachers and students—were distributed among three of its branches, Castleton, Lyndon and Johnson (*sic*) State Teachers Colleges. The University of Vermont, intrigued by this possibility of extending the range of noted lecturers to a greater number of faculty and students throughout the state, decided to test the Tele-Lecture service on a larger scale. The University now plans

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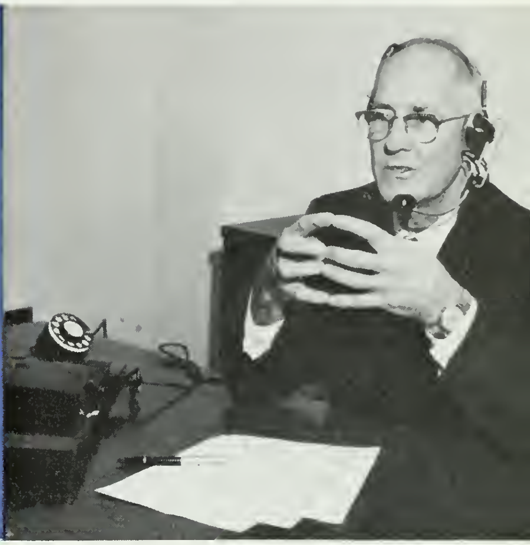

to offer some 20 off-campus courses in a variety of subjects to be held weekly in secondary schools throughout Vermont. University staff members feel that perhaps 75 per cent of their courses could be taught via Tele-Lecture.

At Ricker College in Maine, six national political figures participate by Tele-Lecture in an American Government class. At the University of Texas a course in mathematics is taught by this technique to six communities in various parts of the state. At the University of Washington, prominent international figures such as the Governor of Puerto Rico and government officials from Holland have addressed world affairs students. At the University of Cincinnati, Tele-Lecture talks are programed as part of undergraduate enrichment in history. At Ohio State, the College of Veterinary Medicine has Tele-Lecture service as a permanent installation. The University of Wisconsin uses Tele-Lecture service as part of multi-media experiments in communication, which are being underwritten by the Carnegie Foundation. At the University of Colorado this summer, European scientists speaking from England and Germany, will address American scientists. At Columbia University in New York, Professor Frank W. Cyr of Teachers College used Tele-Lecture in a question-and-answer series for a rural education project.

Examples of Tele-Lecture's use in education could be multiplied far beyond our limitations of space. Clearly, its great potential in that field is just beginning to be realized. It is proving to be an increasingly valuable means for helping the information explosion to keep up with the population explosion, for coping with the problems of growing enrollments, teacher shortages and limited funds.

From this brief look at Tele-Lecture in education, it should come as no surprise that its use is spreading into many other areas—into industry, the professions, government, even into politics in this election year.

Among the professions, medicine is making extensive use of the technique. A Tele-Lecture series of medical "grand rounds" between the Davis Clinic in Marion, Indiana, and the College of Medicine at Syracuse University has been going on weekly, helping doctors to continue their medical education via telephone post-graduate seminars. Malden Hospital in Boston has combined television and Tele-Lecture to open a whole new horizon in post-graduate medical study, according to hospital director John E. Vanderkilsh. The Bangor, Maine, medical club scheduled a session for 65 of its members which was highlighted by a lecture given by three prominent doctors at Massachusetts General Hospital in Boston. A group of clinics in DeKalb, Illinois; Madisonville, Kentucky; Toledo and Gallipolis, Ohio; Jacksonville and Lakeland, Florida; and others in Georgia, Oregon and North Dakota, will join with medical schools and hospitals across the country in a Tele-Lecture grand rounds network for exchange of information and up-to-date techniques.

Agencies of the Federal Government are finding Tele-Lecture useful in their nationwide activities. The General Services Administration, for almost a year, has been programing Tele-Lectures in management, information dissemination and training in ten cities throughout the country. Other governmental agencies are using the GSA's Tele-Lecture network for similar purposes: both NASA and the Post Office are conducting weekly meetings via telephone with widely scattered points in the nation.

In business and industry, Tele-Lecture is finding an almost un-

Artist's sketches show how two types of Tele-Lecture work. At left, one speaker addresses audiences in three locations; at right, three lecturers participate in a seminar being held at one location.

limited opportunity to assist in sales, general management, administration, training and other functions. Sears Roebuck is using it for discussion of advertising among some 35 of its stores in the East. New York brokerage houses are using Tele-Lecture extensively on a weekly basis for sales summaries and for actually conducting sales meetings. One house uses it for a daily two-way exchange of ideas between 70 salesmen in the field and the home office.

The Pillsbury Company used Tele-Lecture for their grocery product salesmen as a kick-off for a new sales program. Formerly discussion of this and other corporate matters entailed flying headquarters office people out into the field in private planes, obviously at great expense. Tele-Lecture gives them a quicker, simpler, more efficient and much cheaper means of contact. On one occasion, Pillsbury connected 47 cities across the United States for a special presentation to about 600 people. The company is contemplating the continued use of Tele-Lecture for sales and marketing and plans to extend the technique to their Bakery and Refrigerated Foods divisions as well.

General Mills has used the system to enable stockholders outside the Minneapolis home office to attend annual meetings via telephone. At many of the remote locations, such as San Francisco, employees also could listen in to the proceedings. The George T. Johnson Company of Burlington, Massachusetts, has used Tele-Lecture for their annual sales meetings. On one occasion they talked to about 15 cities in the United States and Canada, with guest speakers who were executives in affiliated companies, editors of the trade press, executives of supplier companies, and even a representative of one of their large competitors.

The Eastman Kodak Company, as part of its product promotion campaign, has programed a series of 80 color slides which are mailed in advance to retail dealers, and which they then discuss on a question-and-answer basis via Tele-

Above, professor at Drury College, Ohio, makes initial connection for Tele-Lecture; below master teacher at Stephens College, Missouri conducts summary discussion after Tele-Lecture

Lecture. The presentation, called "The Kodak Company and Its Latest Products," has been sent to dealers in New York, Toronto, Nebraska and California. Kodak has also run telephoned programs for widely scattered groups of 20 or 30 dealer representatives who had requested speakers from Rochester qualified in the firm's latest technical developments.

The Borden Company, Equitable Life and Mutual of Omaha are among other large corporations who are presently using Tele-Lecture service in nationwide programing for various administrative and sales functions.

TELE-LECTURE

Demonstrating that the cobbler's children do not always go shoeless, to reverse the old adage, the Bell System itself uses Tele-Lecture for a number of purposes.* A conference room at A.T.&T. Headquarters is equipped for Tele-Lectures using multiple Speakerphones and a lavalier microphone. To date users include groups concerned with providing a sales training package for telephone selling throughout the Bell System. Sales meetings on educational television originate from the same room. Since many of the Bell Telephone Companies across the country have conference rooms similarly equipped, representatives of all departments can join in System-wide meetings via Tele-Lecture.

Recently at least two political campaigns have made use of the telephone lecture technique. Senator Barry Goldwater availed himself of the service to address a group of students at Washington and Lee University, while he spoke in Washington, D. C. Governor Rockefeller also used the medium in the Oregon and California primary campaigns.

Participant at Adult Education Association conference in Miami Beach, Florida, questions then F.C.C. Chairman E. William Henry, who addressed the conference from his office in Washington, D. C.

Inevitably, Tele-Lecture is being thought of in connection with other communications media. Data-Phone, slow-scan television, closed-circuit television, facsimile and handwriting-transmission devices—all will probably be used, singly or in combination, with Tele-Lecture. Already, the service has been used with Data-Phone and a device for transmitting handwriting over telephone lines at the Georgia Institute of Technology. Graduate students there requested instruction from an expert in nuclear engineering at Oak Ridge, Tennessee. Since the 200-mile distance created an impediment to regular lectures on the campus, Dr. William B. Harrison, head of Georgia Tech's School of Engineering, arranged a course by Tele-Lecture. To augment the voice discussion, a second circuit enabled the lecturer to transmit formulas and other handwritten information via Data-Phone service. A television camera in the classroom is used to project the expert's handwriting onto a large screen, so that all the class can watch as they listen to the lecture.

At Stephens College in Columbia, Missouri, a pioneer in the use of Tele-Lecture, a system was installed last spring for transmitting handwriting over telephone circuits for display before an audience. It is used only in conjunction with Tele-Lecture service.

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*During the ceremonies inaugurating the new U.S.-Japan cable (see page 2), the Tele-Lecture principle was used at the Tokyo end. An audience in the Imperial Hotel there, according to the *New York Times*, "heard President Johnson's voice, magnified on a loudspeaker, come in almost as clearly as if he had been speaking on a public address system in the same room."

Above, Tele-Lecture conference with Marketing, Plant and Public Relations people at Mountain States Telephone in Colorado.

Left, science seminar via Tele-Lecture at Wilberforce University; moderator at right.

Below, the famous anthropologist Margaret Mead, shown on the screen, addresses a remote audience of the University of Omaha.

In this day of incredibly rapid change, anything that has been around for a few years is hardly considered "new." But the potential and flexibility of Tele-Lecture will keep it new for some time to come. In a way, it is as old as the telephone—and as new as Picturephone Service. Its future is promising for the people in many areas of American life who use it, and challenging for the Bell System people who provide it.

in this issue...

■ Edgar C. Gentle, Jr., author of "Keying the Executive to Real Time Concepts" on page 6, is responsible for market planning of services, systems and uses of data communications. The conduct of the Bell System Business Communcations Seminar at Chicago is also his responsibility. This centrally-located program is one of several continuing seminars designed to acquaint executives of American business with the role of data communications in planning and implementing business information systems.

Mr. Gentle joined the Southern Bell Telephone and Telegraph Company after receiving his B.S. in electrical engineering at Auburn University. While serving as transmission and protection engineer for Southern Bell's nine-state operation, he helped plan and implement the first of the Bell System's Communication Engineering courses at Clemson College. Later, this program evolved into the Regional Engineering Program now being conducted at several college campuses. After coming to A.T.&T. in 1962, he was successively Dean of Engineering, Dean of Marketing and Director of the Bell System Data Communications Training Program at Cooperstown, New York.

■ "Microwave Today and Tomorrow," beginning on page 14, reviews one of the Bell System's fundamental and most flexible communications techniques. And its author, Herbert H. Goetschius, has been concerned with microwave development since its beginnings in 1945 and the first experimental Boston-New York link in 1947. He joined A.T.&T.'s Long Lines Department in New York 40 years ago as an equipment attendant in the Plant Department. Since then he has had Plant experience in Pittsburgh, Pa., Springfield, Mass. and Washington, D.C.

Edgar C. Gentle, Jr.

Herbert H. Goetschius

Donald F. MacEachern

David Younger

He served in Cincinnati as assistant to the general manager and area Plant manager, and later returned to New York as assistant Plant operating engineer. He assumed his present duties as Plant operating engineer in August of 1960.

■ In describing "A Plan for Preventing Fraud," beginning on page 21, Donald F. MacEachern brings to his subject the full weight of his 34 years of accounting experience in the Bell System. It is part of his job to devise and put into effect means of controlling fraud in all its forms within and outside the business—and to coordinate these means with the various Bell Companies. As he remarks in his article, "Accounting officers have a big responsibility to see to it that top management is kept constantly informed of the status of fraud and of any important weaknesses in internal control . . ."

Mr. MacEachern joined the New York Telephone Company in 1930 after receiving his B.S. from the Sheffield Scientific School at Yale University. Since then he has held a variety of positions on the accounting staffs of the New York Company and A.T.&T. and was appointed A.T.&T.'s chief accountant in 1958.

■ David Younger, author of "Telecommunications in the Tropics," starting on page 28, has specialized in government communications for the past six years and participated in the initial surveys in both Thailand and Nigeria. He is, in fact, one of the "two Bell System engineers," referred to so modestly in his article, who first surveyed those far-away lands for modern communications systems. He has just made his fourth trip to Africa in 15 months, and averages over 50,000 miles a year in airplanes.

A member of A.T.&T.'s Long Lines Department from 1929 until he joined Western Electric in 1958, he was chief engineer of Long Lines Central Area from 1951 to 1956 and general staff engineer until his move to Western. Currently he is manager of advance engineering and costs in Western's Government Communications Projects unit where, among other assignments, he has been responsible for system engineering of communications for the Ballistic Missile Early Warning System and the DEW Line extension across Greenland to Iceland. These assignments were prior to his recent experiences in Southeast Asia and Africa. Having experienced both, he says with conviction that he much prefers palm trees to icebergs.

Lee C. Tait

Michel Beilis

■ Lee C. Tait, author of "The Service Representative" beginning on page 34, has a rich background of experience in Operations and specifically in the Commercial Department to draw upon. Now assistant vice president in charge of the Commercial Division of the A.T.&T. Operations Department, he has had many other assignments in this and allied fields during his Bell System career. In 1941 he joined the Chesapeake and Potomac Telephone Company in Richmond, Virginia, as a Commercial representative after having earned his B.S. in Electrical Engineering at Virginia Polytechnic Institute. He then successively held positions in Engineering and Traffic, becoming general Traffic supervisor in 1953.

In 1955-56, he spent a year as a Sloan Fellow at Massachusetts Institute of Technology, where he received the S.M. in Industrial Management. Also, during that time and until 1958, he was division Commercial manager at Richmond. He then came to A.T.&T.'s Administration-R Department, went back to the C&P Companies for a couple of years as, at various times, general Operations supervisor, comptroller and vice president and director of the West Virginia Company, and returned to A.T.&T. as assistant vice president in Public Relations. He assumed his present duties last February.

■ Michel Beilis, although relatively a new-comer to the Bell System, has had several years of experience with Tele-Lecture, and, if not actually the father of the technique, at least certainly assisted at its birth. The author of "Tele-Lecture—A New Look," on page 40, got the idea for bringing remote lecturers to the college campus via telephone lines when he was directing the University of Omaha's adult education program. With the cooperation of Northwestern Bell, he developed a series of Tele-Lectures with distinguished speakers for Omaha's adult and undergraduate students. His article tells you more about where it went from there.

Mr. Beilis was born in Romania and grew up in Haiti, where he developed an already lively interest in linguistics. He studied at the University of Pittsburgh, George Washington University and Pitt before moving on to Columbia University, where he received his M.A. in philology and completed residence for his Ph.D. Although he denies that his linguistic ability goes beyond six or seven languages, his friends insist the he can speak more that a dozen fluently.

in the news...

COMSAT Progress

W. E. Price Cuts

'Heartprints'

FTS Completion

Computer Film Language

NASA Communications

Jr. Achievement Award

Co-ax 20

COMSAT On The Go

The Communications Satellite Corporation has taken several important steps in recent months that promise to bring the era of space communications a little closer.

On June 11, payments were made by the communications firms that were together allotted half of COMSAT's stock. A check for $57,915,000 was presented by A.T. & T. to COMSAT, representing the purchase of the 2,895,750 shares of common stock which A.T. & T. was allotted.

The remaining half of COMSAT's common stock, 5 million dollars, was fully subscribed to by the general public when that issue was made available June 2. The total offering, 10 million shares at $20 a share, amounts to $200 million.

In addition, the FCC has approved a COMSAT proposal to use the A.T. & T. Andover (Maine) ground station for experiments with its "Early Bird" communications satellite. COMSAT signed the agreement with the Long Lines Department of A.T. & T. to lease the Andover facilities for one year. The contract carries an option for two renewals of one year each. The proposed arrangement would permit COMSAT to use the Andover station for two-thirds of each month, with provisions for increasing this usage.

"Early Bird" is currently scheduled to be launched next March. It would be placed in a synchronous, nearly equatorial orbit over the Atlantic on an experimental-operational basis for service between North America and Europe.

As part of its overall program for developing a "basic" global satellite communications system, COMSAT plans to award contracts for engineering design studies to several contractors. A.T. & T. and the Radio Corporation of America are expected to receive individual contracts but will work jointly to design a medium altitude, random orbit satellite system.

The A.T. & T. contract will be with the Long Lines Department and the work will be performed by Bell Laboratories.

To meet the criteria established by COM-

SAT, the A.T. & T.-RCA proposal is for the design of satellites equipped with two repeaters. The satellites would be placed in a polar orbit at an altitude of 6,000 miles. Each satellite would provide a capacity of about 530 two-way voice circuits when used with earth stations such as Andover or Pleumeur-Bodou in France. The random system would require a total of 18 satellites with at least two of them being simultaneously in view between two communicating earth stations.

After the designs are submitted, COMSAT will decide which one to develop. By 1965, following "Early Bird" experiments, the Corporation plans to determine which satellite system or combination of systems will be adopted.

Price Reductions By Western Electric

■ Beginning July 1st, the Western Electric Company reduced the prices of the products it makes for the Bell Telephone Companies by some $44 million a year at current sales levels.

In announcing the price cuts, which range from two per cent to 16 per cent on various products, Paul A. Gorman, Western Electric's president, said: "These price reductions reflect increases in demand for our products substantially above previously forecast levels. This increased demand derives in part from the stimulus to the economy provided by the recent tax cut and the resulting increases in the construction programs of the Bell Telephone Companies. To meet this demand we have added some 2,700 employees since the end of the year. Clearly these results match the intent of the Administration and the Congress in enacting the tax reduction.

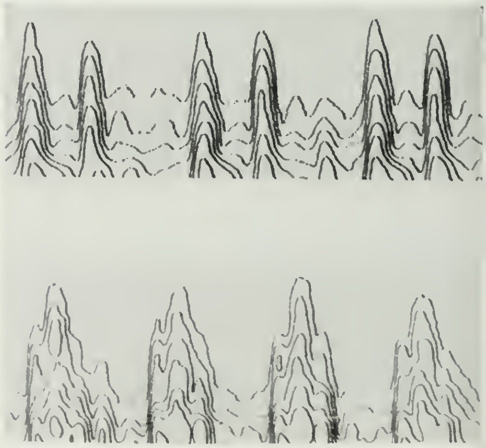
Mr. Gorman pointed out that the current price reduction would not have been possible if not for the sustained program of cost reduction engineering that the Company conducts throughout its operations. He noted, too, that Western Electric's close working relationship with Bell Laboratories, which is jointly owned by Western Electric and A.T. & T., facilitates the introduction of more economical product designs.

"These efforts," Mr. Gorman said, "have contributed to an increasing demand for our products and services over the years and have permitted us to reduce our price to a level 15 per cent below the level of 1950. Employment in our Company has nearly doubled since then. We feel the government tax policies and regulatory policies which provide incentives for initiatives like this are good for our business, good for our customers and good for the country."

'Heartprints' May Offer Improved Heart Diagnosis

■ Heart murmurs often possess the key to valuable answers about the organ's state of health. Some day, your doctor may be using a "heartprint" to learn even more about the secrets concealed within the murmuring sounds, according to Bell Laboratories. These secrets, unlocked, could possibly provide more accurate diagnoses with less discomfort and physical danger to future cardiac patients than some present methods.

The heartprint is a modified version of the phonocardiogram, which depicts the sounds of the heart as it functions. Typically, the first and second heartbeats and various



Heartprints show normal heart (top), diseased heart (bottom) where murmur occupies most of interval between first and second beats.

characteristics (intensity, frequency and duration) of an intervening systolic murmur may be recorded. The degree of each of the murmur's various characteristics helps a doctor diagnose a malfunctioning heart.

By using the heartprint, it is proposed to gain even more knowledge about the intensity of the heart murmur. Hopefully, heartprints will provide finer scrutiny of a murmur's intensity, allowing cardiologists to obtain a correct diagnosis with considerably less expense to the patient.

The heartprint technique is an outgrowth of the contour voice spectrogram which was developed by Bell Laboratories in 1960. The voiceprint technique detects and traces on paper many characteristics of the human voice which are normally imperceptible to the ear. It is believed that each person's "print" carries unique qualities, similar to fingerprints.

FTS Completed

The world's largest private telephone network — serving 1,250,000 federal government employees in 427 cities—went into full operation July 6. Government officials expect the new network to provide substantial annual savings.

The Federal Telecommunications System, a massive Bell System project which will provide fast private-line switching between the widespread civilian offices of the U.S. government, was requested by the General Services Administration.

The new system includes a series of 34 main telephone switching centers spread throughout the country. Nine of the switching centers were remotely located to help provide a "backbone" survivable network in case of enemy attack. Linked to these central offices are 625 private branch exchanges at various government locations.

Eventually, the system will include several special calling facilities that will be used by government agencies in times of national emergency. These are provided with dual routes, at least one of which is routed away from possible target areas for maximum protection.

FTS provides the government with a "dedicated" network, in which all facilities are reserved for its use at special, economical rates. In addition, other modern Bell System services, such as Direct Distance Dialing and direct inter-office dialing are provided by the system.

The July sixth cutover completed the second and final phase of the Federal Telecommunications System. The first phase of FTS, which interconnected 250,000 phones in 43 cities, was placed in service February, 1963.

'Movie Language' For Films by Computer

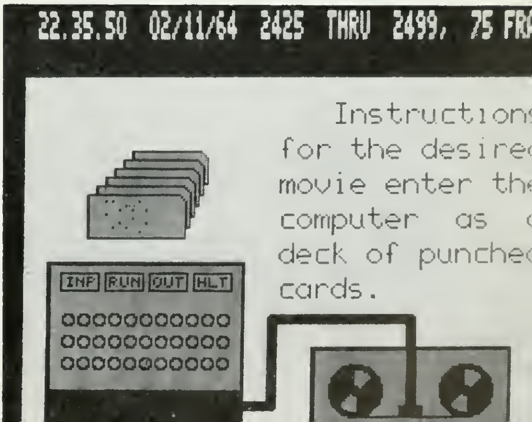
A general programing language has been developed at Bell Laboratories for making simple animated films quickly and cheaply with a computer.

Called BEFLIX (Bell Flicks), the "movie language" was used to program a computer at Bell Laboratories to make a 17-minute film.

The language includes instructions for drawing pictures consisting of straight lines, arcs, complicated curves, letters, simple geometric shapes and shaded areas. BEFLIX also makes possible many special effects, such as "dissolving" by gradually "sprinkling" the new picture onto the previous one.

Computers can be programed with this language to make educational films and to generate visual displays for psychological experiments or to depict certain of their own operations.

Scene from Bell Labs film produced by computer programed in new BEFLIX language.



Western Electric installer tests switching equipment made by W.E. for NASA center.

NASA Communications

The effort to land men on the moon within the next decade is being helped by the installation of a massive communications system at the government's new Manned Spacecraft Center at Clear Lake, Texas.

The new center, a huge complex of buildings situated on 1,600 acres 22 miles southeast of Houston, will house the control, research and development facilities for projects Gemini and Apollo — the National Aeronautics and Space Administration's two-man spacecraft and three-man mooncraft flights.

In answer to the space center's need for modern communications service to help it conduct its vitally important business, Western Electric installers and Southwestern Bell telephone people have been working to provide one of the largest Centrex telephone systems in the country. Centrex is a telephone service that permits in and outward direct dialing of long distance, local and inter-office calls without the assistance of a switchboard operator.

For those calls that do require operator assistance, such as requests for extension numbers, the Centrex installation at the space center incorporates ten of the Bell System's newest push-button switchboards. It also contains terminal equipment for a microwave radio relay system that will transmit great numbers of telephone calls between the center and Houston, where NASA will maintain several other facilities.

The new telephone system will also provide for as many as 800 tie-lines—private access circuits that permit calls to reach distant points by dialing fewer digits than normally. Among the points to be connected to the center on a tie-line basis are the NASA facility at Cape Kennedy, Fla., NASA Headquarters in Washington, D.C., the Missile Test Center in White Sands, N. Mex., and a number of government contractors. Terminals connecting to the Federal Telecommunications System are also an integral part of the space center installation.

Junior Achievement, Inc., Honors Bell System

The Bell System has received the national award of Junior Achievement, Inc. The award was made "in recognition of the industry's outstanding contributions toward the education of our nation's youth in the principles of the free enterprise system through the Junior Achievement program."

A.T. & T. President Eugene J. McNeely accepted the award last night at the national Junior Achievement banquet in Cleveland. The plaque was presented by John Davis Lodge, president of the organization and former governor of Connecticut and ambassador to Spain.

Each year Junior Achievement honors an industry, and this year the telephone industry was singled out. Besides Mr. McNeely two representatives from the independent telephone industry accepted awards.

Junior Achievement is an economic education program in which high school students organize and manage their own small-scale businesses under the guidance of adult advisors from business and industry. The Bell System has been active in this effort for many years. Last year 18 Bell Companies sponsored 271 Junior Achievement companies and provided 883 advisors.

Co-ax 20

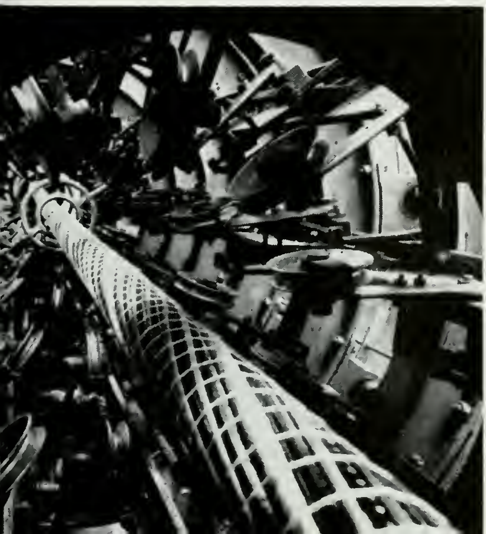
A unique form of cable as thick as a man's arm is about to make its debut as a superhighway for carrying telephone calls, television and other communications across the country. Known officially as Co-ax 20, the cable was designed by Bell Laboratories and is soon to be manufactured by Western Electric.

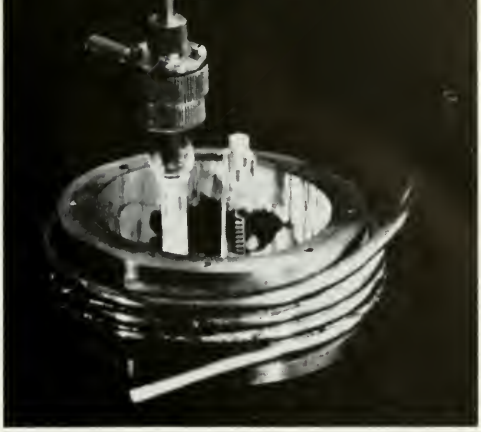
It can carry as many as 18,740 telephone calls using existing carrier equipment. This number will be increased to about 32,400 by a new carrier system now under development.

As its name suggests, Co-ax 20 is mainly composed of 20 coaxial units, plus a small number of regular wires for test circuits. Development of the new cable was prompted by a program aimed at supplementing the rapidly growing microwave radio relay system which forms the backbone of the Bell System's long distance network. At present, the surging growth in long distance calling requires that network facilities be doubled every eight to ten years.

Among other projects, Co-ax 20 will be used on several major cable routes now in the planning stage. To meet this demand, production of Co-ax 20 is scheduled to begin at Western Electric's Baltimore plant by early summer, with approximately 50 miles of cable to be in service during mid-1965 and 1,000 miles by 1966.

Neatly bundled core for sample length of Co-ax 20 moves through cable stranding machine.





One-inch crystal of yttrium aluminum garnet is shown in the elliptical housing on left.

New Garnets Promise Continuous Maser Operation At Room Temperature

The development of rare earth aluminum garnet crystals at Bell Laboratories has made possible a solid-state optical maser which can operate continuously at room temperature with only a small fraction of the pumping power previously required. The new optical maser can be pumped with a tungsten lamp that has a rated life of thousands of hours. This is a major step in putting solid-state optical masers on an equal footing with gas optical masers so far as continuous operation is concerned.

Portable DATA-PHONE Data Set Transmits Electrocardiograms

A portable DATA-PHONE data set, light enough to be carried in a doctor's medicine bag, has been developed by the Bell Laboratories Data Communications Laboratory for use in service trials. The battery-powered set makes possible transmission of electrocardiograms from a patient's bedside to cardiac specialists miles away.

In a recent field trial of the portable DATA-PHONE data set by A.T. & T. and the New York Telephone Company—in collaboration with Long Island College Hospital—electrocardiograms were transmitted over a telephone line from Prospect Heights Hospital Pavilion to

Long Island College Hospital more than two miles away. This trial marked another test of data transmission for diagnostic purposes.

High Speed Data System For Facsimile Transmission

■ An experimental data communications system that transmits black and white facsimile at high speeds has been designed at Bell Telephone Laboratories. The system transmits up to sixteen 8½ by 11 inch pages per minute over a communications channel equal in bandwidth to 60 voice circuits. Over the same channel, the experimental system is potentially capable of transmitting digital data at speeds of about 200,000 bits per second.

Facsimile machines scan a black and white page in a succession of parallel lines and detect the changing light intensity of the copy. When the machine detects black, it generates a voltage; when it detects white, it generates a voltage of the opposite polarity. The experimental system can transmit the 16 pages of facsimile with a 100 line per inch definition. Changes between black and white as close together as 1/100 of an inch will be detected.

Laminate Shaped By Deep Drawing

■ A new type of light-weight, high-strength laminate and a process for deep drawing this material into a variety of shapes have been developed at Bell Telephone Laboratories.

The laminate—two aluminum sheets bonded to a solid polyethylene core—appears well-suited for many commercial applications. These might include airplane and ship panels, small boat hulls, luggage, automobile body parts, and housings for portable equipment. The Bell System is considering the laminate for telephone equipment housings.

Unlike other reinforced plastic laminates, this new composite material can be welded. It also can be adhesively bonded to many other materials, and it can be riveted,

Left to right, strips of Bell Labs' new laminate, another laminate and steel weigh the same, support equal loads. Below, samples of new laminate that have been deep drawn.

bolted, punched, and sheared. Though it is comparatively inexpensive to produce, its flexural properties in relation to its weight are superior to most widely-used commercial materials. For example, a four-pound laminate sheet would deflect the same amount under the same bending moment as would a ten-pound steel sheet of equal width.

It is the first low-cost, solid-core, structural metal-plastic laminate that does not use an adhesive to form a bond between its component materials. The solid core adds strength to the laminate and permits deep drawing of the material when the core is heated.

Triode Laser

■ A new type of gas laser, which, like a triode, can be modulated by varying the voltage on the grid in the tube, has been invented at Bell Telephone Laboratories. The triode laser oscillates without the usual glow discharge present in ordinary gas lasers.

Inside the triode laser tube is a cathode, grid, and anode in the form of ribbons parallel to each other and extending about eight inches along the horizontal axis of the laser. By varying the grid voltage which controls the electron flow in the laser tube, the light beam can be both switched and amplitude modulated.

Super-Pure Nickel Alloy for Reliability

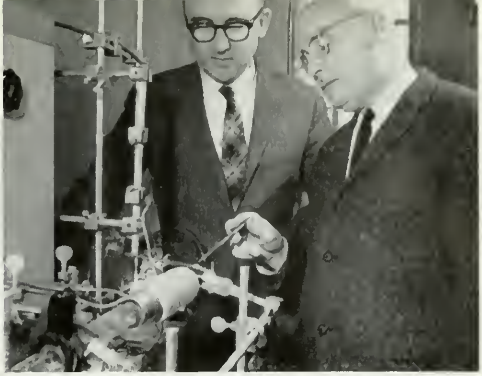
■ A super-pure nickel alloy, created to give certain electron tubes longer, more healthy lives, is now in production at Western Electric's Hawthorne Works in Chicago. This chemically "clean" metal was developed to give electron tubes many times the service life that could be expected from tubes made of regular nickel alloys.

It means that tubes used in undersea cable amplifiers, for instance, will function far longer and with improved transmission. It holds true also for land-based radio relay systems and for certain important defense systems—all of which depend for their value on the assurance of continuing, trouble-free operation.

The new super-pure alloy, while developed by Bell Telephone Laboratories primarily for use in undersea amplifier tubes, is today the basic material from which cathodes for many types of high quality electron tubes are made.

Bell Laboratories experiments showed that by employing gases and vacuum systems in the material manufacturing process, the nickel alloy could be made virtually free of all contaminants — it would have only 1/20 the impurities inherent in regular nickel alloy. This process is today followed at W.E.'s Hawthorne plant.

W. E. engineer checks white-hot batch of super-pure nickel in huge vacuum furnace.



Discovers of VLS mechanism of crystal growth with apparatus used in experiments.

Near-Perfect Crystals

■ A new fundamental mechanism of crystal growth resulting in the formation of near-perfect crystals has been discovered by metallurgists at Bell Telephone Laboratories. Termed the vapor-liquid-solid (VLS) mechanism, VLS growth occurs when a droplet composed of a saturated solution of a crystalline material and an impurity receives atoms from a vapor and deposits these atoms at the interface between the droplet and a crystalline substrate.

It can be applied to most crystalline substances and can be used to grow diverse crystalline forms, varying from whiskers to epitaxial layers. The crystals are near-perfect in structure, and they can be grown at temperatures much lower than those required for current vapor-phase crystal growth processes. Hence, the technique has great technological potential for semiconductor, laser, piezoelectric, and magnetic devices, all of which require precisely grown crystals.

New Electronic Switching Laboratory

■ Bell Telephone Laboratories has announced plans to build a new laboratory near Naperville, Illinois. It will be headquarters for the Electronic Switching Division, now located at Bell Laboratories at Holmdel, N. J.

Approximately 1,200 people — including scientists, engineers and supporting staff plus a small group of Western Electric engineers—will work at the new laboratory. The installation, with equipment and apparatus, is expected to cost between $7 and $9 million. Plans call for construction of the building to begin early in 1965 with completion set for 1966.

The new laboratory will be within convenient traveling distance of Western Electric's Hawthorne Works in Chicago, where the manufacture of electronic switching systems (ESS) will be increasingly centered in the future. ESS is now being manufactured at Hawthorne and at Columbus, Ohio.

The world's first electronic central office, developed by the Laboratories, was installed on a test basis at Morris, Ill., in 1960. The first commercial installation of an electronic central office providing service for an entire community will go into operation early in 1965 at Succasunna, N. J. Eventually, electronic central offices are expected to replace all existing Bell System central office switching equipment.

Electronic switching systems will provide telephone users with new services and conveniences, including abbreviated dialing, in which the user can dial fewer digits to reach phones frequently called, and call transfer, in which the customer may transfer his incoming calls to any other nearby phones.

New Military Network

A new continent-wide military telephone network, providing long distance dial service between major command points of North American Air Defense (NORAD) is the latest fortification in this country's growing wall of defense. The new network, recently placed into service for NORAD by Western Electric, consists of nine switching centers strategically located for maximum security in small out-of-the-way towns across the country. It connects NORAD headquarters at Colorado Springs, Colo., with the eight NORAD regions in this country as well as with other major command points.

Each location is equipped with long distance telephone and data communications facilities. Unlike most Bell System private line networks, which transmit over specific point-to-point routes, all communications on the NORAD circuits are channeled into the switching centers, from which they can be sent to their destinations over several alternate routes. Initially, about 35 far-flung agencies of NORAD are being served by the system.

It provides for direct long distance dialing between telephones, automatic conferencing, and permits priority callers to automatically take over lines busy with routine calls when all lines are in use. The system also provides large-capacity channels for transmission of voice, teletypewriter, telephoto and other data signals.

Installation of the system required the close cooperation of A.T.&T.'s Long Lines Department, Western Electric and the local Bell Telephone Companies. The equipment was designed by Bell Telephone Laboratories and manufactured by W.E.

L-4 Transmission System

Bell Telephone Laboratories is developing a new transistorized transmission system capable of doubling the number of simultaneous telephone messages that can be transmitted on one coaxial cable. An initial installation for the new system is in the planning stages.

The new system is known as L-4. It will handle 3,600 voice channels on one coaxial pair, compared with 1,860 voice channels on the L-3 system currently in operation. At the present time over 40 per cent of the long distance telephone message circuits in the Bell System are transmitted on coaxial cable using the L-3 system or the earlier L-1 system.

The L-4 system employs a ⅜ inch diameter coaxial cable with transistorized repeaters every two miles along the cable. The L-4 will be capable of transmitting telephone messages up to 4,000 miles, meeting the Bell's System's "long haul" objectives.

Plans call for L-4 to be an underground system whose repeaters will be housed in cylindrical gas and water-tight housings. L-4 was chosen as the next step in the progress of transmission facilities because it is more economical than L-3 and its use of transistors will greatly reduce maintenance.

For one and all and the right size for everybody — this young gentleman's rapt attention is being held by the Marketing Exhibit in the Bell System Pavilion at the New York World's Fair.

VOICELESS. Many people who have lost the use of their vocal cords can learn to talk again with the help of an electronic artificial larynx, developed by Bell Telephone Laboratories. It's available at cost on your doctor's recommendation.

BEDFAST. Over 5000 shut-in students go to school from home or hospital with the help of Bell System School-to-Home Telephone Service — and keep up with their classes almost as if they were present in person.

BLIND. Special "Seeing Aid" equipment helps blind operators serve regular telephone switchboards. Its basic principle is a sensitive probe which causes a buzz in the operator's earphone when it passes over a lighted lamp.

HARD OF HEARI people with in hearing, we offer handset. It looks other but it has a ient fingertip co the center which the volume of i voices to the be ing level.

Some Bell System services to help the handicapped

Ours is a service business—and we serve almost everybody. But not everybody has the same health, hearing and sight. So we try to be flexible enough and resourceful enough to adapt our services to people's needs.

There are many ways in which we do it. Four are shown here. For information on any or all of these aids, call the local Bell Telephone Business Office or ask your telephone man.

BELL TELEPHONE SYSTEM
Serving you

BELL TELEPHONE MAGAZINE

AUTUMN 1964

All the way from Pennsylvania, Ohio, Indiana, Illinois, Texas and West Virginia they came — convoys of trucks, bringing telephone men and equipment from other Bell System Operating Companies into Florida to help Southern Bell restore service in the wake of Hurricane Dora — one more example of how the entire Bell System springs into action with an immediate, coordinated effort to bring the fastest possible restoration to areas hit by such disasters. Above, in a suburb of Jacksonville, a station repairman from Philadelphia does his part to speed the restoration job.

BELL TELEPHONE MAGAZINE

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VOLUME XLIII ▪ NUMBER THREE ▪ AUTUMN 1964

A non-technical review, published quarterly to give Bell System management people a broader view of the history, objectives, operations, and achievements of this business than they might attain in the course of their day-to-day occupations, and an added sense of participation in the problems and accomplishments of our nation-wide public service.

Cover:

This photograph by Arthur Schatz shows a cable-laying tractor putting down coaxial cable for the Bell System's new transcontinental cable system. One of the major undertakings discussed by Richard R. Hough in "The Bell System Construction Program" on page 2 of this issue, the new $200 million "hardened" cable system will help guard this country's communications in the event of war, tornados, hurricanes, ice storms, floods and fires.

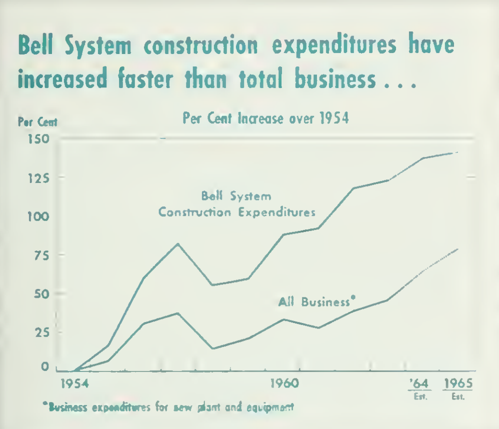
the BELL SYSTEM CONSTRUCTION PROGRAM

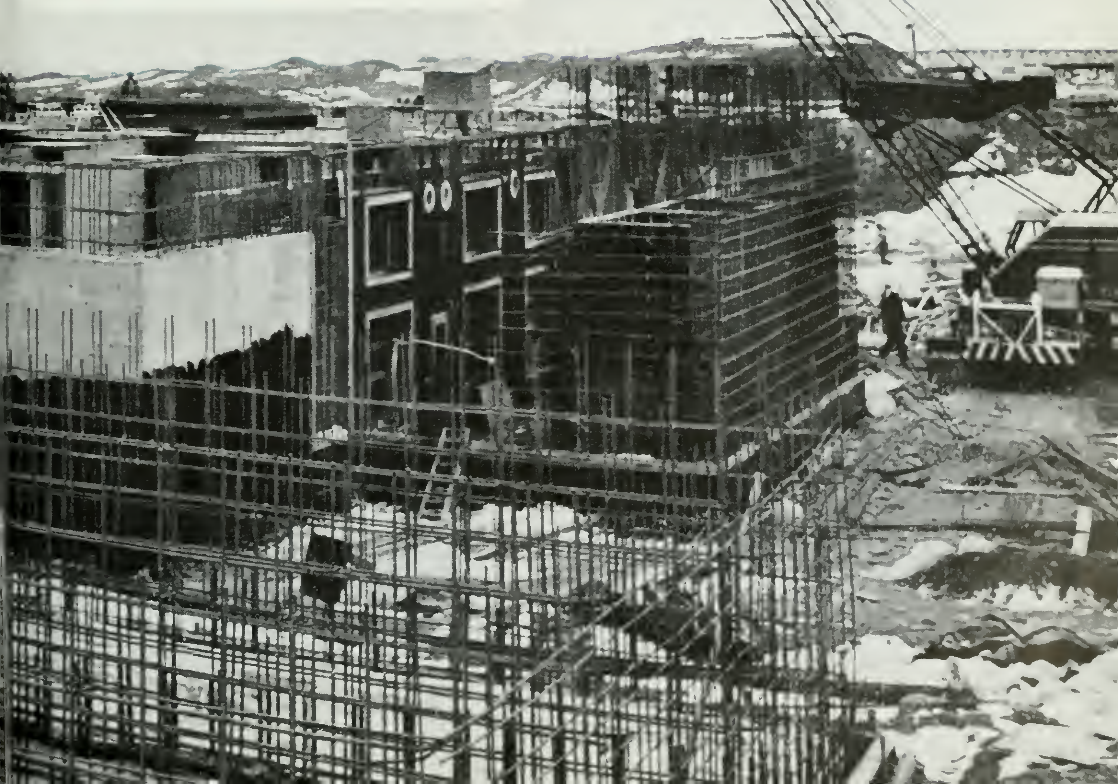
Richard R. Hough, *Vice President, Engineering Department, A.T.&T. Co.*

Nearly three and a half billion dollars will be spent this year and—earnings and tax savings permitting—construction expenditures will be even higher in 1965. Such massive programs not only provide more and better telephone service but more jobs both within and outside the business.

Over the past ten years, Bell System construction expenditures have increased at a much faster rate than those of all business. In 1954 we spent $1.4 billion. In 1965 we plan to spend $3.4 billion—an increase of 142 per cent. By comparison the total expenditures by United States business for new plant and equipment have risen from $26.8 billion to an estimated $48.0 billion, representing an increase of 79 per cent for the same period.

Obviously, these annual Bell System construction programs have a substantial impact on the national economy particularly in terms of jobs both within and outside the business. For example, it has been estimated that our expenditures of $3.1 billion in





the BELL SYSTEM CONSTRUCTION PROGRAM

1963 accounted for the employment of 365,000 persons; 155,000 of these jobs were outside the Bell System.

Our anticipated construction programs for 1964 and '65 will result in the creation of even more jobs. Included in the overall figures for these years—($3.35 billion in 1964 and as noted above $3.4 billion in 1965) are $75 million in 1964 and $125 million in 1965 which were added to the proposed programs as a direct result of the anticipated increased earnings resulting from the reduction in the corporate tax rates.

As Frederick R. Kappel, A.T.&T. chairman of the board, emphasized in March of this year after passage of the tax law:

> "We already have going, in 1964, the largest construction program we ever had. We intend now to make it even larger. Provided, of course, that the Bell Companies are free to use their tax savings in this manner."

Our construction program, therefore, consistent with the intent of the tax reduction program, would create 9,000 additional jobs this year and 15,000 jobs in 1965. The job totals include those provided both within and outside the Bell System. The program is premised on a rate of return at a reasonable level, including the benefit of the corporate tax reductions.

■ Let us consider how we manage our construction program and its direct relationship to our level of earnings. In order to do this, it is helpful to examine in greater detail the processes of management decision concerning capital spending and the components of our anticipated program.

The Bell System construction program represents, for each of the years 1964 and 1965, about 775,000 separately engineered projects. In addition, it provides for the installation of more than 17 million telephones each year.

Each of the 775,000 projects must be planned and implemented by detailed engineering and must be compatible with long range plans. And the ensuing effects of these hundreds of thousands of decisions on the over-all aspects of the business must be readily subject to review and control by higher management. There are numerous choices open to the management of each Bell System Operating Company and the A.T.&T. Long Lines Department in formulating its capital expenditure policies.

Management throughout the System must strive for a balance among such considerations as the availability of capital, the service needs of customers within the framework of available technology, and the impact on operating results. Decisions are made with a full understanding and recognition of their effect on the level of earnings.

Each Bell System Company and the Long Lines Department determines its own construction program by summarizing all of its respective projects. This summarization is then analyzed and evaluated to see, first, that the *Growth* expenditures, which provide for the expansion of the business, are reasonable and

have adequate revenue support. Secondly, that *Service Improvement* expenditures, which are planned to improve existing equipment and services, as well as provide new ones, are consistent with the long term customer requirements and financial needs of the company. And lastly, that the *Standing Still* expenditures, or the capital required to maintain the present size of the business, are adequate. The company construction program is then submitted to its management for its consideration and approval. The program is reviewed at this point in light of its effect on the company's earnings and service objectives.

■ Once approved locally, the Companies' programs are assembled at A.T.&T. headquarters in New York and constitute an over-all Bell System program. In New York, the program as a whole and for each company is analyzed and appraised by the A.T.&T. engineers and management on much the same basis as is done by the individual companies. It is reviewed in some detail with the senior management of the companies at operating conferences held three times each year. Additions or reductions are suggested from time to time as conditions indicate.

One of the underlying problems in engineering any project concerns the economical sizing of a plant addition to meet estimated future demands. Using engineering economic study techniques, we have established a relationship between rate of growth and the economical size of an addition for central office and outside plant facilities.

The illustration on page 7 shows a typical series of curves resulting from these economic studies. You can see that the present worth of annual charges is much higher for the short relief intervals and considerable savings can be realized by engineering for the proper interval.

If the cost of an addition were directly proportional to its size, then it would always pay to place the smallest size of package since this would minimize our investment at any given time. But many

items of plant are "cheaper by the dozen" and there are generally "getting-started" costs common to any size project. If there were no time value to money, the "giant economy size package" would always be the best buy.

Using the fact that money has value in time, we can find the present worth of expenditures associated with each of the alternative size packages as plotted on the chart. As you can see, the present worth of annual charges increases more slowly with longer intervals. It usually is better, therefore, to select an interval somewhat longer than the knee of the curve in order to protect against the economic penalty of unexpected growth.

Now, the company that is financially healthy will follow the thinking just outlined and design jobs with these economic principles in mind. But, a poor-earning company, in order to care for growth with minimum capital requirements, will be forced to engineer projects at the short end of the curve. Here a sudden increase in demand can result in a most uneconomical addition. The results, of course, are a deterioration of service to customers and a further economic hardship to the company.

The Bell System's construction program has been increasing in size annually to keep up with and anticipate customer demand for new and improved services. In order to meet these needs, we expect to increase our construction expenditures in the future as earnings permit. Because of the complexity of the program, proposed expenditures are grouped into the classifications, "Standing Still," "Growth," and "Service Improvement," mentioned above that can be examined with better understanding.

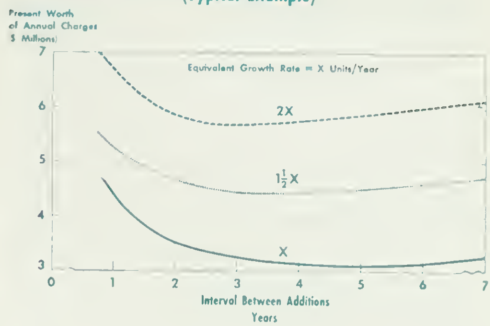
■ First, let us consider the Standing Still expenditures. These account for 25 per cent of our total construction program and are the least flexible part of the program. Standing Still expenditures are required primarily to maintain the current level of business with over two-thirds of the dollars spent to care for the ever-increasing movement of existing customers which results in no telephone gain. Last year, we connected 16.5 million telephones and disconnected 13.8 million to gain only 2.7 million telephones, giving us a connect-to-gain ratio of 6 to 1. In 1955 we connected 11.6 million telephones and disconnected 8.7 million telephones to gain 2.9 million telephones for a ratio of 4 to 1. The increasing movement of existing customers, as evidenced by these connect-to-gain ratios has caused the Standing Still expenditures to more than double in the 1955-1963 period. As stated above, we have very little control over expenditures that fall within this classification.

As we look at our 1964 and 1965 construction expenditures we find that Standing Still expenditures are over $800 million in each year. Public requirements, which account for about $60 million each year, are necessary because of the large highway construction programs being undertaken across the nation. The remainder of the money in this classification includes expenditures for replacement of motorized equipment and various other units of our plant which have worn out.

We have much more latitude in managing Growth investment than we do

Economic intervals . . .

(Typical Example)



Standing Still expenditures. Growth expenditures provide for the expansion of the business and account for 60 per cent of our total construction program. Management appraises total growth expenditures in terms of ability to meet customer service requirements, the economic climate, revenue-producing potential and effect on earnings.

We estimate that over $2 billion will be spent each year to meet 1964-65 Growth requirements, provided an adequate earnings level can be maintained. These sums will enable us to meet our obligation to take care of all new demand in line with current service objectives. Our interstate message volume has grown rapidly. In 1963 it was 1,266 million messages. In 1964 we anticipate 1,355 million and in 1965 1,440 million messages. In order to care for the increasing volume of long distance services for both our old and new customers, we must spend $584 million in 1964 and over $600 million in 1965. These sums will provide for additional toll switching facilities as well as new radio and coaxial systems plus the expansion of most of our existing routes. Since 1949 the number of long distance circuits has been increased from 85,000 to 238,000. Our 1965 construction program provides for the addition of 23,500 long distance message circuits at a cost of over $350 million. Over $400 million in each year in Growth money is to take care of the labor and equipment associated with providing service to new business and residence customers, and to provide additional services requiring more sophisticated equipment.

■ The third classification, Service Improvement, currently represents 15 per cent of our total construction expenditures. These expenditures are the most flexible from an investment standpoint. Included in this category are those dollars spent to provide new types of services and improvements in existing equipment and services. Although expenditures for Service Improvement do not always result in an immediate increase in revenues or an expense reduction, they do have a long range effect. Ultimately they permit better service to the consumers and many of them also result in lower costs.

Current Service Improvement projects include the Direct Distance Dialing program, a Uniform Numbering Plan, transmission improvement, Extended Area Service, and the modernization of our central offices by the introduction of electronic switching.

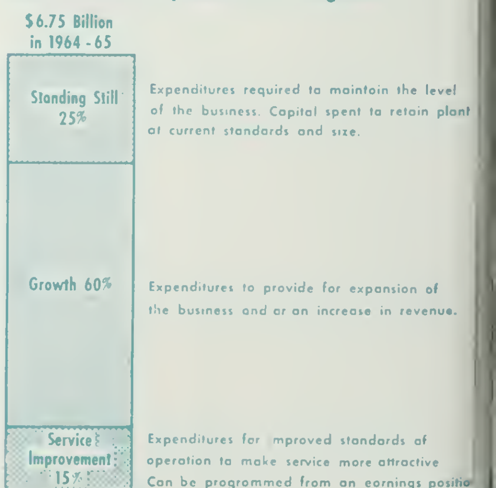
The enlargement of local dialing areas to eliminate long distance charges has been one of the strong desires of our customers. We call this Extended Area Service. Toward this end we have budgeted about $50 million for each year. Many of our rural customers have an equally strong desire to be included in the base rate area. In many sparsely populated areas, customers are currently required to pay an added charge if they wish to be served on a line with fewer than four parties. As these areas build up, our program over the years has been to extend the base rate area and reduce rural multi-party service. Toward this end about $30 million each year is currently budgeted for 1964-65.

Our Direct Distance Dialing program has reached a point where 78 per cent of the main stations and 94 per cent of our operator handled traffic have access to the DDD network. The orderly continuation of this program calls for expenditures of $105 million in 1964 and $113 million in 1965 so that by the end of 1965 87 per cent of our customers and almost 98 per cent of our operator-handled traffic will have access to this direct dialing network. Direct Distance Dialing improves service to the customers and reduces operating expense to the Companies, but it does require substantial capital expenditures to achieve.

Another item under Service Improvement involves improved transmission performance. High quality transmission is essential to the proper functioning of DDD and to the provision of data services. This portion of our service improvement programs amounts to $75 million for 1964 and 1965.

■ Over the last 44 years, we have replaced substantially all our manual central offices with electromechanical equipment. We did this while the total lines in service grew from under seven million to almost 40 million. The next cycle will gradually replace the electromechanical systems with all-electronic equipment capable of providing a new family of sophisticated services. Last year we spent about $25 million to re-

Construction expenditure categories . . .



place older types of equipment with more modern types. This year, of the $97 million total in our central office Service Improvement program, $40 million are earmarked for replacing older types of dial equipment. In 1965, of the total of $100 million earmarked for modernization of central office equipment, $60 million are for replacing older types of dial equipment.

The miscellaneous expenditures in this classification include the mechanization of clerical operations involving the purchase of electronic computers as well as projects designed to improve plant operations. These expenditures are $100 million in each year.

The Service Improvement category includes expenditures of $475 million in 1964 and $490 million in 1965. These capital expenditures would provide jobs for 56,000 people in 1964 and 58,000 people in 1965.

As I have indicated, Service Improvement expenditures can be tailored to a pace commensurate with our earning ability. However, we must recognize that we cannot merely maintain the status quo in providing communications services. The program for service improvement is part of a long range plan to meet the increasingly complex and changing needs of the public.

Expenditures for interstate service requirements are $875 million for 1964 and $950 million for 1965. Interstate Growth and Service Improvement expenditures account for roughly 90 per cent of the interstate program for each of the years.

Continuity of Service

A very important consideration in our capital spending program involves planning to assure continuity of service and "survivability." This aspect of our planning deals with emergency conditions and disasters, such as hurricanes, floods, fires, earthquakes, snow and ice, and even for war itself. A substantial part of our construction program is designed to assure that communications will survive under the worst imaginable circumstances. The following are a few examples of planning by the Long Lines Department to ensure survivability of service to the public.

Routes have been chosen to avoid target areas. Since 1955 almost all of the routes we have built, both radio relay and coaxial, have been laid out on what we call the "express route" principle. That is, instead of running from city to city and interconnecting in downtown areas, they avoid major cities, military installations and industrial complexes entirely, and connect to the cities by means of side legs. During this period Long Lines has added about 20,000 miles of express and by-pass routes. $50 million has been spent to provide by-pass routes around 12 major cities.

We are also "hardening" our toll facilities, making them as blast resistant as practicable. The trans-continental coaxial cable, which will be completed this year, will provide a hardened backbone route clear across the country, with legs into such places as Offutt Air Force Base, Blue Ridge Summit, and NORAD. At San Luis Obispo, it will connect with the new Trans-Pacific cable. All of the main and auxiliary repeater stations along the route are underground. The main stations are in heavy, reinforced concrete buildings under two feet of earth. They are equipped with emergency power, air conditioning, food, fuel and safe water supplies to permit them to operate "buttoned up" and safe from fall-out for a period of about three weeks. On completion, we shall have spent about $185 million on this project alone. Similar hardened cables are planned from Massachusetts to the vicinity of San Francisco and from New York southward along the Atlantic coast.

Fall-out protection is also being provided for personnel at selected switching centers and junction points on other cable and radio relay routes. A program is under way to provide such protection at some 170 points across the nation at a cost of about $10 million.

Considerable effort has been expended to ensure uninterrupted service. On both coaxial and radio routes, protection channels are provided that are automatically switched into service in the event of unforeseen equipment troubles. Some $25 million will be spent through 1970 to improve the effectiveness of presently installed automatic equipment to accomplish this operation.

Should our regular primary control offices be knocked out in a nuclear attack, communications would be supervised from emergency control centers which are being established at strategic points across the country. Long Lines has 17 of these centers spread out around the country. Each of the operating companies has at least one similar installation.

■ In addition, we have eleven Network Management Centers in operation about the country. These centers function on a day-to-day basis to control the nationwide Direct Distance Dialing network under normal and abnormal conditions. They have been very successful in initiating measures to relieve unforeseen traffic congestion.

The existence of this highly survivable DDD network has enabled us to provide the government with a switched services network (the Federal Telecommunications Service) that has a high degree of dependability as one of its basic features. In addition, we have been able to offer the Department of Defense a highly survivable network which includes many new features essential to command and control operation for our Armed Services. This is the AUTOVON project. It would be practically impossible for the government to obtain this level of reliability and service by other means.

I could enumerate countless other ex-

amples of our planning for improved continuity and survivability—pressure protection of cables, replacement of aerial wires with buried cables; automatic alternate routing, etc.

■ The effectiveness of these various measures is indicated by the trouble-free service the nation enjoys. We are indeed proud of the fact that, with a communications network of such vastness and complexity, so few interruptions occur. Equipment does fail from time to time, but the public is rarely aware of this because of our long term efforts to assure that when one part of the network goes out another is ready to take its place—swiftly and automatically.

It is not possible to categorize precisely the expenditures affecting continuity of service and survivability, since this work is integrated with our regular construction program. It is not something that is done "on top" of, or in addition to, our other work, but is part and parcel of our day-to-day activities. Suffice it to say that the investment in time, money and manpower is considerable. It is also important and necessary.

The Bell System construction program increases jobs and has a beneficial impact on our entire economy. Moreover, the investment in capital spending throughout the System's history has resulted in better quality service—and at lower rates. The American public has been the beneficiary of this program.

Telephone service today is a better bargain than yesterday and within a price range that encourages a more ex-

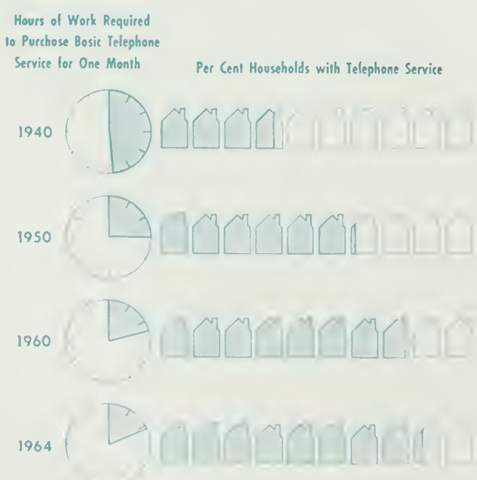
tensive use of communication services by the general public and government.

Let us look at the reduction in real cost of residential service since 1940. In 1940 it took a factory worker 5.8 hours to earn enough for one month's basic telephone service. At that time, less than 40 per cent of the households in the United States had telephone service. The 1940-1960 period shows a decline in the real cost of residential service and an increase in households with telephone service. Today, residential service can be purchased with slightly over two hours' work and generally provides greatly enlarged local calling areas. Households with service have risen to 83 per cent.

■ Even more dramatic has been the reduction in real cost of long distance calls. In 1940 it took a factory worker ten hours to earn enough to make a three-minute daytime call to San Francisco from Washington, D. C. This person today will work one hour to earn the price of this call and will complete his call more quickly and hear better.

Decline in real cost . . .

More households with service . . .



Not only has the relative cost of service declined in the United States but the average cost of service in our major cities, still in terms of hours of work required, is lower than in any of the other major cities in the world. The real cost of service in the United States is less than half as much as in most of the rest of the world and about one-eighth as much as in Paris. The cost of service in most other countries is not only higher but service is poorer and is quite often subsidized by the government instead of contributing to the general economy. As a result of lower cost and better service, the United States has more telephones per capita than any other major country in the world. As of January 1, 1963, the United States had 43 telephones for every 100 people.

The *real cost* of telephone service has declined rapidly; also the *quality* of service has markedly improved. The average time required to establish a long distance call from Washington, D. C. to other cities within the continental United States in 1934 was 108 seconds. Now, with Direct Distance Dialing, an average call is put through in 23 seconds.

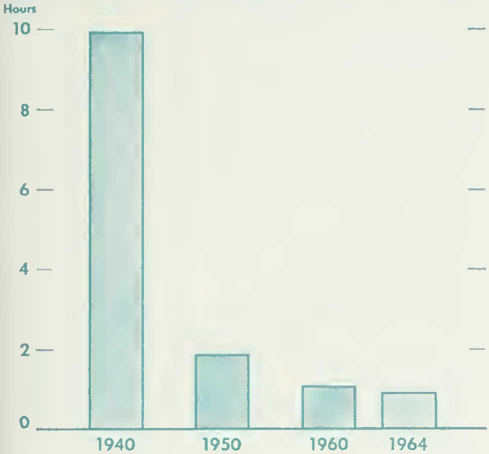
In addition to the fact that the connection is established in a much shorter time, it is also much easier to hear and be heard over a long distance circuit than it was 30 years ago. Improvements in transmission facilities have enabled the average customer to converse with the other party as though they were only about four feet apart. This compares with a distance of 35 feet for the same type of call back in the early 1930's.

There are three additional matters which bear importantly on the future of communications and the health of our business. They are:

- *Growth Prospects*, including the new products and services necessary to meet that growth;
- *Research and Development*, without which communications progress would soon cease;
- And *Risk*, an increasingly important factor in our business operations.

Reduction in real cost of long distance calls . . .

Hours of work required for 3 minute, daytime long distance call, Washington D.C. to San Francisco



First, growth.

Telephone growth in the past depended very largely on our ability to penetrate the basic market for our products and services—that is, the market for single black telephones and local calls. Whereas in 1940 only about 40 per cent of U. S. households had telephone service, the figure today is 83 per cent. We have penetrated the market for basic service so deeply that this element of growth—we refer to it as "horizontal growth"— is now quite limited. Only 17 per cent of the non-user market is before us today, compared with 60 per cent at the beginning of World War II.

We estimate, from opportunities we see to penetrate this market further, and from projected increases in U. S. population, that the total outlook for horizontal growth in our business will be about 2.9 per cent a year over the next decade. Economists tell us that the country's economy is expected to grow at the rate of 3.5 per cent a year over the same period. If we had to rely on horizontal growth alone, our growth would lag behind the economy, an unsatisfactory situation for our customers, owners, and the general public. We would, in fact, be a drag on the economy.

■ However, there is another area of growth which has become increasingly important both to our customers and to us.

As communications have improved, businesses and individual consumers have asked for more than just basic service. The result has been the creation of a new market—a so-called "vertical market"—which involves growth in offering many communications services above and beyond basic service.

An outstanding example of our efforts to meet the public's demands for new and better communications services is the electronic central office. Our first commercial electronic central office is now being readied for operation in Succasunna, New Jersey.

The next four years will see the rate of shipment of electronic equipment increase from 90,000 lines in 1964 to about 1,160,000 lines in 1967. About two-thirds of this equipment is planned to replace existing electromechanical systems and the remaining one-third to care for growth.

The expense reductions we expect to realize by replacing our electromechanical equipment are significant, but not nearly as dramatic as those obtained through the original conversion from manual to dial. The main point is that this new electronic system will allow us to provide economically many new and improved features that will make communications service even more useful.

Some time will be required to provide such service features on a nationwide basis. It would be physically and economically impossible to replace overnight the billions of dollars of electromechanical equipment now spread out over the continent. So, electronic systems will be introduced gradually over a period of years. In fact, it will be the year 2000 before Bell System switching is completely electronic. If this seems rather slow, consider the fact that it will require 600 million dollars per year during most of this time even to meet this schedule.

Meanwhile, improvements have been made in existing electromechanical systems, such as No. 5 Crossbar, which enable that equipment to perform many service functions not contemplated in the original design. CENTREX, Direct Distance Dialing, TOUCH-TONE calling, and improved data communication—to name but a few—are examples of improvements stemming from advances in transmission and switching using existing equipment.

As you can see, our efforts to meet the public's changing needs and demands are bearing fruit. We are encouraged by the public's acceptance of our new products and services. Service is our reason to be, but how well and how completely we serve depends not only on what we would like to do, or are technically capable of doing, but on what our earnings make prudent and practical.

It depends too on something else—a continuing heavy investment in research and development.

Bell Laboratories' Contribution

The *research and development* history of the Bell System is a long and substantial one. It has laid the foundation for the facilities employed in the nationwide communication system of our country. Bell Laboratories research and development over the years have made possible communications to meet the challenge of our times. Among the things which have come quite naturally from our work, each stemming from our central communication purpose, are the transistor, announced in 1948; the Bell Solar Battery, in 1954; high-quality antenna designs going back to the 1920's; a frequency-modulation scheme for vastly improving receiver performance, invented in the early 1930's; and the negative feedback principle discovered in 1927. This last principle deserves special note. It is one of the most important discoveries of all time. It is fundamental to the operation of precise control systems used in modern aircraft and guided missiles, and to the stability of high performance electronic amplifiers used throughout present day communication systems.

Our best progress in research and development will come about only if we realize good earnings today and tomorrow. The dollars we spent yesterday are paying off today. The dollars we spend today will pay off tomorrow. A huge investment is required to support these undertakings, but there can be no question that the investment is warranted.

Bell Laboratories developments and Western Electric manufacturing skills have enabled us to reduce circuit costs from $150 per circuit mile using open wire to $25 per circuit mile using radio relay systems.

Competition and Risk

Now, a word about some areas of increasing risk as visualized from the engineering and operating side of our business. It is well known that technological advances have been widespread throughout the communications and related industries. This has introduced a great deal of competition into our business. For example, computers which heretofore have been used only for processing data are now being used increasingly to perform communications switching functions in the data area. There are a number of large networks now in service which do this. Many of these involve switching previously provided by the Bell System; it is business we have lost in the competitive struggle. In addition to the competition from computers, the doors are wide open for other firms to provide microwave systems to serve the communications needs of government and business in competition with the common carriers.

Risk also continues to increase in the Bell System as substantially all capital is invested in facilities where usefulness is frozen, both geographically and functionally. Expenditures that are required to provide service at the time of construction may leave us with idle capacity because of population shifts. The deterioration of the central areas of large metropolitan cities illustrates this risk to utilities. Net plant investment per employee at the end of 1963 was over $41,000—four times higher than 20 years ago. This increasingly heavy capital investment is necessary to lower cost and improve service. But as the amount of capital committed to fixed long term assets increases, our ability to adjust to cyclical economic variations is substantially reduced.

A review of the sources of our revenue and an examination of our competition illustrates the increasing risks in our business. In the years immediately following the war, almost all operating revenues came from basic local and long distance service. As late as ten years ago, only ten per cent of our revenues came from special telephone apparatus and private line service. Some of these services are discretionary in nature while others are in direct competition with private microwave systems and alternate communication services. These revenues account for nearly 25 per cent of total operating revenues today.

In Summary

To summarize briefly the main points: *First*, our construction program involves over three-quarters of a million separate projects that must be analyzed and engineered. In planning this program, our earnings prospects have an important bearing on the extent to which we can choose programs that operate for the long term advantage of the Company and its customers. Reasonable earnings enable us not only to avoid the piecemeal approach, thereby saving money for the Company and its customers over the long pull but also, at the same time, to provide improved service sooner.

Second, with the increasing complexity of business and governmental operations, their geographic spread, and the greater mobility of our population, communications have become more and more important to our country's economy and the public is demanding more and better service of all kinds.

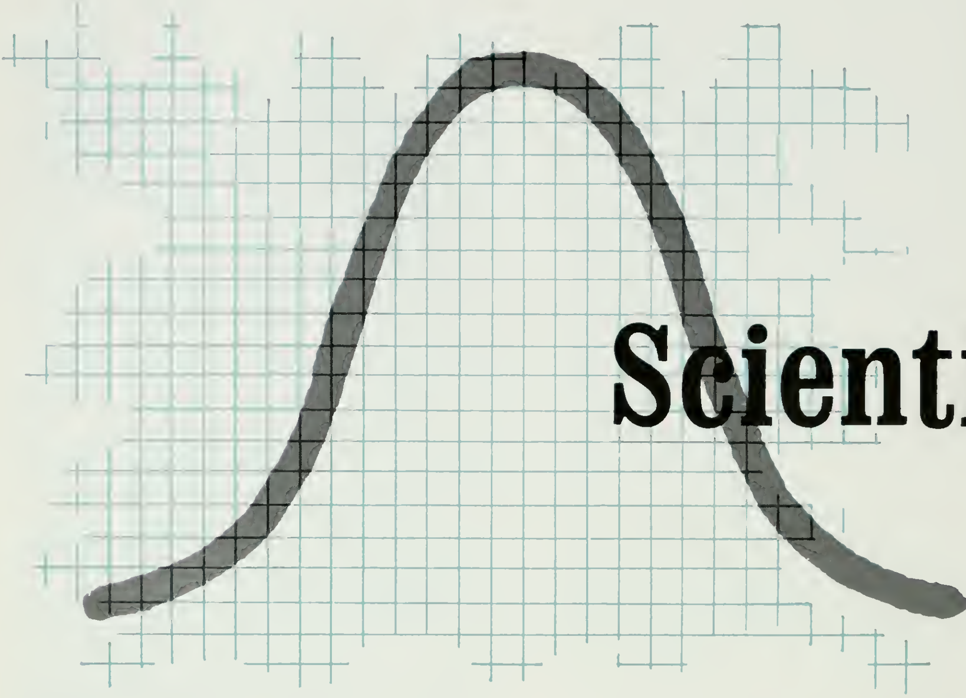
Third, communication progress depends on basic research and development. Good earnings support the cost of research and development to assure that we can continue to create and offer better communication values.

Fourth, risk is an increasingly important factor in our business for several reasons: The growing competition from computers and private microwave systems, our increasing dependence upon a market for communications services which is beyond basic telephone service and therefore more susceptible to customer discretion, and our larger proportion of fixed capital assets.

We are not deterred by the increasing risk; however, as good managers, we must see that the Company is maintained in a financially healthy position to accept this risk.

The construction program which I have outlined, and which reflects the added stimulus of the tax cut, will benefit telephone users and the general economy. Telephone consumers will enjoy improved service through an efficient program designed to produce the best quality service at the lowest cost. The general economy will be immediately stimulated through the creation of thousands of additional jobs. We believe this program furthers sound economic policy. Its continuation will insure for the future a healthy and progressive business able to meet the ever advancing needs of the public for the communication services so vital to the country's economy.

Note: This article is based on a statement presented by Mr. Hough in a general meeting before the FCC in July of this year.



Scientifi

Reliability, economy and speed. These three characteristics go far towards explaining the growing popularity of scientific sampling as a valuable tool for many different management purposes in the Bell System. Reliability, because a properly designed sample can be counted on to give results which are precise within the specified limits built into the sample design. Economy, because such results may often be obtained with only a fraction—and sometimes a very small fraction—of the effort required to make a *complete* study. And Speed, because the much smaller effort required with sampling can be translated into much more rapid completion of studies made by sampling methods.

These three important advantages of scientific sampling are all attainable if we are willing to make one concession—to accept *approximate* results; for sampling produces approximate, not exact, figures. But how often do we really need data that are 100 per cent accurate, or "right on the nose?" When one thinks of the uses made of all the varieties of data developed in our business, he will find himself hard put to discover many instances in which exact values and pinpoint accuracy are really indispensable.

A more telling question here is "how approximate?" No one is interested in data too rough to be significant for his purposes. However, the degree of precision needed in the sampling results will vary with the particular purpose of the study. For example, in developing a revised accounting plan, the aim was to obtain sampling results accurate within a range of two per cent, either way. On the other hand, in cases where only

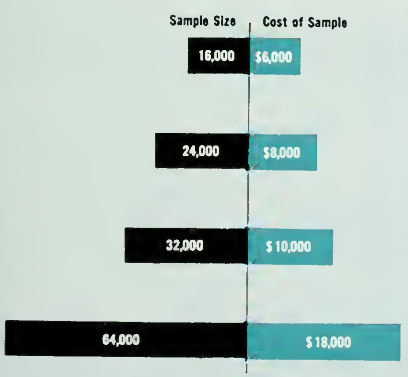
Sampling is a method of measuring some characteristic of a group of items, (or universe) by examining only a portion of the items. **Scientific** sampling has two important features: 1) the sample must be drawn by completely objective methods; 2) the reliability of a scientific sample can be controlled by the use of mathematical procedures.

ampling

ıbert B. King, *Mathematical and Personnel Statistics Administrator*
mptroller's Department, A.T.&T. Co.

NTIFIC SAMPLING IS FLEXIBLE

Illustrative Example of Alternative Choices for a Study



Interval at 95% Assurance Level

h entific sampling, the statistician can offer management a choice
ile sizes, costs and reliability values for a contemplated study.

the general order of magnitude of a quantity is needed in order to make a decision, an approximation accurate within a range of ten per cent, either way, may be sufficiently close. Fortunately, sampling methods are flexible. Where a more precise result is needed, this can usually be attained by using a more efficient even though a more complex sampling method or by increasing the sample's size. In designing the sample, the precision of the results can be fitted to the most appropriate degree of accuracy, balancing cost requirements against the needs of the study.

Recent Surge of Interest

Almost ten years ago, a System-wide program was started to encourage the use of sampling wherever it could prove of practical value for management purposes.

FOUR IMPORTANT CONCEPTS UNDERLYING SCIENTIFIC SAMPLING

Random Selection

In scientific sampling, random selection of items to include in the sample is selection governed wholly by the laws of chance. In drawing a sample from a group of items, each of the items must have a known chance of being selected.

Variability

The variability of the items in a group of items to be studied substantially affects the sample size required. With wide variability, a sample must be larger to yield results of a specified precision than when there is little variability among items.

Absolute Size of Sample

In scientific sampling, it is the absolute size of the sample that is most important. The percentage of the complete universe represented by the sample is of little importance, except when the sample is a substantial part of the universe.

Reliability

Scientific sampling procedures provide control over the reliability of the sample results. It is possible to determine what size of sample is necessary to yield results which are reliable within specified limits. After the sample has been drawn, its reliability can be determined more exactly from the sample itself.

Several of the Operating Companies were already engaged in sampling work, and the prospects for extending the use of sampling appeared promising. At the 1954 Comptrollers' Conference, Burton R. Young, then chief statistician of the A.T.&.T. Co., recommended that all the comptrollers organize to stimulate the application of sampling methods in their Companies. The following year, the first Bell System course in mathematical sampling techniques was held in New York City for the men in the Companies who had been assigned to sampling work under this program. Since then, similar courses have been held at two-year intervals for newcomers to the sampling field. The sampling program has now spread through the System Companies and major departments and has led to the use of sampling in well over a thousand studies.

■ Although this extensive adoption of sampling methods is quite recent, sampling is by no means a new thing in the telephone business. Over fifty years ago, scientific sampling was first used to measure telephone traffic characteristics. Ever since then there has been continuing use of it in traffic operations and some use before the middle nineteen-fifties in other areas of telephone operations.

The recent surge of widespread interest in sampling during the last ten years has come about not only because of deliberate efforts to introduce this valuable management tool, but also because of several concurrent favorable factors. Among these are the continuing growth of the business, which has stimulated demand for economical methods of obtaining information, and the recent development of more flexible and universally applicable sampling techniques. Also, the telephone business is a "natural" for sampling, because in a certain sense, it is similar to a retail business in that many elements are in terms of thousands, or even millions, of units, such as calls, telephone directory listings, telephone instruments and wire mileage. This multiplicity of similar items readily lends itself to the sampling method.

Among the new techniques referred to above, are replicative sampling and sampling with probability proportionate to size. In replicative sampling, a number of subsamples (say, ten) are drawn instead of one large sample. Each of these subsamples is an independent sample in its own right. The subsample means or totals may then be used to determine in a simple way the reliability of the sample results, with relatively easy control over the necessary computations.

Sampling with probability proportionate to size is often used when the size of the sampling unit is related to the quantity of items being studied. For example, suppose we want to select a sample of central offices in order to estimate the number of dialable long distance calls placed by time of day. Here, the larger the office, the more effect it will have on the sample results. Rather than making a random selection of offices in this case, it would be better to give the larger offices a higher probability of entering the sample. The estimating procedure, of course, must take into account these varying selection probabilities. When handled correctly, this can be a very efficient sampling technique.

Bell System Use of Sampling

The three principal advantages of sampling—reliability, economy and speed—have led to many different uses of sampling methods in the Bell System. These range all the way from everyday jobs of verifying the quality of work operations to special fact-finding studies needed for management decision-making.

Two recent applications of sampling of particular interest are the following:

The Special Federal Communications Commission Cost Study. This is a special study requested by the F.C.C. in connection with their domestic telegraph investigation. The purpose of the study is to develop revenue, expense and investment data for each of seven categories of our interstate business—message toll telephone, private line, TWX, etc. In this study, sampling procedures are being used mainly to develop data on the investment in each of the seven categories of business. This has required a number of sampling studies on a Systemwide basis.

The Comptroller's Department Work Observation Plan. In this plan, sampling procedures are used to determine the distribution of clerical employee hours among the individual work codes of the production measurement plan for Billing and Collecting and Payroll and Cost Accounting work. This replaces the detailed 100 per cent time recording used previously. At randomly selected times each day, a signal is sounded throughout an office and the operation being worked on by each employee at the sound of the signal is recorded. Total hours for the month are then assigned to the individual work codes based upon the code distribution of sampled observations obtained during the month.

In some of the Bell Companies this sampling plan has already been extended to certain machine as well as manual operations. It is expected that in 1965 all the Companies will be reporting the distribution of both manual and machine time on a sampling basis.

■ An indication of the wide range of sampling applications is given in the exhibit below. This lists many of the activities in which sampling studies have been widely used. Some of the studies in these fields are System-wide; many others have been made by individual Operating Companies. Some are periodically recurring studies; others, one-time "spot" studies, or studies made only from time

SOME FIELDS IN WHICH SAMPLING STUDIES HAVE BEEN WIDELY USED

- Developing production measurements, including work sampling in billing operations
- Toll supplementary peg counts
- Customer attitude studies, market surveys and studies of the effectiveness of advertising and public relations activities
- Auditing
- Joint pole rental arrangements with electric power companies
- Measuring quality of work in construction, maintenance and installation
- Developing service indexes
- Rate studies, such as the effect of rate proposals on usage, revenues and costs and the effect of extensions of local service areas
- Measuring accuracy of records and inventories such as Continuing Property Records
- The Revised Station Accounting Plan
- The coverage, format and accuracy of telephone directories
- Measuring characteristics of calls and subscribers by type of service
- Division of revenues (Bell System separation studies and toll settlements with the Independent Telephone Industry)
- Wage surveys
- Determining circuit costs and other elements of plant investment, used in developing new service offerings
- Quality control and verification of clerical and other operations
- Substantiating reports of revenue from sales, and measuring sales efforts
- Determining the average condition of plant and the quality of transmission
- Taking care of demands for information by governmental taxing authorities
- The monthly Message Analysis Sampling Plan
- Miscellaneous fact-finding studies in a wide range of fields, to aid in management decision-making

to time as need arises for them.

There are, of course, instances where the sampling method should *not* be used; as for example, where exact figures are required, or where over-all sampling costs may equal or exceed the costs of a complete study. Such cases, however, do not often occur, as is demonstrated by the range and variety of Bell System sampling applications. And the prospects are for continuing and probably increasing use of this valuable management tool.

Sampling Procedures

These multifold applications of sampling have made use of a variety of sampling techniques and procedures. Planning a sampling study requires consideration of the individual characteristics of the material to be sampled. These characteristics would help determine the type of sampling used, the procedures required to insure valid selection of sample items, and other factors which enter into the design of the study. Reliable results can be achieved only if the sampling procedures are tailored to the particular job in such a way as to satisfy the mathematical concepts of sampling.

For example, in revised station accounting, where line numbers are sampled, it would be undesirable to use systematic sampling, in which every nth item (e.g., 5th or 10th item) is selected. Such a sampling plan might result in the selection of sample items including those with telephone numbers -0100, -0200, -0300, etc. These numbers are frequently those of large business concerns and the sample might therefore contain a disproportionately high number of such concerns, distorting the sample results.

The basic concepts of sampling are themselves fairly simple and can be understood without mathematics. But the application of these concepts to a particular study and the details of designing and completing a study are often complex. These technical problems can best be left to the statistician.

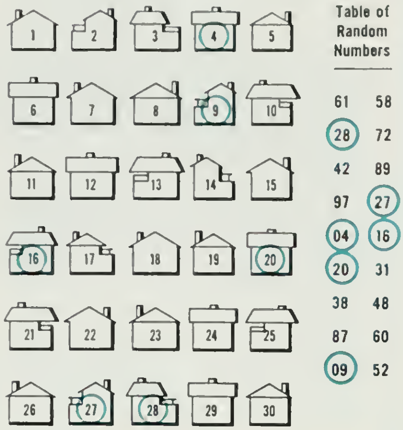
The panels on pages 22 and 24 give some of the important basic concepts of sampling and describe some of the more common types of sampling.

■ One of these basic concepts has particular significance with respect to the future value of the sampling method in a large organization like the Bell System. This is the concept that the absolute, rather than the relative, size of the sample is important in determining the reliability of the sample results. For example, suppose a sample of 1,000 items provides sufficiently accurate results in studying a universe of 20,000 items. Suppose further that the growth in the business causes this universe to increase to 30,000 items. A sample of 1,000 items will still suffice to give almost equally precise results for this larger universe, if other characteristics of the universe do not change. The significance of this is that a growing business will not over the years require larger and more expensive samples than formerly were used. On the contrary, sampling will become relatively more economical as the business grows.

Acceptance of Sampling

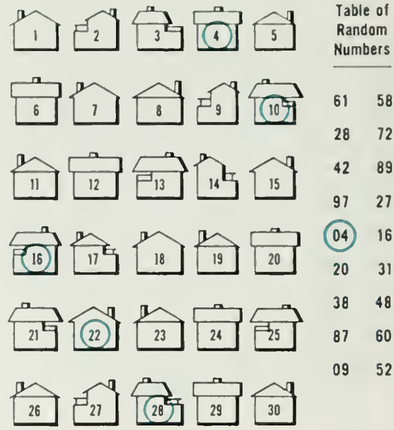
Another important aspect of the Bell System sampling program has been the acceptance of that program.

From the start of the program in 1955, it was recognized that gaining acceptance of sampling methods was an essential first step in putting this technique to work. To achieve a wide use of sampling, this meant obtaining acceptance of these methods by many different groups of



SIMPLE RANDOM

Starting anywhere in a table of random numbers, all numbers of 30 and lower are taken consecutively until required size of sample is reached (six households, in this illustration).

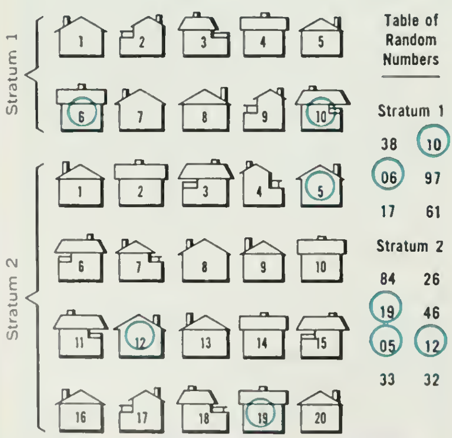


SYSTEMATIC

Calculated sample size (in this case, five) requires taking every sixth household. Random start is determined by taking first number of 6 or below from table entered at random.

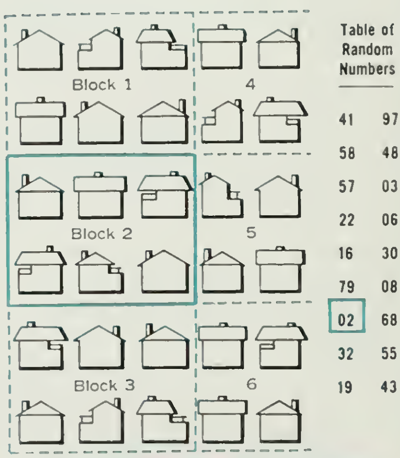
...FOUR COMMON TYPES OF SCIENTIFIC SAMPLING

Illustrated by selection of a sample from a universe of 30 households. Sample is determined from a table of random numbers and corresponding households identified.



STRATIFIED

Households are stratified by some criterion such as type of telephone service. Then, the sample is selected by an appropriate method in each of the strata independently.



CLUSTER

Clusters (blocks) to be included in the sample are selected by means of a table of random numbers. Then, a census (or a sample) is taken of the households in these selected blocks.

management people, most of whom in the late nineteen-fifties had had little or no occasion in their work to learn about such mathematical techniques.

It is entirely understandable that people with no previous knowledge of sampling should sometimes hesitate to accept it on first acquaintance. To the uninitiated it may be difficult to believe that a small fraction of a group of items can be made to produce an accurate representation of the entire group. An example of such scepticism is the delightfully frank admission of the employee who remarked to a Bell System statistician: "I don't believe in sampling, but my boss wants me to talk to you about using it in a study."

The requirement of complete *randomness*—independent of human judgment—in the selection of the sample items has been particularly difficult for some to accept. An illustration is the well-meaning employee assigned the job of pulling toll tickets from the file for a sampling study of long distance business. Instead of drawing the tickets by the random method specified in the sample design, the employee deliberately selected tickets for calls between two particular cities to represent a large proportion of the sample. The effect of this was a distortion of the sample results which was easily detected. The reason given for this departure from instructions was that the route was a representative one and would give better study results.

TYPES OF SAMPLING PROCEDURES

There are a number of different types of sampling procedures, each of which has advantages for certain purposes. The more commonly used types of sampling are: simple random sampling, systematic sampling, stratified sampling, and cluster sampling. Examples of each are shown on the opposite page.

Simple Random Sampling. In this procedure, the items included in the sample are drawn completely at random from the entire universe. A common procedure for making this random selection is: first, assign a serial number to each item in the universe; then, using a table of random numbers, make a random selection of the serial numbers (and associated items) to be included in the sample.

Systematic Sampling. In systematic sampling, the sample items are selected from the array of items in the universe in such a way that there is a uniform interval between each sample item and the next sample item. For example, if a sample is to include 1 of every 100 items in the universe, the selection would be made by first drawing an item at random from the first 100 items in the universe, and then selecting every 100th item thereafter.

Stratified Sampling. In stratified sampling, the items in the universe are first segregated into two or more classes called strata. Usually these are chosen so that items which are generally comparable in the characteristic being measured fall within the same stratum. Then each stratum is sampled independently and the results for the several strata are weighed together to give an over-all figure for the universe. This type of sampling is often appropriate when there is wide variation among the sampled items in the characteristic to be measured.

Cluster Sampling. In this type of sampling, the universe is formed into groups or "clusters" of items. The first step is to make a random selection of clusters to include in the sample. Then, the items within the selected clusters may be sampled or a census may be taken of them. This type of sampling is often advantageous for cost reasons. For example, in surveying households, travel costs can often be reduced by the use of cluster sampling.

HOW IS THE SIZE OF A SAMPLE DETERMINED?

A question frequently asked is "How is the size of a sample determined?" In scientific sampling, this is done by means of a mathematical formula, but the solution of the formula itself is usually the easiest part of the process. The most difficult part is that of obtaining reliable information on the necessary "input" data to use in the formula.

Generally, the following three items of information are needed:

a) The number of items in the universe (the entire group of items to be studied).

b) An estimate of the variability of the items in the universe, with respect to the particular characteristic of the universe being studied.

c) A statement of the reliability needed in the sample result.

Item (a) may or may not be available. If not, it will have to be estimated.

Item (b) is usually the most difficult item for which to obtain a sound figure, unless previous samples or other reliable data are available. A satisfactory estimate of it can often be obtained by a small pilot study or from the expert knowledge of someone who has had considerable experience with the data being studied.

Item (c), the reliability needed in the sample results, is a matter of decision by those who will make use of the sample, with the assistance of the statistician.

Following is an example of a formula used in simple random sampling.

$$n = \frac{N \times t^2_a \times \sum_{i=1}^{N} (Y_i - \bar{Y})^2 / (N-1)}{N \times R^2 + t^2_a \times \sum_{i=1}^{N} (Y_i - \bar{Y})^2 / (N-1)}$$

where n = sample size

N = universe size

R = precision range of the sample result

t^2_a = factor expressing the probability a that the universe figure lies within the precision range

$\sum_{i=1}^{N} (Y_i - \bar{Y})^2 / (N-1)$ = the variance of the Y values in the universe

Another possible source of scepticism, strangely enough, is the very fact that sampling saves money. Some management people may feel that sampling results must therefore be inferior, on the basis that one never gets something for nothing. Actually, the only penalty for the lower cost is that sampling results are approximate. And in fact, sample results may sometimes be superior to the results of a complete study because of the problems of controlling accuracy in extensive studies made with the assistance of large groups of people.

In earlier years uncertainty about sampling methods led in some cases to verification of sampling studies by making 100 per cent studies simultaneously. These expensive checks proved that sampling methods were valid. Such checks have disappeared with increasing acceptance of sampling procedures.

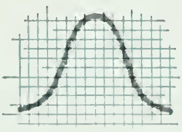
The merits and the validity of sampling have now been accepted by most management groups. For this a great deal of credit should be given to the people in the System Companies who have devoted time and effort in explaining to management the whys and wherefores of sampling methods.

A Matter of Decision

The widespread application of sampling methods in the Bell System represents the combined result of a large number of separate decisions made by individual groups of management people. In each case, the decision to use sampling was made by those responsible for the particular operation or study to which the sampling methods were to be applied. The fact that every application of sampling has been individually decided upon, after consideration by those most knowledgeable about the particular job, goes far towards assuring the soundness of the sampling program.

■ In conclusion, one of the most significant things about the sampling program is that it represents the first multi-purpose mathematical-statistical method introduced and used on a broad scale in the Bell System—that is, if one excludes such commonly used and relatively simple methods as averages, distributions, and the like. Sampling has been used by all major departments and for a wide variety of purposes. It has convinced many operating management people that such mathematics can be of practical value in their work, and that they can acquire a broad understanding in non-technical terms of how such methods work without having to know all the technical details. Thus, the success of this program helps to pave the way to acceptance of other mathematical techniques such as simulation and other Operations Research techniques which are now beginning to be used more and more in the operating side of our business.

Note: The charts in this article are taken from **What is Scientific Sampling**, a non-technical booklet on this subject prepared by the A.T.&T. Busiiness Research Division.



Over the years, telephone men and women of many lands have cooperated closely for the betterment of overseas telephone service

International Cooperation

Edwin C. Laird, Jr., *Executive Assistant, Overseas Operations, Long Lines Department, A.T.&T. Co.*

■ IT HAS BEEN a commonplace over the generations that good telephone service requires the cooperative activity of many people in many different places. Nowhere is this more true than in the field of overseas telephone service—and nowhere does such cooperation require more continuous and delicate practice. For not only are the people who create overseas service particularly remote from each other, but also they are affected by the special communications problems and methods as well as the customs of their individual lands.

Cooperation takes many forms. It may be as simple as showing a visitor from a foreign telephone administration, who has come to see the New York World's Fair, the exciting view of Manhattan from the top of Long Lines Headquarters. Or it may be as complex as the arrangements which were agreed upon before the first transatlantic telephone cable system could be inaugurated in 1956.

Some of the major factors involved in bringing that international venture to a successful conclusion were—despite the long cable experience of the British—the determination to use deep sea amplifiers developed by the Bell System for the deep water portion of the route . . . the choice of British repeaters for the shallow water in Cabot Strait . . . securing permission from Canada for the new cable system to cross its territory . . . agreement that much of the cable would be manufactured in British plants, to keep dollar payments at a minimum and thus not to draw upon the British dollar balance . . . equal partnership in the enterprise for the United States.

Numerous groups cooperated to make

the enterprise possible: the British Post Office, which operates their telephone service, British parliamentary committees, the Canadian cabinet, the U. S. Office of Defense Mobilization, the U. S. Departments of Defense and of State, bodies customarily interested in communication developments, such as the Federal Communications Commission—including of course, Bell System representatives.

A later cable project offers another example of the cooperation which underlies the opening of international telephone facilities and services. When a second transatlantic telephone cable was established between Clarenville, Newfoundland, and Penmarch, France, in September, 1959, the French and the West German telephone administrations became joint owners with the Bell System. In addition, five other European countries took circuits in the cable on the basis of "indefeasible right of user."

It was also arranged for the French and the Germans to manufacture parts of this cable. Such an arrangement called for technical and operational assistance to be furnished by the Western Electric Company to each of the cable manufacturers. This ensured that the cable would have the electrical and mechanical characteristics identical with the cable made in the United States and would be compat-

(left) 100 communications experts from 24 countries meet in Tokyo in May, 1959 to discuss all phases of telephone communications in Asiatic countries; (right) Delegates from overseas observe the placing of the shore end of cable from England landing in New Jersey; (below) opening ceremonies for the first transatlantic cable in Clarenville, Newfoundland.

ible with the original standards.

The British and the Canadians were also involved in this cable project. Time and money could be saved by supplementing the radio relay system already built across the Canadian Maritime Provinces as well as the terminal facilities in Newfoundland for the first transatlantic telephone cable. Their approval of this made it possible to keep new construction at a minimum.

Still another instance of such international cooperation relates to the ocean telephone cable recently built between Hawaii and Japan. Aside from decisions on the percentage of ownership for each partner and their financial obligations, it was agreed to manufacture the cable in plants in the United States, England, and Japan. Again, Western Electric offered technical and operational assistance to ensure that the cable would have identical characteristics.

The most recent instance in which telephone people of different nations have met to work out an improvement in overseas telephone service involves the decision to build a deep-sea telephone cable between St. Thomas in the Virgin Islands and La Guaira, Venezuela. This would interconnect with the existing cable between St. Thomas and Florida. Service between the United States and Venezuela was opened in 1932, using high frequency radio, but as long ago as 1959 it was deemed wise to build a cable in the waters north of South America which would ultimately link with cable and over-the-horizon facilities in the Caribbean area. Problems of routing, traffic volumes, and changing policies in international affairs necessitated a delay in working out exact plans. In June, however, representatives of the Bell System and the Venezuelan telephone administration met in Caracas and agreed to place an undersea cable. In July technical men of the organizations concerned were busy implementing the agreement in terms of the many necessary construction and operational details.

Officials of A.T.&T.'s Long Lines Department, of Kokusai Denshin Denwa of Japan and of the Hawaiian Telephone Company are shown gathered in 1962 to sign the agreement for now completed transpacific telephone cable between Hawaii and Japan.

Ceremonies in Caracas, Venezuela, above followed the recent signing of an agreement to build a submarine telephone cable between that country and the Virgin Islands.

A Language Agreement

One of the first examples of international cooperation in the field of overseas telephony dates from the 1920's. At that period, English was by no means the international language it is today. Nonetheless, the Bell System urged that English be chosen for operating the service. As we frankly told our prospective foreign partners, Americans are seldom linguists, and we would have great difficulty in hiring operators and technicians able to talk all the languages it might ultimately be necessary to employ in dealing with an expanding list of overseas partners. Our telephone friends abroad, who were better equipped linguistically than we, saw the point and agreed that it was practical to use English in all operations. Since that time, of course, we have seen the growing use of English —particularly in scientific fields—all over the world.

Such agreements involved cooperation in the actual negotiations. On the occasion of his retirement in 1958, William G. Thompson, assistant vice president, Long Lines Department, summed up his long experience in negotiating with representatives of foreign overseas services. "Before you even start negotiations," he remarked, "you need an atmosphere of friendliness and mutual confidence . . . a meeting of minds will be achieved in an atmosphere that is frank and cordial. Over the years, we have gained a reputation for dealing fairly with our overseas partners. This has caused them to trust us, which in turn, has had a great deal to do with our success in negotiations with representatives of all nations.

"Ours is a mutual service, don't forget. . . . Actually, you may work it out so that your mutual strengths and weaknesses offset each other."

A "working party" of foreign delegates meet at Long Lines Headquarters, to set up intercontinental telephone operating instructions.

This historic first call between New York and Paris took place on March 28, 1928.

■ In the early days of overseas telephone service, the Western Electric Company sold high frequency point-to-point radio transmitters, receivers, and control terminals to organizations abroad. In many cases, Western Electric people also installed this equipment and trained personnel in proper maintenance and testing procedures. At that period, this was highly important, as most other countries did not have equipment in this field of as advanced a design and performance as that of the Bell System. The Bell Laboratories, for example, had perfected the multi-channel single sideband systems now so widely used. In the intervening years, this situation has changed and a number of foreign countries can now provide equipment comparable to ours.

A Way of Life

Once overseas telephone service was established in 1927, cooperation became a daily way of life. At first, overseas telephony had been an exciting stunt but, as time went by, it became an important tool of business, social, and governmental affairs. Greater clarity, increased speed of service, and lower rates were now the goals. To achieve them called for an interchange of skill and experience by the several administrations. The differing methods of distant partners had to be reconciled and their equipment made more compatible in the interest of better and expanded service.

In this international service, Bell System representatives associated with communications people familiar with all the intricacies of the most modern telephone systems. Often, however, they were called upon to deal with complete newcomers to the field of international communication or to assist those faced with the need to upgrade their systems. Under these circumstances, our representatives — long experienced in handling heavy traffic over continental distances or in using advanced equipment—could be extremely helpful. Plant or traffic methods could be suggested or organizations encouraged to introduce equipment which would produce larger volumes of business because better service could be offered with it.

All of this contact has engendered a continuous flow of correspondence, with attached reports detailing how the other fellow handles a particular problem. Telephone calls to discuss a variety of problems and visits between people in offices separated by thousands of miles of ocean are now a commonplace. As a result, traffic operating procedures, plant maintenance and testing practices, and statistical methods have been reviewed, improved, changed, and coordinated.

Training activities are an excellent example of mutual cooperation. Not long ago, for instance, Bell System people helped train three technical men and three traffic operators who will be involved when the service with Monrovia, Liberia is opened later. Such efforts as this have been a Bell System practice for many years.

Three trainees from Liberia came to New York to study overseas telephone operating methods. Above, they are shown receiving instructions at a Long Lines office.

International Cooperation

■ Year after year, understanding and trust between the distant partners have grown as individuals have become familiar with each other's problems, the factors governing their operations, and their philosophy of doing overseas business. No longer, for example, are two records (or tickets, in Traffic Department terminology) kept for an overseas call, so that both countries involved can check on the charges involved. Today, only an "outward ticket" is usually kept, because the second country has complete faith in the integrity and accuracy of the procedures for timing calls and dividing overseas revenues.

A significant example of international cooperation occurs in connection with communication by means of radio telephony. For decades, it has been the practice for all offices to relay service messages to help maintain or continue service which may be in danger of blackout because of poor atmospheric conditions or to relay emergency calls that may arise out of the regular hours of commercial service for ships or particular land points. In continental Europe, for example, such cooperation by telephone people in Bern, Switzerland, and in London has won high praise. This long-established mutual assistance can be compared to similar efforts in the world of navigation or perhaps to the shared observation and experience which marked the recent International Geophysical Year.

■ International cooperation is not limited to matters of daily operation, important as they are. Sometimes a significant development in international telephone service requires more elaborate considerations. Until recently, for instance, the overseas operator has passed the details of a call to her counterpart at the other end of the line. But now, in many instances, she is able to dial directly to the foreign telephone requested by the customer — and the operator overseas can dial telephones on these shores.

To make this possible, it was necessary to agree upon the design requirements for an inter-continental dialing and signaling system that would be compatible with national networks at each end. To overcome the problems and establish all the features involved in this change, representatives of the A.T.&T. Long Lines Department and of Bell Laboratories negotiated for several years with representatives of several foreign nations.

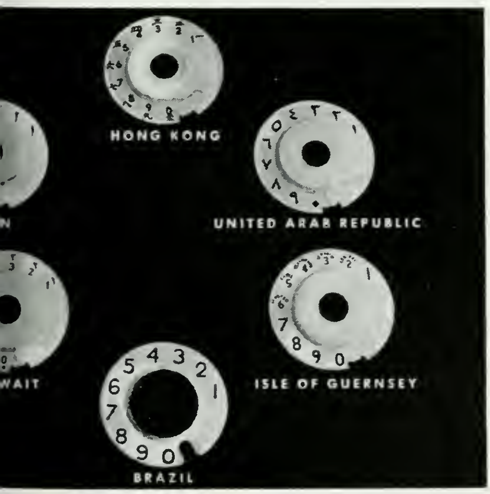
Today, operator dialing is in effect between the United States, the United Kingdom, West Germany, France, Belgium, Switzerland, Italy, Japan, Australia and The Netherlands. Again, new operating practices have made it possible for the regular long distance operator to dial telephones not only in Alaska and Hawaii but in Bermuda, Jamaica, Puerto Rico, and the Virgin Islands as well.

Cooperation in International Committees

The dialing and signalling system approved for this purpose was subsequently recommended to the International Telegraph and Telephone Consultative Committee (CCITT), the international body which studies and recommends standards for adoption in the telecommunications field. To implement world-wide dialing, international agreement was also reached on the signaling and switching system to be known as CCITT System No. 5. Last February, the CCITT, meeting in Rome, decided on future long-term arrangements for operator and customer dialing of world-wide telephone calls. In attendance, incidentally, were 22 U.S. representatives — representatives from government, telephone and telegraph carriers, manufacturers, research institutes, and the Communications Satellite Corporation (COMSAT). It is expected that several CCITT study groups may meet in New York next year.

In principle, the world-wide plan agreed upon in Rome follows the arrangements in use in North America, with comparable world switching centers and zones for a numbering plan. CCITT in also making recommendations that dials be made uniform—which is not the case now—and that letters be eliminated in favor of numbers only. (Outside of Canada and the United States, nine out of ten of the telephones that can be dialed have all-number designations.)

For some years Long Lines has participated in meetings of CCITT study groups charged with drafting practices for maintenance and testing in inter-continental communication systems, as well as with helping to formulate new rules for "personal" and "station" calls. Because of its extensive experience in the operation and maintenance of long haul telephone communication—with which European countries had never been confronted until the advent of ocean cable systems—Long Lines has offered its considerable experience to this world organization.



Because some of the dials on telephones in other parts of the world differ from the standard U.S. dial, all-numeral numbers will be needed for world-wide dialing since these are understood by people everywhere.

■ There are many other examples of international cooperation. For instance, the Bell System works continually with the Federal Communications Commission, to assist the International Frequency Registration Board in policing the use of high frequencies for both telephone and telegraph use throughout the world. (This is an effort to ensure that all transmitters keep to the licensed frequencies. In a world of varying technical skills and differing ideologies, lapses may occur because of poor adjustment, negligence or occasional pirating of frequencies.) In the field of radio, a number of Bell System organizations participate in the work of the International Consultative Committee for Radio (CCIR) in all phases of radio communication, from mobile service to intercontinental point-to-point telephone operation.

Much cooperation has already marked the present development of communication by satellites in space. Aside from its own design and launching of the Telstar experimental communication satellites, the Bell System furnished technical assistance and, in some cases, operational supervision to the cooperating British, French, German, and Italian satellite units. In the case of France, most of the ground equipment was manufactured and sold to the French by the Bell System. In other words, the spirit of cooperation remains the same whether we communicate by satellite or by more familiar means.

Jules Franz of the French telephone administration (PTT) has made the point that we have passed through the stone, bronze and iron ages. Now, he feels, we are in the midst of the paper age—with far too many papers for either comfort or efficiency. This suggests that one reason for the present excellence of overseas telephone service is that in their relationships, the representatives of world-wide service have not depended on the exchange of documents alone. Instead, hundreds of times over the years, they have worked together, face to face, to solve their problems in an atmosphere of mutual good will and trust. **E.C.L. Jr.**

The Northwestern Bell Telephone Company
was one of the first in the Bell System
to establish the value of the employee
discussion programs which are
attracting such widespread interest today.
Here is Northwestern Bell's story,
based on nine years' practical experience.

How We Developed Our Discussion Program

Vern L. Bronn, *Public Relations Supervisor, Northwestern Bell Telephone Company*

ABOUT NINE years ago, a Northwestern Bell study indicated that when Plant Department service foremen took time to sit down and hold regular discussions with their installer-repairmen, something pleasant and profitable began to happen.

To reap these same sort of discussion payoffs throughout the entire company, several employees in the Northwestern Bell Public Relations Department were assigned to prepare discussion outlines on subjects that would interest all telephone people. To identify and generally promote the discussion program idea this small group, representing a blend of Public Relations and operating experience, decided to call themselves the Employee Discussion Group.

They found the job of writing good discussion material a new and challenging experience. Rules and suggestions for writing informative articles and speeches were commonplace, but ways to encourage two-way communications were not so easy to find. Yet the problem of writing good discussion material was simple compared to the task of persuading busy tele-

How We Developed Our Discussion Program

phone people that it was important to take time to talk to one another.

Northwestern Bell's Employee Discussion Group soon found it was going to take missionary zeal to reach this goal. They took a long look at the situation and then headed out to carry the story of the discussion program throughout their five state territory.

At first there were few believers. Here and there a listener was found but progress was slow. Then as converts joined and added their experiences to the growing proof, more and more Northwestern Bell people saw the value of the two-way communications. The program resembled a small snowball headed down hill, picking up size and speed as it went. Given enough time and push it was going to make it.

■ Today, most Bell Companies have embarked on employee discussion programs. Yet, in spite of this acceptance, there are some individuals who are not buying. Among them are the "no nonsense" supervisor and the hardboiled cynic. They have only one question—"What's in it for me?" There are also the "nice guys" who smile benignly and say, "I think it's nice to listen to my people. Just as soon as I get caught up, I'm going to do it."

And then there are those with honest doubts and misgivings who want to know:

- "How can I build a two-way communication pipeline?"
- "What do I do about the hard-nose on my crew who delights in upsetting the apple cart?"
- "What happens to telephone service while I'm talking with my people?"

When these questions are tossed to Northwestern Bell's Discussion Group, they back away. They have developed a conviction that when *they* provide the answers, believers become back-sliders shortly after the telling is over.

In fact, the whole discussion program hinges on the belief that when you tell people the answers, not too much happens. But when you help people work out the solutions for themselves, there is real understanding and goals will be reached.

■ Within their own five states—Iowa, Minnesota, Nebraska, North Dakota and South Dakota—Northwestern Bell's Discussion Group tries to help people answer their own questions and provide their own solutions to the challenge of establishing two-way communications. A first-line supervisory discussion session, which is a part of the testing of each discussion package, is one of the ways of doing this job.

Every discussion package is tested on at least three craft groups. On these test trips, supervisors of the people who took part in the test sessions are brought together to learn what their people said and did.

During this feedback session, many questions are asked of the staff group. Usually some supervisor in the group will have the answer—a testimonial or a sound idea. Thus, instead of being told the answers, provided with pat explanations and ready-made solutions for their problems, supervisors are encouraged to use the "discussion-sharing" approach—to find out for themselves how and why two-way communications are important.

Not all questions can be answered by the supervisors. For instance, this one is tossed out as soon as the meeting pot begins to boil, "How do you find time to hold honest-to-goodness discussion meetings without hurting your indexes?" "Index" is a familiar term to Bell System people. It is a measurement of how a job is being done.

Sometimes a dedicated discussion user has the answer . . . like the service foreman who uses all the regular packages and puts together some of his own. He answers, "I never go beyond two weeks without a meeting . . ."

At that point doubters jump him before he can continue and say, "What about your indexes?"

"Haven't missed an index since we began holding meetings," he replies.

Skeptics who check his statement find out he does what he says . . . that he and his crew are out in front when results are posted. This earnest backer of two-way meetings has made converts out of quite a few doubters.

Or in other sessions where the question of time and indexes is raised, there are users like the three chief operators whose offices are among the top performers . . . they tell how, faced by indexes and associated personnel problems, it was decided to try anything . . . even "time consuming" discussion meetings.

"How do you do it? How do you schedule your girls?" they are asked.

"Usually, we schedule three additional girls at the board and relieve five to attend the discussion session."

"Uh-huh," say the pencil experts, "And down goes your daily load and up go your slow answers."

"Of course the load for that day goes down, but our answers are every bit as good. The girls are so interested in going to the meeting they all pitch in and work a little harder so that everybody can attend. Then, as their knowledge about the business grows, they develop a continuing desire to see that the goals are reached. When the end of the month rolls around, our over-all load is up and going higher . . . more important, the girls realize they are a part of the telephone business."

■ Not all of the supervisory meetings have a dyed-in-the-wool believer who has discovered the value of two-way communications. This gives the Northwestern Bell discussion people a chance to ask the supervisors if they have heard about the Sioux City-Davenport, Iowa, experiment.

A "no" is the tip-off to review how the company conducted a two-city study to measure the results of a series of 14 weekly discussion meetings; how "before" and "after" surveys showed evidence of better customer and employee knowledge and feelings, plus eye-opening performance gains by 40 installers in the "discussion" city while the "non-discussion" city actually lost ground in the same areas.

In nearly every meeting an "aginer" will pop up and announce, "That's all well and good, but I know a boss (probably himself) who holds every one of these meetings and he's got more troubles than he knows what to do with."

How We Developed Our Discussion Program

The "aginer" could be cut down to size if the discussion leader asked pointed questions such as:

- "Does this boss hold discussion or telling sessions?"
- "What other two-way meetings does he hold?"
- "Does he run the meeting, occupy center stage, take the bows?"

These pointed questions are never asked. Someone in the group always turns the spotlight on the problem and asks the same questions in a nicer way. In the ensuing discussion the group not only reprimands the "aginer" but the people who state the case for the affirmative usually reinforce their own convictions.

Then there is the "sharpie" who tosses a monkey-wrench into the machinery . . . so he thinks. "Is it really necessary to use these discussion packages to build good two-way communications? Can't it be done just as well some other way?" he asks knowingly.

There is a quick answer which startles the wrench tosser. The answer, "There certainly is!"

And then the discussion team adds, "Anytime a supervisor is willing to put together his own discussion meeting dealing with things closer to home, we invite him to toss the regular package out the window. After all, this is the real purpose of the program—discussing matters that are meaningful to local people."

The Discussion Group can say this with absolute honesty. Their general interest topics are written mainly to encourage regular get-togethers and to provide a sort of training ground where people can practice the art of communication. And they know if a first-line supervisor recognizes the need for two-way discussions and prepares his own, he welcomes and uses the bi-monthly packages.

■ Perhaps the supervisors who get the most sympathy are believers who just can't seem to find ways to get the job done.

One, whom we'll call Mike, was this sort. He sat in one of the supervisory sessions, agreeing wholeheartedly that two-way discussions were important. He wanted to hold them. But he didn't have a meeting room—at least not one that was suitable.

It seems he and his installers occupied a room adjacent to a storeroom . . . which in turn was often occupied by a construction crew. When Mike scheduled his discussion meetings the luck of the Irish was seldom on his side. Instead, he often found a construction crew on the other side of a very, very thin plywood partition. Thus, when Mike asked a question of his group, he sometimes got answers from the other side of the partition which contained earthy comments—completely innocent—that added little to a thoughtful discussion.

Mike explained his dilemma to the supervisors and asked, "What can I do for a meeting room? The boss says to try to get along as best I can, but I'm getting gun shy. I flinch every time I think about holding a discussion meeting."

■ The supervisors had some suggestions. One said, "Hire a motel room and send the bill to your boss. You'll get action."

The real solution was offered by a quiet individual who wondered, "Why don't you hold joint meetings with the construction crew? You and the crew foreman could take turns leading the meetings."

This Solomon-like proposal has also been used to solve a problem that bothers managers who have only a couple of people reporting to them, as well as other supervisors, who can't take more than one or two off the job at the same time.

Supervisors who have used this mixing and sharing approach say it not only helps solve the number problem but often results in better understanding . . . smooths ruffled feathers . . . it can help change a strictly departmental sales effort or index goal into an all-exchange objective.

The only warning discussion people offer them is, *"Be sure you don't sign away your share of the two-way pipeline . . . it is one of your valuable management assets."*

■ There is a problem that is common to nearly every force group. It's the "hard nose." He (they are generally male) comes in all sizes and grades of orneriness. He has one common goal . . . shoot the discussion or its leader full of holes.

"What do I do with him?" supervisors ask the discussion team.

The situation is so common that nearly all supervisors have experiences to share. Once in a while there is a boss who has stumbled onto the perfect answer. One of these lucky ones related his experience in these words:

"I've got Fred on my crew. Every time he gets a chance, he takes me on. I was sort of scared to tackle him, but finally I decided it was either he or I."

"I remember I asked a question—something about working conditions, as I recall. He began to blast. I took a deep breath and was about to offer him a choice of shutting up or getting out when one of the other guys turned on him and let him have both barrels. About that time, the whole crew joined in and he hasn't been mouthy since. In fact, I think Fred is really trying to make up to the crew and get back on the team."

■ Some supervisors have trouble conducting a good discussion meeting in spite of the fact they have had training in leading group meetings. They remember "the tricks of the trade" but they don't feel comfortable up in front, unless they have a set of charts, a pointer in their hand and are lecturing the group on the facts of life.

It seems a lot of people have forgotten the word, *listen*.

One service foreman who does listen explained his reason this way: . . . "I was born with two ears and one mouth so I figured I ought to use my ears about twice as much as my mouth."

Of course, the Discussion Group assures

supervisors that a leader doesn't roll over and play dead. He has to keep a discussion on track . . . act as a moderator or referee, bring out both sides of a question. He also has to encourage fair play and, at appropriate spots, sum up the ideas of the group.

■ There is another important ingredient in a recipe for good two-way communications. Somebody has to do something about the group's problems, ideas and suggestions. This gives the hard-driving, take-charge boss a chance to show his stuff.

In spite of their discussion and sharing of experiences, supervisors often have trouble believing that they can lead a good discussion meeting just by studying the material beforehand, reading the remarks and questions from the Leader's Guide and listening . . . listening . . . listening.

"What do you do when the group discusses a subject and comes up with the wrong conclusion?" asks the true-blue company man.

About the only sensible answer is a couple more questions:

- Would a "father and son lecture" cause the group to do an about face?
- Aren't most telephone people intelligent and reasonable . . . given the entire picture, aren't their opinions and judgment apt to be right?
- Isn't it possible, with more facts direct from the scene, a company decision can be changed?

■ As one of these supervisory discussion sessions draws to a close there is an air of eagerness among the participants to get back on the job and start holding better meetings. For a moment it seems that all have seen the light . . . and then when the next batch of meeting reports roll in from the field, stern reality takes over.

- There's a report from a man who got carried away and called his force together and held three meetings, on three different subjects, one after the other.
- There's another report with a written-in comment praising the material and mentioning that it was helpful in pepping up a combined sales, safety and discussion session.
- Or the saddest of all, the eager beaver intent on getting "the job done." His report shows he called 40 people together and raced through the guide in half an hour.

When these things happen the Discussion Group asks, "How do we get awareness that three helpings are too many—or that when you clean out the icebox, it's usually hash?"

Or most important of all, they ask, "How do we make it clear that these are discussion-*sharing* sessions and that the boss who sees them as merely something 'to get done' will probably never reap the benefits?"

■ In spite of this, stories of Northwestern Bell's successes have been widely told. Telephone people in other companies have heard bits and pieces of the story. Faced at home by a need for better two-way communications, they take hope and call on the group by phone and plane to hear the message.

As sometimes happens, the cures credited to the program have grown in the telling. Consequently, when inquiring visitors arrive, you often sense they expect to find a panacea . . . some sort of a miracle drug.

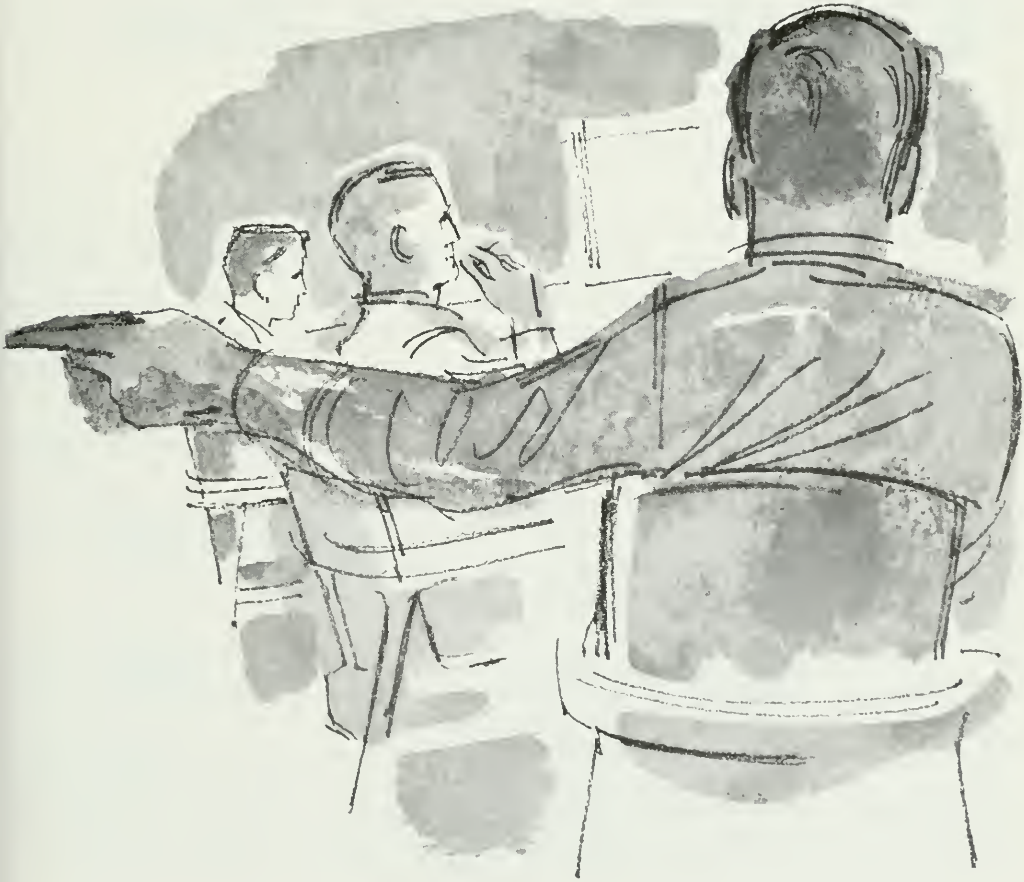
Later, when the whole story is told, the visitors are still waiting for their bottle of pills. "Where" they ask, "are the practices and specs on this program? Where are the black binders? Why, after all this time, isn't this thing firmed up?"

Northwestern Bell's Discussion Group replies quite honestly, "We're still looking and finding ways to increase usage . . . to make the reporting and administrative job easier and better. Most important of all, we're trying out new ways to develop better discussion leaders and with some success, too."

"That's fine," the visitors agree and then ask, "When will you have the answers ready for distribution?"

Again, the honest reply, "We probably never will. It will be a dull day when bosses run their 'people job' with an engineering slipstick."

"We think it's a lot more challenging and rewarding to be a participative kind of a boss—or for that matter, a missionary—whose associates are well informed, cut in on the problems; encouraged to take part, find solutions; given a chance to carry the ball and share the glory."



FORUM

A meeting place for ideas

What are the risks facing regulated utilities in general—and the Bell System in particular—and how do they compare with risks for non-regulated businesses? Here is an analysis of that question, taken from testimony given before the Federal Communications Commission

Comparative Risk

Dr. Burton A. Kolb, *Associate Professor of Finance University of Colorado*

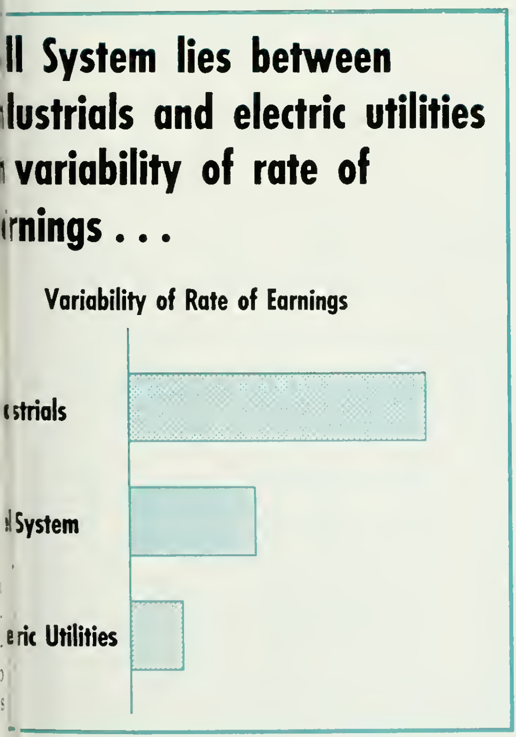
■ A GREAT DEAL has been written by economists over the years on the subject of comparative risks, and the discussion of the subject continues today to be as lively and concerned as at any time in the past. On one point there is complete agreement, I believe, among economists, which makes this notable in itself, namely that no two companies have precisely corresponding risks. Different industries, such as the retail grocery industry, the automobile manufacturing industry and the telephone industry, and different companies within an industry, bear different degrees of risk because, among other factors, of variations in their operating characteristics. My point is that the relative risks borne by different industries or companies may be recognized even though it is impossible to find two industries or two companies whose risks are precisely the same.

For some purposes, economists sometimes split the broad concept of risk into two categories: risk and uncertainty. Where this distinction is made, *risk* is considered in the narrow actuarial sense, as the probability of occurrence where the expected frequency distribution of occurrences among a population is known or predictable, and *uncertainty* is considered as the degree of ignorance about the probability distribution. Splitting the broad concept of risk into these two categories is unnecessary for our purposes, I believe. Therefore, as I discuss risk here, I shall always use it in the broad sense.

For the purposes at hand, it is sound to regard risk in the sense of the dictionary definition, namely "the possibility of loss, injury, disadvantage or destruction." Thus, risk to a company or an investor represents the possibility of loss, injury or destruction of capital values resulting primarily from loss, injury or destruction of earning power.

It is important to recognize that risk always relates to the future, not to the past or present. The record of the past only provides some basis for judgments relative to the future; the best that men can do is to act prudently in the present giving regard to what may reasonably be expected to be out there. This, of course, is where the judgment becomes necessary.

There is a popular notion that public utility businesses are less risky than those unregulated enterprises engaged in manufacturing, mining, distribution and services, which the financial analysts broadly group into the "industrials" category. This notion, I believe, rests largely upon a preoccupation with one aspect of business risk to the neglect of another aspect of equal or greater importance.



Two Kinds of Risk

I propose to discuss both of these aspects. The first relates to the risks which are the continuing, more or less accepted and well understood concomitants of the particular industry or type of business. These are the risks of immediate or near future impairment of earnings and are largely functions of the operating characteristics of the particular type of business. They exist within the context of only evolutionary changes in the economic, social and technological environment. These kinds of risks I shall refer to as short-term risks.

The second aspect of business risks relates to possibilities which are further off, less definite, not so generally recognized, but nevertheless involving grave possibilities for loss, injury or destruction of earning power and capital values. They comprehend the possibilities of sweeping, revolutionary changes in the economic, social and technological environment. These kinds of risks I shall characterize as long-term risks. As we go along, I think the distinction between these two kinds of risk will become more clear.

■ One feature of short-term business risk which perhaps may explain the preoccupation with it, is that the past evidence relating to it can be statistically analyzed and evaluated. The popularly accepted concept is that the relative risk of different industries or companies can be compared on the basis of the degree of fluctuation in their rate of earnings on invested capital in the past. This orthodox analysis, I believe, has considerable validity when properly made and when it is recognized that it pertains only to the short-term aspect of risk.

I have had an analysis made along these lines comparing the fluctuations in earnings for industrial companies, the Bell System and the electric power industry. This is shown in the illustration on the previous page.

Over the period 1929 through 1962, the average year-to-year fluctuation in the rate of earnings on total capital for the Bell System has been about half as great as for the industrials and about twice as great as for the electric power industry. Thus, to the extent that such fluctuations reflect short-term risk, it would seem reasonable to conclude that the short-term risk for the total investment in the Bell System lies about halfway between the greater short-term risk for industrials and the lesser short-term risk for the electric power industry.

After completing my study of industrials, the Bell System and electrics, I investigated the volatility of earnings of the gas industry. In searching the available data, I was unable to find statistics directly comparable to those used in my study of the other industries; for example, no comprehensive series relative to the gas industry appears to be available covering the pre-World War II period. However, I have studied data covering the post-war period relative to natural gas transmission and retail gas distribution. By comparing these to the data for industrials, the Bell System and the electrics covering the same period, I am satisfied that, from the standpoint of short-term variability of rate of earnings, both gas transmission and distribution fall between the Bell System and the electric power industries.

These results are not surprising. They are what one would expect, considering the difference in the basic operating characteristics of the three types of businesses, which I would like to describe briefly.

The Basic Differences

There are four fundamental relationships which reflect basic differences in operating characteristics for these three industries. These differences, in combination, largely account for the differences in earnings fluctuation. Later on, I will show why some of these differences also are important with respect to long-term risk.

The illustration on page 46 shows the order of differences in operating characteristics among industrials, the Bell System and the electric power industry. The data are representative of the period 1929-62.

■ The first two of these characteristics are (1) the average year-to-year change in dollar volume of sales (adjusted for growth) and, (2) the relative ability to control costs when changes occur in sales volume. The sales of the industrials have shown greater year-to-year fluctuation than those of the Bell System; which, in turn, have fluctuated more than those of the electrics.

A closely related characteristic is the degree of control over costs. If all costs were completely variable (or controllable), then a given percentage decline in sales would result in the same percentage decline in earnings. On the other hand, if all costs were fixed, then a given percentage decline in sales would reduce earnings by a multiple of that sales decline (that is, the effect would be magnified). No business that I know of has either completely variable costs or completely fixed costs. But it is well recognized that the control over costs in the typical industrial corporation is considerably greater than in a utility enterprise, either telephone or electric. The principal reasons for this are that a large proportion of an industrial firm's costs are for raw materials and direct labor which vary with volume of operations, while utilities, with their large investment in fixed plant, resulting in high fixed depreciation expenses and property taxes, and their high, largely fixed labor costs, can control a smaller proportion of their costs when volume of services changes.

The net result of these two differences in operating characteristics is that industrials, with the highest variability of sales, partially but not completely offset by their greater control of costs, still have the greatest fluctuation in earnings. As between the Bell System and the electric power industry, the Bell System's greater variability of sales results in greater fluctuation in earnings.

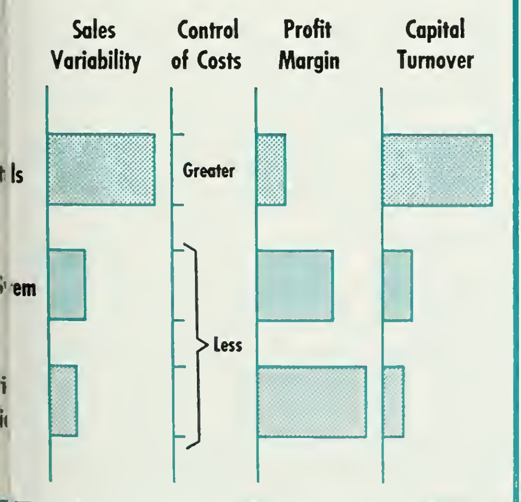
The other two characteristics which influence fluctuation in rate of earnings on invested capital are profit margin and capital turnover. Profit margin is the amount that is left from each dollar of sales after covering all operating costs and taxes. It is available to service all capital—debt as well as stockholders' equity. Thus, if operating costs and taxes take 92 cents of each sales dollar, leaving eight cents to service capital, the profit margin is eight per cent.

Capital turnover is the relationship between the annual sales volume and the capital investment employed. Thus, if a company employing $1,000,000 invested capital realizes sales of $1,500,000 per year, the capital turnover is 1½ times.

Together, these two ratios produce the rate of earnings on total capital. For example, profit margin of eight per cent and a capital turnover of 1½ times results in an annual rate of earnings of 12 per cent on capital. Likewise, a profit margin of 30 per cent and a capital turnover of 4/10 times (or once every 2½ years) also results in a rate of earnings of 12 per cent on capital.

The lower the profit margin and the higher the capital turnover, other things being equal, the greater the change in rate of earnings on capital that will result from a given change in sales volume.

System lies between industrials electric utilities for major icteristics affecting variability ite of earnings . . .



A typical industrial corporation operates on a low profit margin and a high capital turnover. Just the opposite, it is characteristic of the electric power industry to have a much higher profit margin and a much lower capital turnover. It is also characteristic for the Bell System to fall between the electrics and the industrials with respect to both of these ratios, as the chart indicates.

Thus, the industrial corporation, with greater fluctuation in sales volume, not completely offset by greater control of costs, operating on a lower profit margin and having a higher capital turnover, experiences greater fluctuation in its rate of earnings on invested capital than the utilities. Comparing the Bell System with the electric power industry, Bell, with greater sales fluctuation not offset by control of costs, a lower profit margin and a higher capital turnover, experiences greater fluctuation in its rate of earnings on invested capital.

But, having stated this, I want to emphasize two points, because misunderstanding or failure to recognize these points has been responsible for much confusion and many erroneous conclusions from comparative risk analysis.

First, this statement of the relative risks for industrials, Bell System and electrics pertains only to what I have defined as short-term risk and does not reveal the total risk, which encompasses both short and long term aspects.

Second, this relationship between the short-term risk for industrials, Bell System and electrics applies to the short-term risk attaching to the total invested capital and not to the risk borne by the equity investor. The differences in short-term business risks among manufacturing, telephone and electric utility enterprises are reflected in an approximate fashion by differences in capital structures. Financial risks are superimposed upon the operating risks. As a consequence of low debt ratios among manufacturers, moderate debt ratios in the telephone industry and high debt ratios in the electrics, the risk to the equity investor tends to be equalized.

Changing Technology

Now I would like to turn to another aspect of business risk which is always present and which I have called long-term risk. I am convinced that the key long-term risk for a company in either the industrial or public utility field lies in major or revolutionary technological change which may seriously affect the market for its products or services. I do not mean that the risk lies in the chance that major technological change will take place; such change appears to be inevitable, as documented by all modern economic history. Rather the risk—the possibility of loss, injury or destruction of earning power—lies in the ability or failure of the enterprise to adjust to such technological change.

As almost everyone realizes, the pace of technological development is today more rapid than in all the past history of civilization and the pace appears more likely to further accelerate than to diminish. We may, I think, take the amount of resources devoted to research and development as a rough indicator of the rate of technological change to be expected. According to the National Industrial Conference Board and the National Science Foundation, expenditures for research and development in the United States increased from about $\$1/2$ billion in 1940 to about \$15 billion in 1962 (a 30-fold increase). The number of research and development personnel is estimated to have increased during the same period from 120,000 to 1,000,000 (a more than eight-fold increase).

Now, in order to analyze long-term risk, we must remember that whereas short-term risk analysis takes place in the context of the existing technology with only evolutionary changes, long-term risk analysis must be made with the expectation of major and revolutionary technological progress.

■ From the standpoint of long-term risk, *the possibility of difficulty or failure to adjust to major technological change*, it seems clear to me that the risks for public utilities as a group are fully as great as, if not greater than, those for industrial companies. This is so for several reasons.

First, the inherently different operating characteristics of a utility company, which seem to diminish its short-term risk, put it at a serious disadvantage as compared to an industrial company when faced with a major technological change affecting the market for its products or services. As we have seen, a much higher proportion of utility costs are fixed costs. If a drop in demand occurs, as a result of a new technology introduced by others, the industrial company can more readily adjust its costs to the change in sales volume but the utility company must bear the burden of having a large part of the costs continue. Neither its area franchise nor regulatory sanction to increase rates is of much avail; when the city bus system or the commuter railroad line increases fares, it may lose so many passengers that its revenues are decreased (rather than increased, as hoped).

Likewise the very heavy capital investment of utilities in relation to revenues is a serious handicap. Not only is the investment large but also it is in property which is long-lived and specialized as to use. The industrial company has a high capital turnover and its assets are of a more versatile character. Summing up, when a major technological change occurs, producing a change in demand, the utility company, by the nature of the enterprise, is in a more frozen position than the relatively flexible and liquid industrial company and finds it much more difficult to shift its capital and adapt its operations to the change in its market environment.

Second, the inherently greater operating flexibility of industrial companies is enhanced by their relative freedom of exit from markets and entry into markets. Utility companies, because of regulatory requirements and because of the nature of their business, have very limited opportunity to withdraw from furnishing declining services and to enter into new markets. Well-managed industrial companies can and do adjust to technological change by shifting the use of their capital from receding markets to rising markets.

A few examples:

- DuPont started in 1802 as a manufacturer of explosives; it now requires a directory in its annual report to list over 130 *lines* of products produced.
- ACF Industries (formerly American Car and Foundry) was a maker of railway equipment. As this market receded, it diversified and today a few of its products are electronic aircraft and missile simulators, valves, automobile carburetors and radar beacons. As late as 1949, railway equipment sales accounted for 80 per cent of this company's total sales, but by 1955 an almost complete reversal of product mix had been accomplished, with railway equipment sales accounting for only 29 per cent of revenues and the other lines, 71 per cent.
- FMC (formerly Food Machinery Corporation) in the past was solely a manufacturer of canning and other food processing machinery. In 1962, all machinery accounted for 32.9 per cent of its sales, while chemicals accounted for 36.8 per cent and defense contracts, 30.3 per cent (these figures do not reflect the recent purchase of American Viscose).
- Buick, now a part of General Motors, started as a bathtub manufacturer.
- Pittsburgh Plate Glass makes everything from paint to a rather broad line of chemicals including fertilizer.

The managements of industrial companies are alert to technological changes and the shareowners of the companies expect them to be. The industrial company faces both evolutionary and revolutionary changes in its markets resulting from the interplay of competitive forces including technological changes. The preservation of the company's earning power is a function of the ability of the company's management to perceive these changes and to adjust to them.

Because there may be some who feel that no new technological development could possibly arise to threaten our great electric, telephone and other utility industries, let me briefly review some past history. And please keep in mind I am covering a period when science was advancing much more slowly than at the rapid pace of today.

FORUM

A Lesson of History

In the early history of the United States, the great public utility industries were the canals and turnpikes. The canals represented large investments. The turnpike companies were small but very numerous; in Ohio alone 852 turnpike companies were incorporated between 1803 and 1870. Both canals and turnpikes were displaced by the public highways and the railroads.

As the railroads were built across the country, they virtually bankrupted every means of transportation that stood in their way. For many years thereafter, the railroads were imbued with the same favorable characteristics of area (or route) franchise and strong customer demand that apply to the telephone, electric and gas pipeline companies today. But the automobile and the motor truck spelled such serious trouble for the railroads that by 1938, about one-third of the Class I railroad trackage in the United States was in receivership. Even after the elimination of billions of dollars in security values by reorganization, many of these railroads have never fully recovered.

Look at the field of urban transportation. In the early 1800's omnibuses, horse-drawn vehicles pulled over the cobbled streets, dominated this field. They were put out of business by the horse-car lines which came into existence in 1830. By 1890 there were over 5,600 miles of horse-car trackage operating in our cities. This industry was, in turn, made obsolete almost overnight by the electric street railway. In the decade of the 1890's, horse-car trackage in operation dropped from 5,600 miles to about 400 miles while electric street railway trackage reached 45,000 miles. Then the automobile and motorbus took over and forced the demise of the electric street railway. Between 1915 and 1931, 308 electric street railway companies with $1¾ billions of capitalization were forced into receivership.

This incursion into history could go on to cover stagecoaches, wagon freight lines, river steamers, ferryboats and interurban electric railways. Each case would tell much the same story of technological innovation and relative inability of the utility company to adapt to it.

Now, of course, with hindsight we can readily perceive that these technological changes were inevitable and that the companies made obsolete should have taken prudent steps to adjust to them. We could also hold the comforting view that our present day utilities are different and that no such major technological change can arise to threaten their survival. But at the time that these now defunct utilities were prosperous and even when the developments which were to make them obsolete were practically upon them, their future was regarded with the same comfort that is now so widely, and I believe, erroneously, felt for our utility industries of today.

In 1829 the proprietors of the Middlesex Canal stated that, "No safer nor cheaper mode of conveyance can ever be established nor any so well adapted for carrying bulky and heavy articles,"—a very faulty assurance as the construction of a railroad line parallel to the canal only seven years later demonstrated.

During the heyday of the railroads, when industrial securities were generally considered to be speculative, railroad securities along with government bonds were felt to be about the only securities worthy of the title "investments." The security markets at the time were accepting railroad bonds with maturities 500 and 600 years distant (and one issue maturing in 1,000 years) as if the development of competing transportation which would take away a great segment of the railroads' traffic were unthinkable.

In 1927 and 1931, when one would expect it to be evident that the passenger automobile and the bus had doomed electric street railways in the large cities, authorities like Martin Glaeser and Jones and Bigham were writing in textbooks on public utilities that, "In such [referring to large] cities the electric railway bids fair to continue as the popular agency of mass transportation" and "The popularity of the motor bus had led some to conclude that busses will supplant street railways. But there seems no warrant for this conclusion."

■ The gas industry may be cited as an exception in that it has survived almost a century and a half since its beginning in 1817. Actually, the gas industry has twice been threatened and only narrowly escaped extinction by new competitors. The first time was in the 1880's and 90's when, losing to the new electric industry its then market, lighting, two developments in the industry—the process developed by Lowe for manufacturing water gas and the invention of an efficient gas burner—made possible the development of a new market for gas as a fuel for cooking and heating. The second time was in the 1940's and 50's when, just as it appeared it could no longer compete with electricity and fuel oil for cooking and heating purposes, the development of long distance welded natural gas pipelines made possible the widespread distribution of a more efficient and economical fuel.

No one can foretell what new technological discovery, just over the horizon, may threaten grave possibility of economic loss to our present utilities such as the telephone and electric companies. The record of the past does demonstrate that this long-term risk exists.

To restate my conclusion as to long-term risk, I believe that the long-term risk for utilities is fully as great as for industrial companies, if not greater, for the reason that utilities are subject, like industrial companies, to technological change but can less readily adjust to it, because of their large and specialized fixed assets, high fixed costs and limited entry to and exit from markets.

Some Conclusions

Now, having described the various factors which enter into an evaluation of Bell System risk, I can summarize these and state my conclusions. The short-term business risk to which the total capital of the Bell System is exposed is somewhat less than for the industrials and somewhat more than for electric utilities. These differences are reflected in an approximate way through capital structure differences so that the risk to the equity owners is roughly equivalent for the three types of business. The Bell System and other utility long-term risk is at least as high, if not higher, than for non-regulated businesses. Considering all of these factors, it is my opinion that the over-all risk on the investment in A.T.&T. stock is of the same general order of magnitude as the risk on the investment in the equities of well-managed, non-regulated companies generally.

■ Although this completes my evaluation of Bell System risk, I would like to offer some suggestions on strengthening the ability of public utilities, such as the telephone industry, to adjust to technological change.

Adjustment to technological change is the responsibility of management and a test of management. In fact, the really superior management, while alert and resourceful in adapting to new developments outside, is striving more to produce the innovations and developments itself and leave to others the necessity to adjust to them.

In a publicly regulated business such as the telephone business, there is an additional responsibility on management and, I submit, a responsibility which falls on the regulating authorities also. Management must be forward looking and imaginative in continuously planning for the future and flexible in adjusting to situations which develop differently than foreseen, but it must also be articulate in its relations with regulatory authorities, keeping them informed and securing their assent to management objectives where these objectives require regulatory approval and are reasonable. Regulatory authorities, too, can help by encouraging good management and also by maintaining a constructive viewpoint toward making utility companies more adaptable to change.

The things I have in mind as the responsibility of management to do and of regulation to encourage are such matters as: large-scale research and development activities to improve the chances that the company will provide its own technological advances as a basis for coping with risk; adequate provision for technological obsolescence in depreciation charges to protect against capital losses; good earnings both to attract new management personnel of high calibre and to maintain the ability to raise new capital; a debt ratio which provides an adequate reserve of borrowing power to meet all contingencies; a policy of curtailing those services with declining demands and developing and stimulating new services with expanding demands, and a system of pricing which is market-oriented.

These are the practices of those well-managed industrial companies which have demonstrated ability to adjust to the problems of technological and market change. The utility businesses which follow these practices, with the encouragement or insistence of regulatory authorities, should likewise stand in a strong position to cope with the changing situations they will inevitably encounter.

Dr. Burton A. Kolb is particularly qualified to testify before the Federal Communications Commission on comparative risk, and to write on the subject in these pages, for he has done extensive research on the theory of business risk and comparison of risk in industrial vs. public utility enterprises. Since 1956 he has been a member of the faculty at the University of Colorado, School of Business; for the academic year 1964-65, he is Visiting Professor of Finance in the Graduate School of Business Administration at Michigan State University.

Off-campus, he has worked as credit man for the National Bank of Detroit, as economist for Gerber Products Company, and as economic and financial consultant to various public utility and industrial companies. He has served on the faculties of several executive development programs, and has participated in faculty seminars on new developments in business administration at the University of California and on the economics of regulated public utilities at the University of Chicago. He is a member of the American Finance Association and was this year a moderator of a panel discussion at the annual conference of the Great Lakes Association of Railroad and Utility Commissioners.

Plastics in many forms are of increasing importance to the Bell System. We not only use them in vast quantities but are continually finding new ways to use them. Here is an informal account of some of the development work Bell Laboratories has contributed to this field

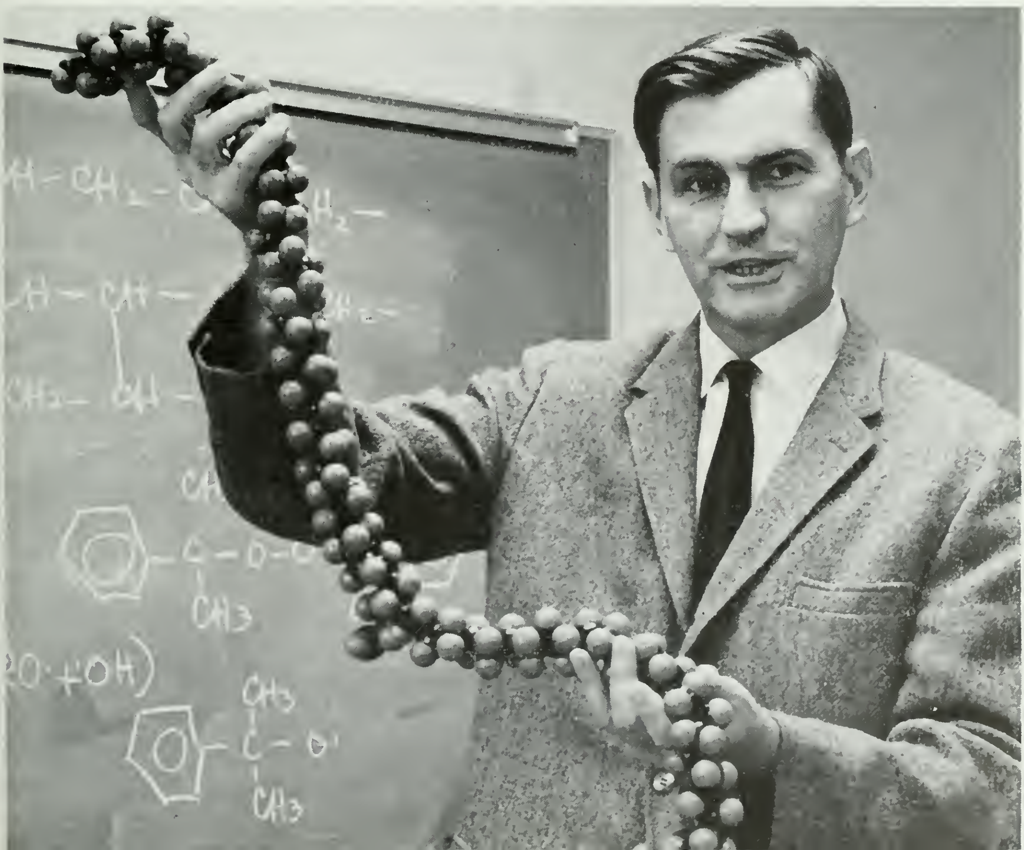
POLYMERS

Dr. Field H. Winslow, *Head, Polymer Research and Development Department, Bell Telephone Laboratories*

A FEW YEARS AGO, the research director of a large company made the prediction that before long the communications industries would be using a greater volume of organic materials—plastics—than steel and copper. Perhaps we haven't quite reached that point as yet, but it's certainly true that the Bell System uses huge quantities of plastics, and almost daily is finding new uses for more.

We carry on a lot of work in developing new plastic compositions to get greater reliability—and reliability is one of the key words by which we at the Laboratories live. Take polyethylene for example: our annual expenditure for it is larger than that for any other material except copper and steel. We use almost as much of another plastic, polyvinyl chloride. These polymers are relatively new materials, man-made, dating from the 1930's. We use them primarily for wire and cable insulation. In addition to these we use smaller quantities of many other plastics. The shell of your telephone handset, for example, is made

"This is a three-dimensional representation of what appears in chemical shorthand on the blackboard behind me: a very small chain segment of cross-linked polyethylene."



of a plastic that was developed in the 1950's. We'll talk more about that a little later. And inside the handset there are about a dozen different types of plastics.

Besides plastics, we use millions of pounds of rubber per year, and, in addition to this, many other polymers in the form of paints, textiles, adhesives and things of that sort, all of which are related to plastics and all of which we use in very large quantities. Many of these organic materials, at least in the forms in which we use them, have been developed since World War II.

Polyethylene, as I mentioned, was discovered in the 1930's. Actually, it was discovered twice by the same group in England—the first time quite by accident, due to defective equipment. The reason for this was that the concepts of polymer science were just beginning to develop in those days, and at the time of the first discovery the people who made it weren't fully aware of the potential of plastics. And in addition to that, of course, they had experimental difficulties: they weren't able to reproduce their work. So, the British went back and repeated their work with a larger task force, and in December, 1935, they found that their original discovery in 1933 was based on the fact that a little oxygen was contaminating the reactants and that this had acted as a catalyst. It triggered the linking-up of ethylene molecules to form a giant polyethylene molecule.

We heard about the success of the British scientists in the late 1930's, and A. R. Kemp of our research staff was able to bring back a very small sample, a matter of a few grams. Later we were able to get enough of the material to actually use it as spacers between conductors in a coaxial cable between New York and Washington, D.C. in 1942. But we weren't able to get large enough quantities for any extensive System-wide use until after World War II. At the time it was discovered, its value in high-frequency radio and radar applications was recognized immediately, and all the available supply was diverted into the war effort.

But in the early 1940's we were able to get enough material to find that it had a built-in weakness, which was somewhat surprising because polyethlyene belongs to a class of materials called paraffins. The name means "little affinity," implying that the materials are chemically unreactive. It turns out, however, that if you put them outdoors these materials very soon become weak. The reason for this is that exposure to the elements changes the size of the molecules.

The strength of the polymer molecules depends primarily upon their size and shape. Polyethylene molecules consists of very long threadlike chains of carbon atoms sheathed in hydrogen, and they are large in terms of molecular dimensions. The fully-extended polyethylene molecule probably wouldn't be longer than, let us say, the diameter of a human hair—but this is still very large in terms of molecular sizes. However, if you were to break this molecule up into smaller and smaller pieces, you would eventually get down to the size of a molecule of paraffin wax. This is very much like polyethylene in many respects except that it is mechanically weak. The difference between paraffin wax and polyethylene is the difference in molecular size.

Finding an 'Umbrella'

If you put polyethylene outdoors it is capable of absorbing energy from light and heat, and in its energy-rich state it will combine with oxygen in the air. The oxygen molecules act like a pair of molecular scissors and will cut the polyethylene molecules up into small pieces until they begin to approach the size of those of paraffin wax. So we immediately realized, and the British did about the same time, that we had to protect this polymer.

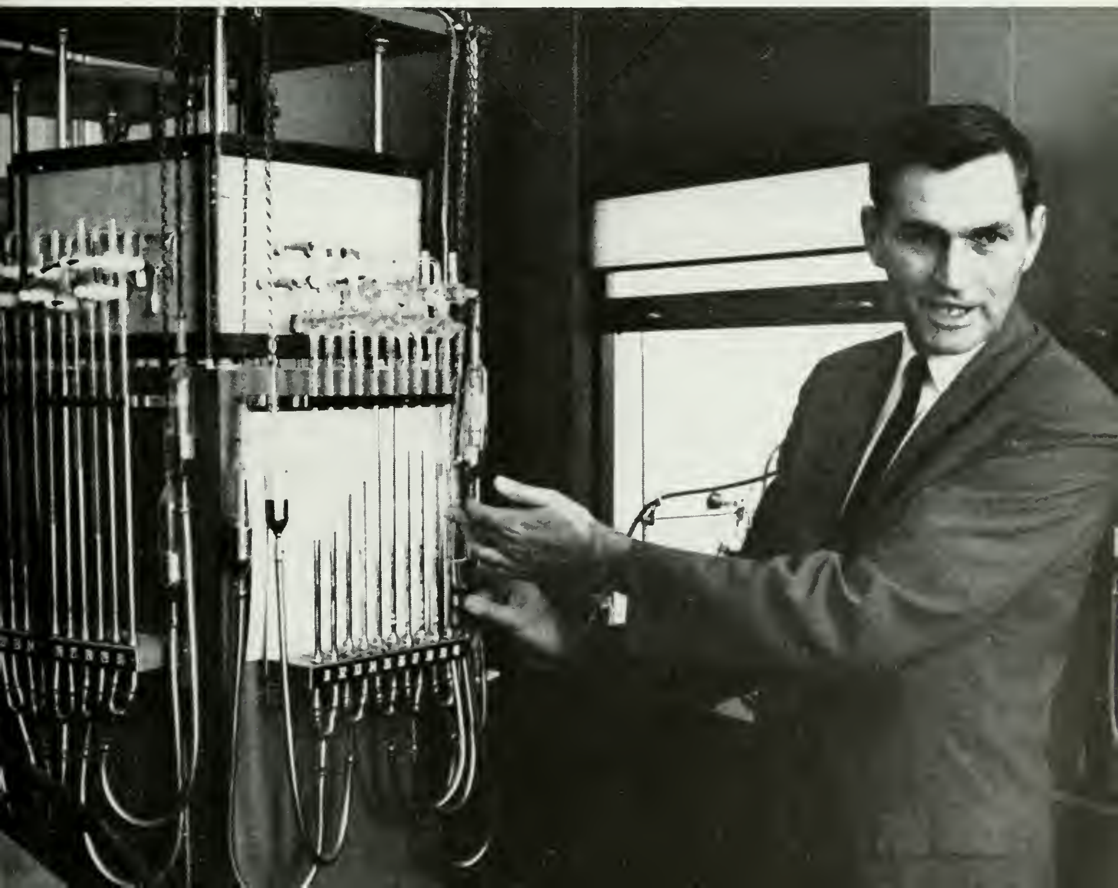
We found that there are two ways of protecting it. One was to shield the polymer from sunlight, and the most convenient "umbrella" was a low-cost material called carbon black, which is used for making such things as rubber tires. Carbon black in concentrations of about 2½ per cent is a very efficient light screen.

In addition to screening out light, we must stop the thermal reaction, and this, we found, is a chain reaction, very much like a game of tag. Examples of a chain reaction are the fire that burns in your automobile engine or the fission process that takes place when an atomic bomb explodes. What happens is that—at least in the case of polyethylene—the molecules absorb energy and react with oxygen, energy released from that reaction is passed on to another molecule which reacts with more oxygen, and so on.

To stop the reaction, since it might go on for thousands of steps, we add a material which behaves as though it were an energy sponge. Such materials are called antioxidants. We need only about one part in a thousand of antioxidants in the polyethylene to protect it. But, once we protect it properly with an antioxidant system and a light shield, this polymer will last at least 20 years outdoors. Unprotected it wouldn't last more than one season. What is perhaps the oldest sample in the world of protected polyethylene continuously exposed to the weather is still giving a good account of itself after twenty-three and-a-half years at our Florida outdoor exposure site.

I would like to digress here to point out that at the time this development was made, plastics in general had a rather bad name, because in the early days they were used as low cost substitutes without very adequate testing. As a consequence, they usually cracked and failed and acquired the reputation of being cheap, "ersatz" materials. We were well aware of these problems, however, in the 1940's,

"We designed and built this apparatus to make accelerated thermal oxidation tests on polymer samples. We can evaluate, in a fairly short time, the effectiveness of various antioxidants."



and one reason why we spent so much time on developing ways of protecting plastics was that Bell System interest in the durability of materials is considerably greater than that in practically any other industry.

It all stems back to what I said in the beginning about reliability. For example, typical specifications for our cables call for a service life of from 20 to 40 years in all kinds of environments, and there are a good many lead sheathed cables that have been in service for a lot more than 40 years.

Polyethylene vs. Lead

In 1946, when polyethylene became available commercially, we felt that we were prepared to go ahead with what we then saw as its primary use: in cable sheathing. At first we intended, in the manufacturing process, to replace the lead which had been widely used as a cable sheath. Lead, along with many other metals, was in short supply at that time, and we could see that shortage still ahead for some years in the future. Polyethylene had several obvious advantages: it was available in large quantities at a very low cost, it was light in weight, moisture-resistant, and easily formed into cable sheath.

As I've said, we had tackled the problem of protection, and we found that even after it had been outdoors for five or six years we could stretch a strip of protected material to about six times its original length. We were fairly sure that, mechanically, it would stand up. But we were unaware of a serious problem. Soon after we sent it out into the field to be tested as cable sheath material, we got cracked cables back. I would say parenthetically that this proves that the best test for any Bell System equipment is actual field use.

It turned out that there were really two things wrong. One was that just stretching the material longitudinally was not enough of a test. It is quite strong in that respect, but if the molecular size distribution is not quite right, the material may fail at a very low stretching point in a multiaxial test—like the two-way stretch advertised for ladies' girdles. If you tried to put the cable down into a duct you'd bend it, and at the same time you might also twist it. A combination of the bending and twisting could cause failure in the sheath, particularly at low temperatures.

Then there was a second source of trouble. In the old days, the men who installed cable in ducts used soap to lubricate the lead sheath as it was drawn into the duct opening. A soap solution was also a good way of detecting leaks in a pressurized cable. But when they tried soap on polyethylene sheath the material cracked right and left. It seems that, under stress, the agents most active in causing polyethylene to crack are surface-active agents: detergents and soaps. The obvious answer, of course, is to avoid such agents.

The problems of regulating molecular size and of finding proper lubricants for the sheath where necessary were solved at the Laboratories in a very short time. They had to be: there was a lot of money involved. We still have some cracking in polyethylene sheaths and we're still trying to find ways to avoid it; *all* of our problems are not yet solved. But, in the main, the problems were recognized and dealt with in those early days.

Polypropylene

We are also interested in another polymer called polypropylene, which is closely related to polyethylene. Both are made of molecular units which differ only in that polypropylene consists of three carbon atoms in each of the building blocks whereas polyethylene consists of ethylene units of only two carbon atoms each. When polypropylene is polymerized, only two of the three carbon atoms are used in forming the main chain, while the third carbon atom sticks up off the

"This tensile test machine, capable of a 30,000-pound pull, is used to test tensile strength of plastic samples; this one being measured by Mrs. Shirley Stills is known as a polycarbonate."

chain. This third atom can be arranged along this chain in two different forms: either a right-handed or a left-handed form. It makes all the difference in the world whether these are all uniform along the chain: that is, all right- or all left-handed, or whether they are randomly arranged in right- and left-handed combinations. If they are randomly arranged, you have a rubber, but if they are uniformly arranged, you have a hard, high-melting plastic.

We're using this hard, high-melting plastic now in the Bell System for many purposes—as a tape inside of cables, for example. At present we are trying it out as a handset material because it's hard and durable, light in weight and low in cost. It is really a highly-branched polyethylene, a new relative of polyethylene that didn't get into commercial production until the late 1950's.

A Terpolymer

Even more recently, another polymer called a terpolymer has appeared on the market. (*Terpolymer* means that it is made up of three different building blocks: ethylene, propylene and an unsaturated compound such as is used in making rubber.) It is in a rubbery form which we think we can use in the Bell System for linemen's blankets or ready-access terminal boots for cables.

The reason for our interest is that it has all the chemical resistance to aging (oxidation) that polyethylene has, but it is still a rubber. In other words, we have a polyethylene rubber that can be vulcanized by the usual processes. It will apparently last almost forever, will be light and flexible at low temperatures and will be low in cost. It is actually lighter in weight than natural rubber. Among many other things, it should certainly be great for things like garden hoses.

You can see that this whole field of polymer chemistry, or at least the polyethylene branch of it, is expanding very rapidly and the Bell System has a big stake in it.

■ There are many other plastics that are very important to us. I mentioned polyvinyl chloride earlier. It's simply polyethylene with a chlorine atom on every second carbon atom in place of a hydrogen. This chlorine atom makes it quite highly flame-resistant; we use it inside buildings for that reason. Besides, polyvinyl chloride is rather low in cost and is fairly easy to fabricate—and ease of fabrication is of great importance in the ultimate cost of any materials.

We use another chlorinated polymer—which is a rubber—for sheathing our drop wire. This is neoprene, actually one of the first man-made polymers discovered. It is still used in very large quantities because it has an interesting combination of properties, among which is its resistance to flame. That's why we use it on drop wire. Also, it is about the only rubber known up until this time that is fairly low in cost and still has excellent resistance to abrasion and to ozone cracking.

In addition to neoprene, we use other kinds of modified rubbers in the Bell System; one of the best examples is the telephone handset. The material of that familiar item is normally thought to be a plastic, and in all its properties it *is* a plastic, but a telephone handset has to be "babyproof." In other words, it has to bounce if dropped—or thrown—on the floor. I mean, it must not shatter at the first impact—or at the hundredth. This is the reason why we have to use special materials in the handset. It has to last a long time (at least, that's our aim), and it has to stand all sorts of abuse. That means that the materials we use in it have to be pretty tough. At the same time, they have to be attractive and low in cost. They have to be scratch- and stain-resistant.

The telephone handset plastic actually is made starting with a rubber of the type used in automobile tires. It gives the toughness and flexibility we need. Onto this rubber backbone is grafted another polymer called polyacrylonitrile. It forms a tough, hard material that gives durability plus resistance to staining. So, we get the best properties of both these polymers by grafting one onto the backbone of the other. Inside the handset we have new types of plastics such as acetals, polyesters, nylons, etc.—and of course, on the outside, the feet of the telephone set are made of rubber to keep it from slipping.

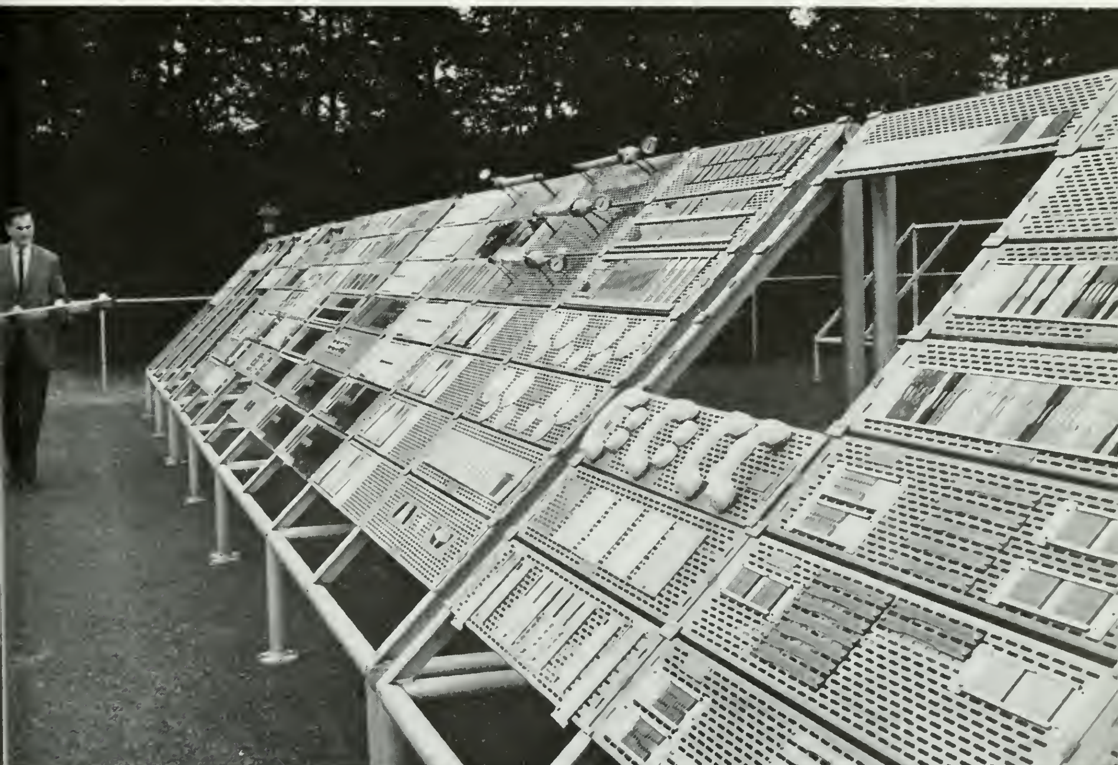
Exchange of Information

Part of our activities—often a large part—in the Research Department consists of keeping up with new developments in the plastic industry. A constant interchange of information on new discoveries and new techniques is necessary to all of us. Part of our job is to know personally the people engaged in polymer research and development throughout the industrial and academic fields and to keep those contacts alive.

This is a necessity that can't be satisfied by academic courses only. You really get this knowledge by working on the job—by apprenticeship. We must know what people in other laboratories are working on. We can't do all the work we need here in our Research Department. Our interests are primarily, of course, in making materials last longer, as I mentioned earlier, or making them less expensive or modifying them in some way to make them suit our specific purpose.

We depend upon laboratories in industry and in universities all around the world for this knowledge; this is true of our people in development work as well as of those working along purely theoretical lines: we need "spouts," if I may call them that, of information. People here who have specialized in various fields of science keep up with the advances in these fields all over the world so that they can acquire information, digest it, decide whether it's of interest to us and useful to the Bell System. We visit these other places continuously to talk with their scientists working in polymer chemistry.

■ In a sense, we are accumulators of information as well as producers of it in the polymer chemistry field. As I've said, we not only communicate constantly with people in other laboratories around the world but also take active parts in scientific organizations. In the course of this give-and-take of information, we have contributed as well as learned, and all of us in the field, in the Bell System and outside, have profited from the free, uninhibited exchange of vital scientific knowledge.



"I've remarked that there's no substitute for field testing for any materials. Here we expose hundreds of samples of many kinds of plastics to all the rigors of weather."

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Changing Attitudes Toward College Communications

George E. Callahan, *Sales Project Manager, Marketing Department A.T.&T. Co*

■ PICTURE for a moment how you would be affected if your use of the telephone was sharply curtailed. Suppose there was only one telephone for every 30 people and you had to stand in line to use it. Suppose, too, that incoming calls to you frequently went astray because there was no one to answer or to bother writing out a slip. Add to this confusion the fact that it would frequently take over an hour of repeatedly dialing busy signals to get through to the tele-

Before college, young people often have easy access to the telephone as suggested above. After they enter college they frequently encounter the situation depicted at left.

Changing Attitudes

phone on which you could (sometimes) be reached.

If you can imagine such a situation, you've got a pretty good idea of the chaotic state of communications on all too many college campuses today.

Teen-agers in the last decade have come to rely heavily on the use of the telephone. Many high school youngsters now even have their own phones. The telephone has become a vital part of their life. Yet, as they enter college they often find themselves virtually in a communications vacuum. At a crucial time when fast, efficient communications can materially aid a student's study and social adjustment away from home, the telephone is almost inacessible.

Fortunately, however, the situation is improving on many campuses. As a result of a special program to encourage modern campus communications, begun three years ago (*BTM*, Winter 1961-62) by the Bell System, colleges and universities are changing their attitudes toward the role of the telephone.

In the past few years, rapidly increasing enrollments have caused many college administrators to realize that their communications services for students are not only antiquated and inadequate, but even a handicap to academic achievement. As a result, modernization of these services is receiving close attention on a growing number of campuses.

Several years ago a telephone in a student's dormitory room was a rarity. Today, over 150 colleges across the country have or are in the process of installing consolidated dial systems to serve the entire campus, including residence halls.

■ What is behind this changing attitude toward the role of the telephone in a student's life? Schools now providing dormitory room phones and other communications improvements have reported a firm conviction that telephones contribute to a student's academic efficiency. Today, schools and telephone companies share a confidence that today's college student is capable of using phone privileges maturely. And there's a strong desire by school administrators for planned rather than haphazard growth in communications facilities.

A primary reason has been the desire to eliminate the constant problems created by facilities which are inadequate. Where dormitory room phones are not provided, students waste valuable time walking to the nearest telephone and waiting in line to make their calls. Parents, friends and faculty, too, are often frustrated by the difficulty in reaching the student.

Most schools that have provided telephones in dormitory rooms have done so as part of an overall program to modernize campus communications. Manual switchboard systems have become inadequate to meet colleges' rapid expansion programs. Experience has shown that an automatic direct dial system can efficiently handle communications for a much greater number of phones without requiring additional operating personnel.

In general, colleges are finding the following benefits from student telephone service and improved campus communications systems:

- Increased productive time for their students.
- Faster, more efficient communications between students, faculty and administration.
- Gratitude and good will of the calling public and parents.
- Protection in case of emergencies.
- Facilities adequate to handle future growth and expansion.

The trend toward providing students with dormitory room telephone service has had its greatest impetus among state universities and colleges. State schools in 35 states have or are scheduled to have this service, including the University of Illinois, Indiana University, University of Alabama, Iowa State University, University of North Dakota, University of Wisconsin, Oklahoma State Univer-

Many colleges are discovering the important benefits of providing convenient telephone service for their students.

sity, Southern Mississippi University and the University of South Carolina. A growing number of private and church affiliated schools—for example, Tulane, Temple, Vanderbilt and Augustana—also have new campus communications systems with student phone service.

■ The experience of Colorado Woman's College is a typical example of how college communications are being transformed to meet today's changing needs. When this school found its campus and student body straining the capacity of its communications facilities, officials thought the solution inevitably would mean the addition of more switchboards and operators. However, following the Mountain States Telephone Company's analysis of the school's needs, a CENTREX telephone system was installed providing faster, more efficient service to faculty and administrators, and enabling students to have the benefits of direct dial telephones in every dormitory room.

"Since we have had the new CENTREX service installed just a year ago, we have enjoyed improved communications between members of our faculty, administrative offices and students," reported E. Dawson, president, Colorado Woman's College. "It has provided great convenience for faculty and students, avoiding irritating delays on both incoming and outgoing calls at the switchboard. The ease and facility of direct communication, as well as being more personal in nature, has given us great satisfaction."

■ Officials at Wittenberg University, Springfield, Ohio, installed telephones in dormitory rooms to improve overall campus communications and especially to provide the students with a convenience they were accustomed to at home.

Louis H. Fitch, the University's business manager, is enthusiastic about the communications system.

"While convenience has been the most important benefit realized," he says, "several by-products of the new installation —notably reduced staff maintenance requirements and decreased need for student help on the switchboard—have been of equal advantage. In addition, we are extremely happy because of what this means to our university development program. We can go ahead with our planned campus buildings with the assurance that present equipment will be sufficient to meet the telephone needs of the university."

■ Students at Eastern Montana College of Education voted unanimously for dormitory room telephones when asked if they would like this new service. A dial system of 70 administrative phones and 260 dormitory phones was put into operation on the Eastern Montana campus in Billings. According to the school's president, Dr. H. L. Steele, "The installation of a private telephone in each dormitory room on our campus has proved to be extremely popular with our students."

■ Communications problems and their eventual solution at Murray State College in Murray, Kentucky, offer another excellent example of a transition taking place on many college campuses today. The rapid growth and increasing complexity of the Murray State campus had multiplied the communications needs

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of both students and college personnel beyond the capacity of the school's existing telephone system. The situation had even reached a point where it became necessary to develop an elaborate special messenger service to help faculty and administrators keep in touch with the school's student body of over 3500.

■ Recognizing that these problems would increase with growth, Murray State officials and telephone company consultants made a detailed examination of the school's present and future communications needs. The result was a decision to install an entirely new communications system, serving administrative facilities, dormitory rooms and housing units. The Bell System's direct dial CENTREX service, handling 770 campus telephones, was put into operation in September, 1962.

Murray State's new telephone system enables students, faculty and administrators to dial their own campus calls as well as off-campus local and long distance calls. Each room in seven dorms, each apartment and all administrative offices have their own telephone and seven digit numbers. On-campus calls can be made quickly and directly by dialing the last four digits.

Direct inward and outward dialing to and from both student's and administrator's telephones is now possible, greatly reducing the work required of switchboard attendants. One operator, using a compact console switchboard, serves the entire CENTREX system, thereby affording prompt and courteous assistance when needed.

Students, faculty and administration have found the new system a vast improvement. According to Ralph H. Woods, president of Murray State, "Communications between departments on the campus, administrative offices and the students living in dormitories is very important. Our new direct dial telephone system has proved to be highly satisfactory from the standpoint of the students and the people who need to reach them."

■ To help administrators solve communications problems efficiently and economically, the telephone industry is devoting its experience to providing communications services to meet the special needs of both large and small educational institutions. In addition, the Bell Operating Companies are now making special communications consultants available to assist in the planning and servicing of adequate college communications facilities for today and tomorrow.

The educator of tomorrow will have the problem of *teaching* and *reaching* far more students than his colleague of today.

This means that the campus of the future must make much more effective use of expensive college facilities during more hours of the day and more weeks of the year than is possible at present.

Improved communications will be needed to meet the increased pressure. Let's see what the future may hold . . .

At present the student is exposed to learning in the classroom, in the library, and in the dormitory. In the future, improved use of communications can be expected to improve the student's ability to learn in all three.

Educators have already satisfied themselves that the telephone can be used by students, not just for the pursuit of the opposite sex, but for the effective pursuit of knowledge as well. The future will certainly see more telephone facilities on campus and *more use of the telephone and the nationwide telephone network as a teaching and learning device.*

For example, a student studying Chinese III will be able to dial the language lab from his dormitory at any hour of the day or night.

■ Looking ahead, it seems inevitable that as we give the individual student access to the facilities of the lan-

Top. Future students may be able to dial computers, libraries and other information repositories and get back the information they need. Facilities to receive such information, suggested in artist's sketch above, could be located anywhere on the campus.

guage lab by telephone, so he will also be able to connect with a computer by telephone line from his dormitory.

According to the character of the information requested, the student may receive his answers *audibly*—as in the case of digital input, voice answer-back; *printed* out on a teletypewriter; as a *visual image* on a TV-type picture tube for close-up viewing, or a *facsmile print* in the case of equations, diagrams, schematics and the like, to which he would wish to make repeated reference.

Facilities to receive such information may be in the dormitory or anywhere on the campus. And, just as the student can be connected by telephone to a remotely located computer, put a problem to it and retrieve information in any convenient form, so he will also be able to dial into other repositories of information — libaries, for example—and receive back the information he needs.

In the library of the future, automatic indexing and classifying, information retrieval, mechanical translation, optical scanning or pattern recognition, high speed photography, and printing will have a profound impact.

Documents or pages of books can be

Changing Attitudes

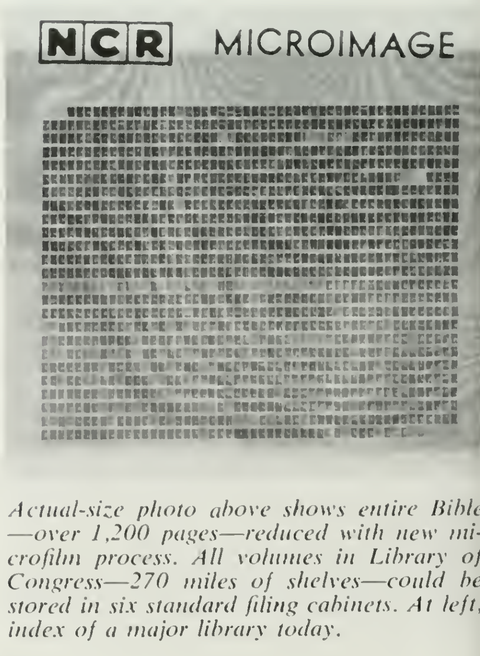
reduced by microreproduction techniques to pinhead size, then stored on film in what is, in effect, an information warehouse. Each item is coded, and a memory unit in a coordinated computer "remembers" where it is located.

The entire contents of 20,000 standard volumes can be stored in a space the size of a small desk. And this is one answer to the problem of storing the yearly crop of 60 million pages of technical papers so that they can be conveniently located, retrieved and disseminated.

In such a library the user would rely on machines, not only to tell him where to locate the book or journal article he wants, but also literally to deliver to him its contents.

Another approach would call for condensing the information itself, and not merely its physical form. The ideal system using this principle would incorporate a device which automatically "reads" printed matter and translates it into machine language. Next the material is abstracted, classified, and indexed automatically and stored in a computer. The user can call up relevant abstracts automatically, as required.

There is broad general agreement among educators that in the future, more and more students will get at least some of their facts—and therefore some of their learning — from inanimate dispensers — films, tapes, television, computers, information banks and teaching machines—in addition to the irreplaceable contact with living teachers. Recognizing this, campus facilities, particularly the lecture hall, the residence hall and individual study spaces will likely be designed or adapted to these new, technological carriers of knowledge—all of which can be made accessible as required over the telephone network.



Actual-size photo above shows entire Bible—over 1,200 pages—reduced with new microfilm process. All volumes in Library of Congress—270 miles of shelves—could be stored in six standard filing cabinets. At left, index of a major library today.

in this issue...

■ Richard R. Hough, author of "The Bell System Construction Program," page 2, joined Bell Laboratories in 1940 after receiving an electrical engineering degree at Princeton University, where he was elected to Phi Beta Kappa and Sigma Xi.

During his 17-year career at Bell Laboratories, he helped design and install the first U.S. Naval gunfire control radar system and contributed to the development of various military weapon systems, including guided missiles. In 1955 he was appointed director of Military Electronics Development and was elected vice president of the Laboratories in 1957. Later that year he came to A.T.&.T. as assistant chief engineer. In October, 1959 he was elected vice president, Operations, of Ohio Bell Telephone Company and remained there for two years until his present appointment as vice president of A.T.&.T. in charge of Engineering.

He also has served as consultant to the Defense Department, first as a member of the Radar Panel of the Research and Development Board and then as a member of the Technical Advisory Panel on Electronics. In March, 1961 President Kennedy appointed him to head Project Beacon, a task force to study safe and efficient use of air space. He is currently chairman of the Technical Advisory Board to the Federal Aviation Agency.

■ Robert B. King's article, "Scientific Sampling" on page 16, discusses the recent surge of interest in the use of sampling procedures in Bell System operations, and comments on sampling methods and their acceptance by System management people. Mr. King has been interested for many years in System applications of mathematical methods, including sampling and operations research. He has been responsible for this work in A.T.&T.'s Business Research Division.

After graduation from Harvard College, he joined A.T.&.T. in 1921 in the Chief Statistician's Division, forerunner of the

Richard R. Hough

Robert B. King

present Business Research Division. From 1925 to 1930, he worked with Illinois Bell, serving as chief statistician of that company. In 1930, he returned to the A.T.&T. and has since headed statistical activities in various fields, including personnel statistical studies and statistical presentation methods.

■ In writing on the cooperation between telephone people here and overseas (page 26), Mr. Laird is in familiar territory. Since 1960 he has been executive assistant in the Overseas Operations organization of A.T.&T.'s Long Lines Department. Four years before that he had become overseas operating engineer. During World War II, Mr. Laird was on loan to the U. S. Government with the Office of Production Management, where he served as assistant deputy director of the Priorities Division. He also had the responsibility for setting up a field organization for the OPM.

His earlier telephone career included various Plant Department assignments with Long Lines in Philadelphia, Pittsburgh, Washington and New York. After returning from his OPM assignment at the war's end, he worked in Plant and Commercial posts until his appointment as overseas operating engineer.

Mr. Laird speaks with conviction on international cooperation in communications: "The representatives of world-wide service . . . hundreds of times over the years, have worked together, face to face, to solve their probems in an atmosphere of mutual good will and trust."

■ One of the reasons Vern L. Bronn was asked to relate some of the trials and successes encountered by Northwestern Bell's Employee Discussion Program is that he is dean of NWB's Discussion Group. He wrote their initial discussion outline nine years ago. Today, he is the only member of their discussion team who has shared in the writing, testing and production of more than 60 packages which NWB has issued.

His early telephone experience also makes him a good choice to explain some of the doubts and difficulties faced by first-line supervisors for whom the program is tailored. In 1933, while waiting for a position as a newspaper reporter, he accepted a temporary position as a central office switchman. His stay extended 21 years while he worked at such jobs as Commer-

Edwin C. Laird, Jr.

Vern L. Bronn

Dr. Field H. Winslow

George E. Callahan

cial clerk, installer repairman, and small town business office manager.

He has also become a sort of unofficial employee discussion "clearing house." Callers and visitors from every Associated Company discuss with him the wide range of problems and solutions they uncover while working on their two-way communication programs.

All this makes his article, "How We Developed Our Discussion Program" on page 34, a down-to-earth account of what goes on when a stepped-up two-way communication program gets under way.

■ Dr. Field H. Winslow, author of "Polymers" starting on page 51, is —as he might say in the language of his profession—closely cross-linked with his subject. As head of the Polymer Research and Development Department at Bell Telephone Laboratories, he has been active in the field of high polymer synthesis and modification, and has done much research toward finding new protectives for plastics such as polyethylene.

A native of Vermont, Dr. Winslow received his B.S. in chemistry from Middlebury College, his M.S. in the same field from Rhode Island State College and the Ph.D. in organic chemistry from Cornell University in 1943. From then until 1945, he worked on the Manhattan Project at Columbia University.

He is a member of the American Chemical Society and is now chairman of the Society's Polymers Division; a member of the American Society for the Advancement of Science, the Society of Chemical Industry and Sigma Xi, and has had numerous papers published in technical journals.

■ George E. Callahan, although he might not admit it himself, has had some responsibility, direct and indirect, for the "Changing Attitudes Toward College Communications," which he discusses in his article beginning on page 58. As sales project manager in the Marketing Department, he has had much to do with communications in and for educational institutions of all sizes and kinds in every corner of the nation. As he remarks in the article, "Educators have already satisfied themselves that the telephone can be used by students, not just for the pursuit of the opposite sex, but for the effective pursuit of knowledge as well." At least some of that conviction on the part of educators has come from the active sales efforts of Mr. Callahan and his staff, and the marketing and sales people whom they advise and assist throughout the Bell System.

Mr. Callahan's first telephone job was with the Ohio Bell Telephone Company in 1946 after three years as a fighter pilot in the Army Air Force. He held various positions in directory sales work in Ohio before joining the directory sales group at A.T.&T. in 1954. There followed a stint on the advertising side of Public Relations before he went to the Marketing Department as sales program supervisor.

in the news...

Hurricane Damage

Freedom Medal to Kappel

AUTOVON Project

Hawaiian Cable

Maser Research

Microwave Watchdog

Electronic Clock

Cleo and Dora

Within two weeks, two hurricanes hit the Florida, Georgia area and inflicted considerable damage to telephone plant.

Hurricane Cleo, which tore into Miami, Florida, early August 27th, with winds above 100 miles an hour, knocked at least 100,000 telephones out of service in its destructive swath up the Florida coast.

Southern Bell reported extensive damage to power company plant and said that 46 telephone central offices had to use their emergency power. Of 900 toll circuits affected, the Company had put 760 back in service by the next day. The damage totaled more than $2 million.

Long distance traffic into and out of Florida was reported well above normal, and there were considerable delays in getting calls through. Network control action was taken throughout the country to assist movement of Florida outbound traffic and prevent the spread of congestion.

Exactly two weeks later, Hurricane Dora, which hit the Jacksonville and St. Augustine area with 100 mile-an-hour winds, inflicted millions of dollars of damage and left thousands homeless. Gusts from the front of the hurricane also hit southern Georgia coastal towns and caused heavy destruction there.

Preliminary reports from Southern Bell indicated that about 50,000 stations were knocked out of service in Florida and 10,500 in Georgia; 7,000 of these were back in

One of the many out of state telephone men who came to help—a lineman from Houston, Texas aids repairs in Florida.

President Lyndon B. Johnson congratulates A.T.&T. Board Chairman F. R. Kappel after presenting him with Medal of Freedom award in ceremonies at the White House, September 14.

service the next day. Also, about 500 toll circuits were out of service of the 900 originally affected. The damage to telephone plant was estimated at $1.3 million.

Restoring telephone service was particularly difficult because many power lines were down. In Jacksonville, for example, 90 per cent of the city was without electricity. In Brunswick, Georgia, 70 per cent of the customers lost power. In addition, phones in the storm area were not heavily concentrated, and there were many drop wires down.

About 200 plant men from several Bell System Operating Companies and the Long Lines Department were sent with their vehicles into Florida to help Southern Bell restore service in the wake of Hurricane Dora. They came from Bell Companies in Pennsylvania, Ohio, Indiana, Illinois, Southwestern, and the Chesapeake and Potomac companies. Southern Bell also brought in 293 of its own employees from other areas.

Western Electric Company had its Jacksonville Distribution Center well-stocked in preparation for the hurricane, and Western plants and distribution centers around the country stockpiled supplies and equipment.

Operator-handled long distance traffic was very heavy into and out of the storm area, and there were some delays on getting calls through. Network controls were again put into effect throughout the country to help move traffic.

Medal of Freedom to F. R. Kappel

■ Frederick R. Kappel, A.T. & T. board chairman, was presented the Medal of Freedom by President Lyndon B. Johnson at ceremonies in the White House on September 14.

The award, which was announced in early July, is the highest civil honor the President can bestow. Mr. Kappel was one of 30 individuals, 25 men and five women, who were named to receive the medal. The recipients are prominent in public affairs, business, labor, science, education, journalism and the arts.

In announcing the recipients in July, President Johnson said: "Collectively, they have made man's world safe, his physical body more durable, his mind broader, his leisure more delightful, his standard of living higher and his dignity important."

AUTOVON

■ In response to a request from the Department of Defense, the Bell System is now at work on another communications system for national defense. It is the AUTOVON project (Automatic Voice Network), a private-line, switched service network for the DOD which will tie together some 1,700 military locations around the world.

When fully operational in 1968, AUTOVON—and its brother AUTODIN (Automatic Digital

Network)—will be the largest, single private line network in the world. The system will have the circuit mileage equivalent of the entire Bell System network during the early 1950's.

There will be two major portions of the network: Continental United States (CONUS) and Overseas. CONUS AUTOVON will be principally a leased network while Overseas AUTOVON will be principally government-owned, utilizing equipment from a large number of manufacturers. Both networks, however, can operate as one.

The project is the outgrowth of an eight-month, three-phase study, undertaken for the DOD by Bell Laboratories, Long Lines and Western Electric.

When fully operational, AUTOVON will link over 1,000,000 telephones, handle both teletypewriter and high-speed data services and meet military requirements for "hot" lines, priority recognition, pre-emption, dedicated internal networks, conferencing and broadcasting communications.

The network will be engineered for survivability, flexibility, speed, service and economy, and the latest communications hardware and techniques will be used. Although AUTOVON initially will be equipped with electromechanical switching equipment, it is geared to convert to electronic switching (ESS) when that equipment is available. When it is converted to ESS, the system will offer almost instant communication throughout the world to military posts on the network.

Design of the network also will assure avoidance of complete system breakdown due to individual component or circuit failure. In the event of heavy network damage, AUTOVON will be capable of adjusting rapidly to loss of trunks through alternate routing and predetermined restoration plans.

The initial portion of CONUS AUTOVON began recently with the integration of SCAN (Switched Circuit Automatic Network) and NORAD (North American Air Defense) switching systems into one common network.

The first part of the Overseas network is expected to be operational early in 1966. Western Electric has the contract to manage the system engineering and implementation of this portion of the network.

New Telephone Cable to Hawaii

■ A new deep-sea telephone cable has been placed in service between the U.S. mainland and Hawaii. The $34 million cable system was a joint project of the Long Lines Department of A.T. & T. and the Hawaiian Telephone Company.

The route, extending 2,400 nautical miles from San Luis Obispo, California, to Makaha, Oahu, will provide 128 high quality voice circuits for communications between the continental U.S. and Hawaii—as well as points beyond Hawaii.

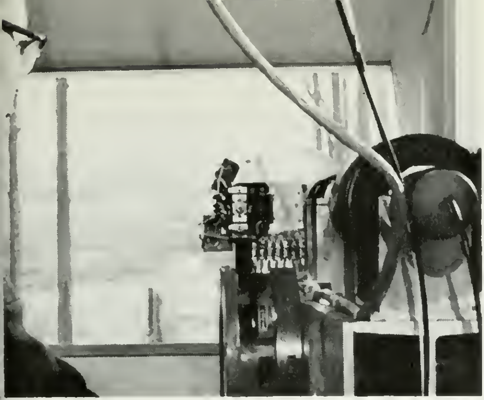
With the opening of the new Hawaiian cable, the C.S. *Long Lines*, A.T. & T.'s cable ship, has completed two of three major additions to the Bell System's undersea communications network in the Pacific. The first was the transpacific cable, a 5,300-mile span linking Japan with Hawaii and the U.S. mainland, which went into service this June. The second was the Hawaiian cable just laid and the third will be a 1,500-mile cable between Guam and the Phillippines. These three systems—totaling 9,200 miles—represent an investment of some $136 million.

This is the second cable linking the U.S. mainland with Hawaii. The first, completed in 1957, has been operating at peak capacity. Additional circuits were needed to handle the sharp rise in telephone calling between the two areas—up 400 percent over the last ten years.

Maser Light Sent Through Atmosphere

■ Scintillating like a star, coherent light generated by an optical maser travels a mile-and-a-half through the atmosphere at Bell Laboratories, Holmdel, N.J. Here, scientists are studying how this bright, monochromatic light is affected by various types of weather from cloudless days to blizzards.

These experiments are designed to study the problems of communicating by light beams through the atmosphere. The power of the light fluctuates randomly in all kinds of weather because of minute inhomogeneities in the atmosphere. On clear days the beam's average power is affected very little. In rain, attenuation reaches 30 db; and in fog



Optical maser beam sent through atmosphere; star-like pattern is caused when highly-directional beam hits edges of camera iris.

and snow, it often exceeds 80 db. Therefore, optical communication systems may require that the light beam be transmitted in underground pipes to shield it from the atmosphere.

In this experiment, a ten milliwatt helium-neon optical maser generates a continuous beam with a wavelength of 0.63 microns. The beam is vertically polarized and sent through a nine-cm-diameter telescope. After passing through the atmosphere it is received by a refracting telescope (with filters, polarizers, and attenuators) and fed to a photomultiplier.

Microwave Watchdog

■ A complex emergency switching system that functions in millionths of a second is giving unprecedented life insurance to long distance communications. By automatically routing calls to standby circuits, the system rescues radio relay stations whenever transmission quality on normal channels falls below par.

Final adjustments for one of bays of equipment in 100A Protection Switching System.

This new electronic watchdog, consisting of six bays of switching and power equipment manufactured by Western Electric, is called the 100A Protection Switching System. Its job is to stand ready at microwave stations that amplify and pass on telephone, television and data transmissions and to protect against service interruptions caused by fading signals or equipment failure.

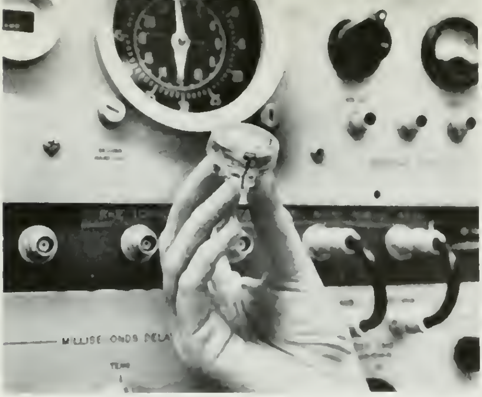
Protection switches for microwave systems are nothing new, but the 100A was developed by engineers at Bell Laboratories specifically to handle the growing speed and volume of long distance microwave transmissions. This first all-electronic protection system works 100 times faster than the fastest previous switch, enabling it to keep pace instantly with even the most rapid data communications.

Electronic Clock

■ A complex clock that in all probability will not lose or gain more than a second in 300 years helps Western Electric provide super-precise timing instruments essential to the tracking of missiles and space satellites. Looking more like a control panel than a timepiece, this sensitive instrument provides the time and frequency standard that guides W.E.'s production of quartz crystal oscillators, which are used to operate electronic clocks for the government.

Developed by Bell Laboratories, W.E.'s crystal oscillators drive the electronic clocks at various U.S. Navy timing stations, which in turn provide time standards of microsecond accuracy to missile and satellite tracking stations. Extremely precise correlation of time over great distances is essential to accurate tracking operations.

Western's electronic clock—which itself is driven by a W.E.-made quartz crystal oscillator—is identical in design to the master clock that maintains our national time standard at the U.S. Naval Observatory in Washington, D.C. In fact, W.E. also manufactured the oscillator upon which the master clock depends for its accuracy. The daily time "drift" in each of these clocks is rarely more than a millionth of a second.



Tiny quartz disc provides standard time frequency for electronic clock in background.

When powered by electricity the quartz disc oscillates back and forth in a steady pattern, similar to the movement of a pendulum. But while a standard mechanical clock might tick once or even five times a second—enough to keep approximate time—the quartz crystal "ticks" or oscillates precisely 2½ million times each second. This incredibly fine splitting of a second, when transformed into voltage to operate an electronic clock, allows for extremely precise measurement and regulation of time.

Automatic Call Distributors Now Available

■ Automatic call distributing systems, formerly provided only on a custom basis, are now being offered by Bell Telephone Companies in two flexible models, making the service available and more economical for a wider number of companies. Both models enable prompt and efficient centralized telephone answering of high-volume incoming calls.

These systems automatically distribute incoming calls to available telephone attendants. If all attendants are busy, calls are acknowledged by a recorded message and "stored" until an attendant is free. "Stored" calls are then released in the approximate order in which they were received.

One model has a capacity for ten to 56 incoming telephone trunk lines and accommodates from ten to 60 attendants; the others handles from 56 to 198 trunks, with from 60 to 200 attendants. Since the systems are leased from the Telephone Company, there is no capital investment and full maintenance is provided at no extra cost.

Gas Lenses For Laser Beams

■ Gas lenses that show promise for guiding laser beams in pipes for communication over long distances have been invented at Bell Telephone Laboratories.

These lenses, which use variations in the refractive indices of gases to guide light, do not reflect or absorb light nearly as much as conventional optical components.

A long gas lens, or series of lenses, can confine a laser beam to a path near the center of a pipe. In a straight pipe, the lens need not be strong because it must only compensate for the small natural spreading of the laser beam. In curved sections of a pipe, the light beam normally would travel in a straight line. However, as the center of the pipe curves away from the beam's path, the beam encounters gas of decreasing refractive index. This region acts like a prism, deflecting the light beam in the direction of the pipe's curvature. The sharper the curve, the more the light beam must be focused to keep it from hitting the side of the pipe. Such a pipe, following the natural curves of terrain, could be the "transmission line" for a long-distance laser communication system.

These and other types of gas lenses currently being investigated at Bell Laboratories represent a basically new approach to the guiding of light beams over long distances. While much has been done, many features must be further investigated. Further time and development will provide the test of whether a commercial system for long-distance transmission of information will ultimately evolve from this and related work.

Bell Labs scientists experiment with helical gas convection lens to guide laser beams.

In a soaring arc, a test model of the Apollo space capsule roars over the White Sands Missile Range, Bellcomm, a Bell System affiliate owned jointly by A.T.&T. and Western Electric, is acting as technical consultant to NASA on the man-on-the-moon project.

BELL TELEPHONE MAGAZINE

WINTER 1964-65

Laser Research

BELL TELEPHONE MAGAZINE

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A non-technical review, published quarterly to give Bell System management people a broader view of the history, objectives, operations, and achievements of this business than they might attain in the course of their day-to-day occupations, and an added sense of participation in the problems and accomplishments of our nation-wide public service.

Cover:

Bathed in an unreal red glow amid the delicate arches and tracery of glass tubing, paradoxically gothic in effect, Bell Laboratories scientists work on one of the most modern of discoveries, the laser, as they conduct a study of a helium-neon laser to determine the relationship of power output to the length of the cavity. The significance and scope of the work of Bell Telephone Laboratories in research, development and systems engineering are the subject of an article starting on page 2 of this issue.

Testing telephone cords in the BTL branch laboratory located at Western Electric's Baltimore Works.

Guardian of technological progress for the Bell System network, Bell Telephone Laboratories' interests and achievements encompass the whole broad field of communications—and more

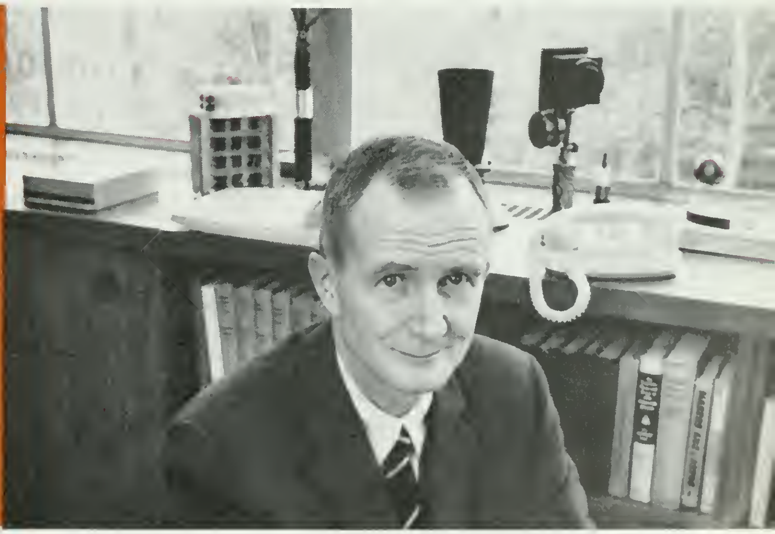
BELL TELEPHONE LABORATORIES

Theodore B. Merrill, Jr.

■ To a telephone customer who has just dialed a number and is waiting for a telephone to ring halfway across the continent, the clicks and tones he hears as his circuit is completed tell him only that his call is in progress. To telephone men, the sounds are the familiar stirrings of specific parts of the world's largest machine—the $22-billion Bell System network. Responsibility for the technical progress of this incredibly complex system lies in the hands of Bell Telephone Laboratories, the research and development unit of the Bell System.

Since it was established as a separate unit of the Bell System in 1925, Bell Telephone Laboratories has had a single charter: to find ways to improve communications. Today, that is about as broad a technical and scientific order as it is possible to find. It explains, to a large extent, why Bell Laboratories is big, why it employs 14,500 people, and why it contains such a diversified group

Dr. James B. Fisk, president of the Bell Telephone Laboratories. Behind him are some mementoes of progress in communications.



BELL TELEPHONE LABORATORIES

of engineers and scientists—a professional staff of 4,500 men and women who, in the aggregate, seem to be interested in just about everything under the sun.

Because the Bell System is so large and uses such diverse equipment, the questions that are technically interesting and economically relevant pile up fast. Even as simple a device as an electromechanical switch—called a relay—when it is used by the millions and is a vital part of the System, leads to many basic engineering and scientific questions:

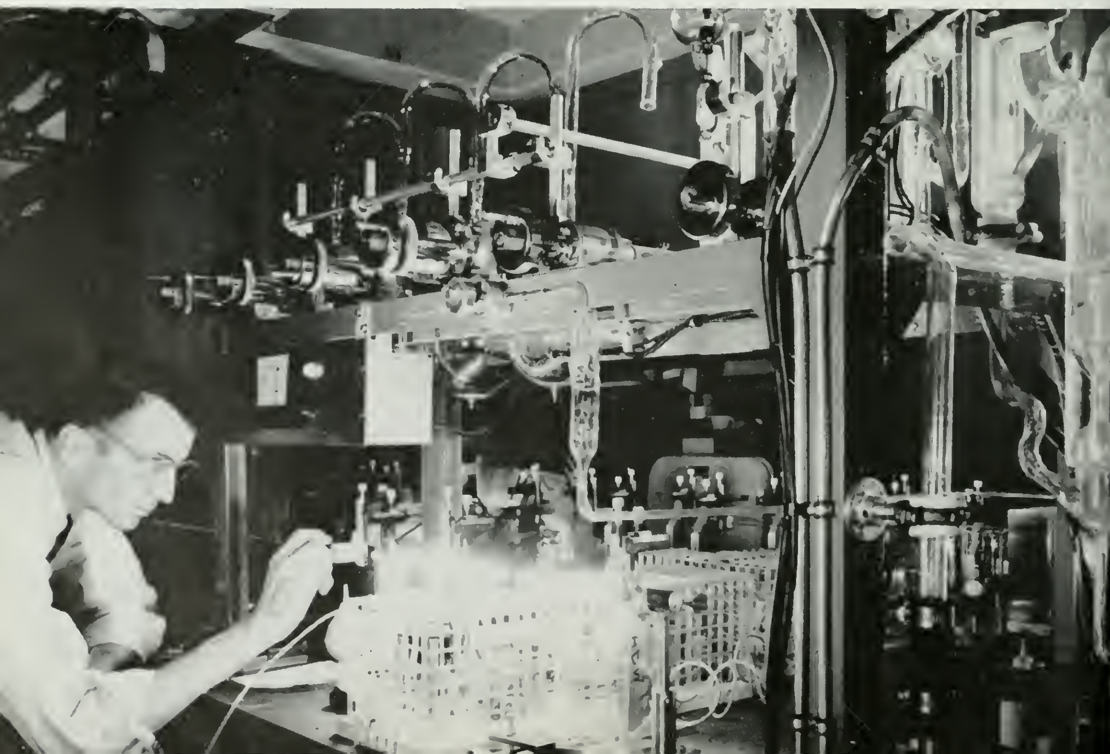
- What makes electrical contacts wear out?
- What is the best material for springs?
- What makes metals elastic?
- What are the best magnetic materials?
- What makes a material magnetic?
- What are the best insulators?

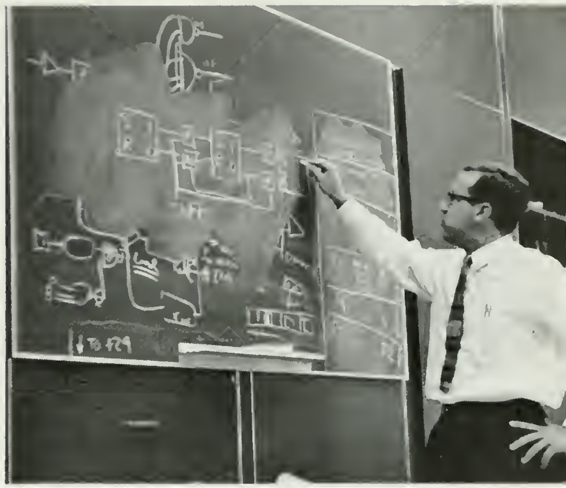
These are all old questions at Bell Laboratories, and each has led to many others, including a fairly basic one: are relays really the best way to switch electrical signals?

The questions lead to exciting research that sometimes provides answers relatively easily, but often leads to no final answers. The continuing search for improvements through understanding basic processes frequently develops the kind of knowledge that contributes to many fields of technology relevant to communications. Some contributions seem far removed from the problem that started the work in the first place.

■ Communications is such a pervasive and broad technology that there is almost no recognized field of physical science where a significant advance is not directly applicable to some

Below: laser studies. This field looks so promising that today many scientists and engineers at Bell Laboratories are spending all or most of their time in it.





Blackboards are omnipresent at BTL. They are a much-used aid in puzzling out problems.

part of the communications art. Even the social and biological sciences often yield important contributions.

The variety and scope of communications technology explains why there are so many engineers and scientists from so many specialties at Bell Telephone Laboratories. And it explains why Bell Laboratories supports selected research projects in several colleges and universities. New ideas in a field of science can suddenly change the economic relevance of broad areas of technology and generate many development projects of potential utility to the Bell System.

One of the better examples of how such outside research can evolve into a major effort is the current work on masers and lasers at Bell Laboratories. Dr. Charles Townes, one of the important pioneers in microwave spectroscopy, began his work at Bell Laboratories. While at BTL, he did extensive work in this then-emerging field. His later work at Columbia University eventually led to his conception of the maser, a device that amplifies electrical signals by molecular resonance and has proved immensely useful in communication systems such as communication satellites.

The maser principle, for which Townes shared the 1964 Nobel Prize in physics, led in turn to the laser or light amplifier. The laser produces a regulated form of light that has potential capabilities for carrying many communications channels on a single beam of light. Bell Laboratories scientists produced the first continuously operating lasers. The laser field looks so promising that many scientists and engineers at BTL are now spending all or part of their time on laser development and research.

Not infrequently, Bell Laboratories scientific research contributions make a like impact on research in academic institutions—the flow of knowledge goes both ways. For example, the science of radio-astronomy stems from the work of the late Karl G. Jansky, a Bell Laboratories scientist. Thanks to his contributions, radio-astronomy is now one of the most active fields of astronomical research all over the world.

Finding ways to advance the communications arts not only demands a variety of talents and a diversity of sources of new ideas, it requires a flexibility of working methods as well. Some Bell Laboratories developments, such as William G. Pfann's invention of zone refining of metals, have come from the efforts of a single person. Others, such as the TELSTAR® communications satellite, required several hundred BTL people working in closely coordinated teams with engineers and operating men from other parts of the Bell System.

■ The administrative headquarters of Bell Telephone Laboratories is in Murray Hill, New Jersey, in a complex of multistory brick buildings strung along a ridge of the Watchung Hills. It was one of the first campus-type industrial laboratories. In addition to Murray Hill, there are both older and newer BTL locations. The original buildings on West Street in New York City are still put to good use, and in Whippany, N.J., a large laboratory is primarily used for government projects. Farther south, in

Administrative headquarters and largest laboratory of BTL is at Murray Hill, N. J.

BTL's Holmdel, N. J. Laboratory is new but filled to capacity and being doubled in size.

The big Whippany, N. J. Laboratory is primarily used for projects for the government.

The original BTL buildings on West Street in New York City are still put to good use.

Holmdel, N.J., a huge new glass-sheathed rectangle soars out of landscaped acres in the soft hills. Holmdel is already filled to capacity and is being doubled in size.

Inside these buildings, the mazes of corridors have an atmosphere similar to that of a large university graduate school. People, working singly or in small groups, seem intently preoccupied. Some are immersed in tangles of equipment, but more seem to be working quietly at their desks or puzzling out problems with their confrères at the omnipresent blackboards.

Many of them also put electronic computers to good use. Bell Laboratories was one of the first to put large electronic computers at the disposal of its scientists and mathematicians. One of Bell Laboratories own people, George R. Stibitz, developed one of the first digital computers in the 1930's. It was an electromechanical machine that used relays instead of electron tubes or transistors, however, so it was pretty slow compared to modern machines. But it did yeoman service calculating problems associated with network design.

Today, Bell Laboratories has three large computing centers, with more than $20-million worth of electronic computer systems. Some 1,000 members of the technical staff use them regularly. A fourth large computation center is planned for the new Indian Hill Laboratory to be located near Chicago, and the existing centers will be augmented by new equipment that will make it possible for researchers to communicate directly with computers from their offices or laboratories.

The difference that these large computers make in the speed of solving problems is remarkable—they are about a million times faster than a clerk doing calculations by desk calculator. Donald P. Ling, who has worked on the Nike missile projects at BTL since 1945, recalls that one of his early projects took two and a half "girl years" of work to figure 60 trajectories. Ling, executive director of the Military Research Division, estimates the whole job could now be run off at the computing center in less than three minutes of computer time. So even though the cost of computers is high, the low cost of doing a single calculation makes it possible to do many problems that simply could not have been approached before. Because many physical experiments can be simulated on a computer—and be run much more quickly and at less cost, many Bell Laboratories scientists predict that eventually much of the experimental work at BTL will involve computer simulation rather than physical models. The need for scientists and engineers who are able to use computers is so great that one of the largest educational programs for BTL personnel is in computer programing. A special three year course for program design trainees was created in 1962 to help meet the need for men and women with computer talents.

■ Because of the Bell System's rather special problems of size and complexity, Bell Laboratories has often had to invent its own kinds of specialists to meet its needs. It has been a valuable seedbed for new disciplines in applied technology. Specialties like electronics of the solid state that were born at Bell Laboratories have been put to use by many other industrial and government organizations.

The telephone network, as the largest integrated system in the world, constantly runs into problems of a nature and scope that are just not encountered elsewhere. Because Bell Laboratories was wisely created as the research and development arm to serve the entire Bell System, its co-owners, A.T.&T. and Western Electric Co. (the manufacturing

Bell Laboratories has three computing centers and is presently planning a fourth.

and supply unit of the Bell System) can readily justify its annual budget. The budget in 1964 reached $180 million excluding funds covering the cost of work for the Federal Government. With such dependable and thorough support, Bell Laboratories has been able to grow and change to the extent necessary to meet both day to day problems and the long range obligation of supporting basic scientific and exploratory development programs that anticipate the new requirements brought by the System's growth and changing traffic loads and patterns.

■ Many of the major technical developments of this century have come from BTL, and are convincing proof of the value of long range, consistent efforts in science and technology. For example, the three-element electron tube, invented by Lee DeForest, was perfected by the Bell System and is certainly one of the great developments of the first half of the 20th century. Electron tubes opened up the entire world of radio and electronics, and although Bell Laboratories perfected this device to the point that some tubes would operate reliably for more than 20 years without replacement, that was not good enough. Continuous searching for better switching and amplifying devices led to study of semiconductors and to the solid state transistor, which promised greatly increased life and lower power consumption. Since 1948, Bell Laboratories has brought this new invention along to the point that it has virtually replaced all vacuum tubes in the design of new electronic equipment. The whole mix of manufacturing and circuit design skills has had to change as a result.

In the long list of outstanding achievements of BTL are many that the general public is familiar with but does not ordinarily associate with their source. High fidelity recording and reproduction techniques, sound motion pictures, and solar batteries are good examples. So are computers, which, as noted earlier, owe some of their genesis to the switching, circuit and component know-how developed at Bell Laboratories.

Other widely known Bell Laboratories contributions aren't really represented by specific products at all, but fall into the realm of concepts and ideas on which large chunks of science and engineering practice have been built. Single sideband transmission of electronic signals, which permits more information to be carried on a communication channel, is a case in point. So is the idea of negative feedback in amplifiers, a concept of Harold S. Black, which permits signals to be amplified many times without significant distortion. Without negative feedback, high fidelity reproduction of sound would be difficult, and long distance telephony would have been virtually impossible. Bell Laboratories has figuratively written the books on switching theory and net-

Invented at BTL, the now well-known solid-state transistor is replacing vacuum tubes in the design of many types of new electronic equipment. Here, experimental transistors are tested.

work analysis, developed the mathematics for quality control, and created a virtually new science through Claude Shannon's work on Information Theory. But these spectaculars are only a tiny part of the work that pours out of individual offices and laboratories, and any picture representing Bell Laboratories as a giant establishment primarily devoted to scientific research alone would be a distorted one indeed.

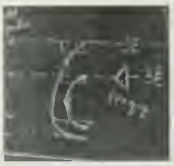
■ By far the largest proportion of work at Bell Laboratories is concerned with converting the results of research—which you might think of as new knowledge—into technology—which is what exists and works and makes our telephone network capable of continuing to provide service as it grows and the requirements on it change.

Out of the intensive research and experimentation on the properties of semiconductors came the transistor invention of John Bardeen, Walter H. Brattain and William Shockley. Within two years of the invention of the transistor, hundreds more engineers and scientists were at work improving the devices, developing ways to make them economically, and inventing ways to use them. Today, about 80 per cent of the development effort goes into designing systems that are dependent on the "new art" solid state devices. Jack A. Morton, vice president of electronics components development, has said, "Once you can prove something is feasible, it then becomes a matter of judicious application of time and money to see it through."

That "judicious application of time and money" is the part of Bell Laboratories' effort that produces the design of all the apparatus and equipment which will make up the Bell System plant of the future. It involves the testing of devices to insure their reliable operation and testing equipment to insure that it will operate in harmony with the overall Bell System network. It is also the part that involves coordination of the demands and needs of telephone customers with the capacities of the operating systems. And it involves the jobs of planning and coordinating the introduction of new products and services that can be phased into operating systems without disrupting them. Such tasks require broad knowledge of the latest techniques in science and technology coupled with an ability to judge wisely when new devices and ideas are ready to replace the older tried and true approaches and when—as is sometimes the case—the older approach is still superior.

■ To outsiders, some of Bell Laboratories' work may seem odd: what conceivable difference can it make if wood has a slightly different rate of decomposition in one type of soil than in another? The problem is not trivial if you have enough telephone poles in enough places. And the Bell System does.

In one sense, Bell Telephone Laboratories is a gigantic insurance policy for the public, A.T.&T. and all its subsidiaries. It is insurance that the Bell System



—a critical public resource—will have access to the best there is in technology, both through its own developments and through cross-licensing agreements with others who are willing to share their innovations with the Bell System in exchange for access to Bell developments. No laboratory in the world could hope to cover all fields of technology thoroughly, and even Bell Laboratories is no exception. But its excellence keeps the doors of other laboratories unlocked on the basis of fair barter. This kind of access to technology, plus the self-cenerated knowledge and skill, is the best possible insurance that the Bell System's communications network will be designed with the maximum of knowledge and a minimum of empirical guesswork and compromise.

Because Bell Laboratories has the final say on whether new devices meet the standards of the Bell System, it is insurance that only reliable components providing low operating costs and good service will go into the network. The sum of those parts is a network that works.

Perhaps one of Bell Laboratories' greatest achievements of all is the proof that such a scientific insurance policy is a very good investment. It continues to produce the scientific spectaculars that attract good men and pay off in the long run, yet it is still able to pay attention to the millions of details that the Bell System brings to it. One of the minor miracles of BTL is its ability to make room for such diversity within a single large organization.

To see how that organization works, it helps to break it down into its component parts, then see how they mesh into a coordinated effort that includes not only Bell Laboratories, but also A.T.&T., the Bell System Operating Companies and Western Electric Co.

From Knowledge to Product

The technical effort of Bell Laboratories is, like all Gaul, divided into three major parts: Research, Systems Engineering and Development. It differs from many other industrial laboratories in that these divisional names are strictly meaningful. Research goes after new knowledge and concepts relevant to communications. Development brings forth new communications equipment based on that knowledge and the requirements of customers. Systems Engineering matches the needs and desires of the Operating Companies against the potentialities of emerging technology.

Research personnel at Bell Laboratories work in an environment that is the most closely akin to the academic. It is their job to look for new knowledge, undisturbed by calls to put out emergency technological fires. Thus, those involved in basic research at BTL are not charged with the responsibility of developing new products for manufacture. Research ends when basic understanding is achieved. It may throw new light on old phenomena —such as superconductivity—or it may explain an entirely new one such as the transistor effect, discovered in 1948. Occasionally a research scientist will carry through his ideas to a working model in order to demonstrate the worth of the idea and intrigue others with it.

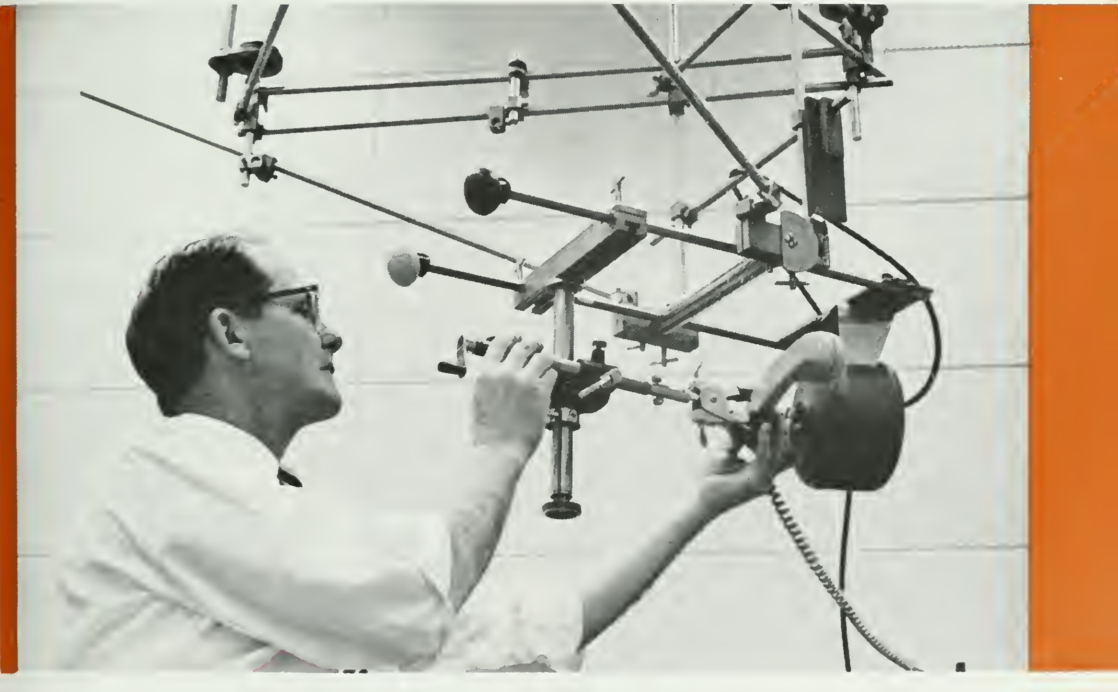
Bell Laboratories attracts scientists who are interested in pursuing research which may be pertinent to the broad field of communications. They choose their programs with two aims in mind: first, that their work will be important scientifically; second, with a general consciousness that applications of their findings may be achieved.

Like all organization heads at Bell Laboratories, Dr. William O. Baker, vice president of research, has given a great deal of thought to the question of motivation and guidance of his staff. Essentially, he organizes his departments to suit creative individuals rather than on a team or task force basis.

"You must realize" says Baker, "that a really top man feels a loyalty to his scientific community—the world of physics, chemistry, or mathematics—that is just as strong as his loyalty to his employer." Dr. Baker has found that it isn't necessary to tell scientists to "do something for the Bell System." There are altogether too many fascinating problems in scientific fields directly related to communications to make such direction necessary. Dr. Baker believes the most vital problem is keeping the work important. "We go to extreme ends to prevent confusion of relevance with importance. You can't justify unimportant work to research scientists who are tops in their fields merely on the basis of relevance," he says.

While judgment of the relative importance of scientific contributions is subjective at best (until that judgment is sharpened by hindsight), there is no doubt that the scientific community at large considers Bell Laboratories a top source of new scientific knowledge. Bell scientists and engineers are major contributors of papers published in the learned technical journals.

The connection between an article in the *Physical Review Letters* and better telephone service is not at all tenuous. Research in the physics of solids led to the transistor and better amplifiers. Support of research in mathematics led Richard Hamming and others to a number of error-correcting codes that ensure data link accuracy. Mathematical statistics permits effective quality control techniques to be implemented. A lot more telephone calls were completed last Mother's Day—a holiday that creates peculiar traffic patterns—because powerful mathematical techniques to simulate the behavior of switching networks under



Testing telephone handset at Holmdel Laboratory. Testing is part of BTL job that helps assure that manufacturable designs will meet all performance and economic objectives.

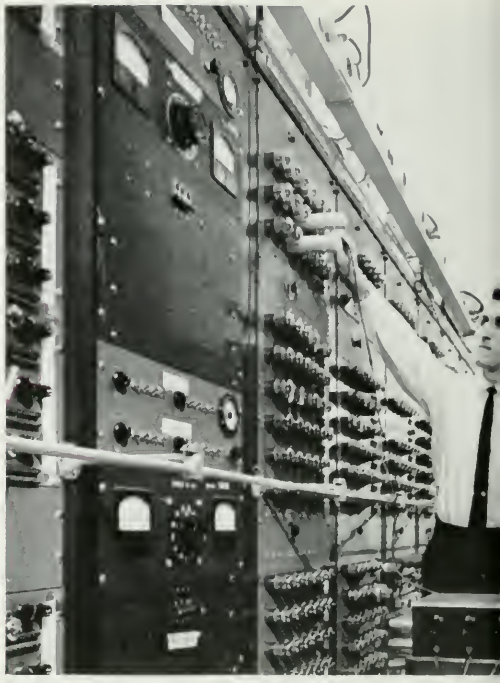
various conditions were put to good use by systems engineers. And within all of Bell Laboratories, as well as other electronics laboratories, "Shannon's immortal discovery"—Information Theory—enables scientists and engineers to make sense of the complexities of communication technology and attack its problems more effectively.

Important as it is Dr. Baker's research organization is a small minority at Bell Laboratories—only 15 per cent of the technical manpower is in research. Another 15 per cent is in systems engineering, and the balance is held by the big development group.

■ Development, under Executive Vice President Julius P. Molnar, is subdivided into four large problem-oriented groups, each under its own vice president. They are: transmission and switching development, electronic components development, customer equipment development, and military development and design engineering. In each of these groups, the work ranges from long term exploratory development to scheduled specific development and design of products for manufacture.

In fundamental development, future needs and limitations guide the selection and application of new research knowledge. Success depends upon the judgment and imagination of its people in spotting long term goals and coupling them with relevant research knowledge. Its sequence is ended when technical feasibility of a new material, device or system is demonstrated and quantitative understanding is achieved.

In specific development and design, the development is carried much further in technical detail but, most importantly, it must result in a design which meets not only specific technical requirements but also economic objectives of cost and reliability as well. The output of this phase of work is a manufacturable design of a device or system which meets all of its performance and economic objectives—at the right time.



Life test on submarine cable electron tubes is an example of BTL development work.

In specific development, therefore, most projects must be scheduled on a carefully planned team basis, carefully budgeted for manpower and time. Scheduling of development is vital in order that the work of BTL engineers can be coordinated with that of Western Electric engineers responsible for preparation for manufacture. By telescoping these activities the time between start of development and start of manufacture is reduced substantially. To accomplish this there are a number of branch laboratories at various Western Electric plants. Such close cooperation feeds back information to BTL on the state of the art of manufacturing technology, and immeasurably speeds the process of approving new devices and product changes initiated by the manufacturer to cut costs and clear up production problems.

■ As the Bell System grew and its growth was paralleled by bigger problems for Bell Laboratories, it became evident that more than just research and development would be required to cope with the growing complexities successfully. A new discipline called systems engineering evolved.

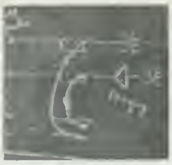
In 1955, systems engineering became a vice presidential group at Bell Laboratories. Since then it has grown rapidly, and today there are over 750 professional staff people in the systems engineering group (about one third are working on military problems). Systems engineering is organized roughly parallel to the development organization, but on a smaller scale. It forms the major interface between Bell Laboratories and A.T.&T., and its charter is a big order: to know the problems and economics of the Operating Companies and to relate this knowledge to the scientific and technical advances that affect communications.

A new discipline, systems engineering, was evolved to cope successfully with the growing complexity of today's problems.

Systems engineering makes many of the recommendations for development projects and maintains close liaison with the research people. Systems engineering also takes on some projects that fall outside of traditional technical disciplines, such as the great problem of network management. Using such techniques as operations research—mostly mathematical simulation—systems engineers can often work out ways to make the system operate more efficiently with existing equipment. They're also able to do simulations of many alternate methods of doing jobs and on this basis select the most economical and best solutions.

As a group, systems engineers tend to be more generalist than specialist—and one of their more important functions is to be able to work with a variety of technologies so they can often suggest approaches that might not occur to specialists. In the systems engineering organization, for example, a single division is responsible for switching—both electro-mechanical and electronic. In development, on the other hand, because of the large number of specific problems and differences in product technologies, a separate group concentrates on each area. Electro-mechanical switching work involves relays and switches primarily, while electronic switching requires programmers, mathematicians and more electronic and solid state device experts.

With so many specialists, there is always a danger of not seeing the forest for the trees. By establishing a formal overlapping organization like systems en-



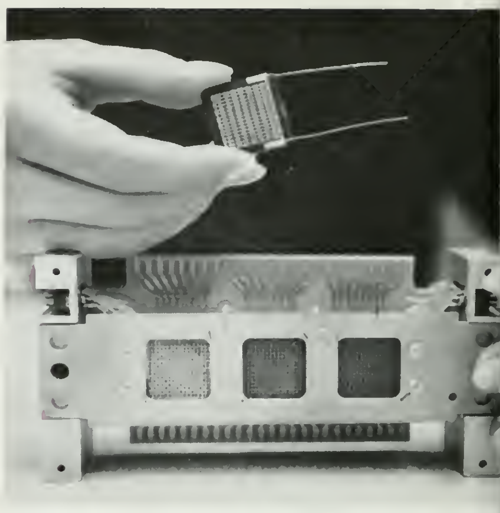
BELL TELEPHONE LABORATORIES

gineering, it is much less likely that duplication of effort or persistent work down a dead end will continue for long.

"We concentrate on the real objectives of new systems" says Kenneth G. McKay, executive vice president of systems engineering. "That involves what a system will do and how little it can cost to be attractive—these are the foundations on which new developments are built. Hopefully, with this approach, new developments will enter the Bell System gracefully, with technical polish and economic rewards."

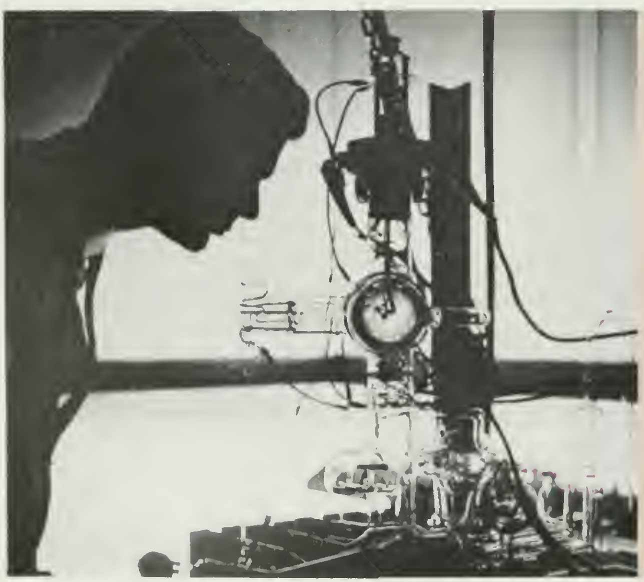
McKay's systems engineers come from all parts of the Bell System—many from development at BTL, and many from the Operating Companies, where their experience gave them a fine background for judging the merits of new ideas, products and customer services.

■ Through this amazing mixture of mathematicians, scientists, engineers and generalists, Bell Laboratories is able to meet the ever more complex needs of communications technology and still continue to turn out the basic advances in science and technology that only work by top men in their fields can provide.



Brain cell for the "scratch pad" memory of ESS was developed by BTL and is now being made by the Western Electric Company.

There are few yardsticks indeed to measure the performance of Bell Laboratories. In research, it competes on equal footing with top universities. Its develop-



Studying arrangement of atoms entering into chemical reaction on surface of crystals in surface physics research laboratory at BTL.

ment work matches the best in industry—and often provides other industries with valuable techniques and ideas. In addition, Bell Laboratories is writing history in systems engineering and research management by simply continuing to be successful.

When a big defense system problem comes up, Bell Laboratories is often approached by the government to participate. Over the years, BTL has been responsible for a number of large defense systems for the military services which have depended heavily on the particular fields of Bell Laboratories competence. Of course BTL has also provided many communications systems and services for the government.

■ Though Bell Laboratories has a long history of creating change and adapting to change, there is an unusual air of excitement permeating its laboratories these days that foreshadows even greater changes to come. The stimulus is electronic switching.

The anticipation is particularly keen because "ESS" is the culmination of many years' effort in one of the problem areas which Dr. James B. Fisk, BTL's president, likes to call "our enduring themes." The continued improvement of automatic switching systems is a major enduring theme—and the story of ESS, which will be discussed in the second part of this article, vividly illustrates how Bell Telephone Laboratories meets such a challenge.

The story of electronic switching is, in addition, one of the best examples of how Bell Telephone Laboratories, a key unit of the Bell System, operates.

(*This article will be concluded in the Spring 1965 issue.*)

The author of our two-part article on Bell Telephone Laboratories was a "natural" for the assignment. At the time he researched and wrote it, he was Industrial Production Editor of **Business Week**, had wide experience as a science writer and a sound background in science.

Important also was his familiarity with Bell Laboratories, its organization and many of its people. During his career at **Business Week**, which spanned the years from 1956 to 1964, he wrote a feature article on the trial of electronic switching at Morris, Illinois, and an article on computers in which Bell Telephone Laboratories was featured. Something of a specialist in communications and computers, he also wrote reports on semi-conductors in communications, microelectronics and integrated circuitry in which Bell Laboratories' developments had a part.

Late last year Mr. Merrill joined the Information Department at IBM, where he now writes about applications of advanced scientific data processing.

Theodore B. Merrill, Jr.

He was graduated from the University of Michigan with a B.S., and also did graduate work there. Prior to joining **Business Week**, he worked on other publications in the industrial and technical fields.

Some day soon you may be able to push a few buttons on your phone and "talk" to a computer at a bank or other establishment. The result: dramatic simplification of many everyday tasks

BANKING BY PHONE

Bell System exhibit used at the Miami convention of the American Banker's Association.

■ LOOK WITH US a little way into the future and imagine a typical housewife sitting by her telephone in a typical home. She reaches for the phone, which has push-buttons instead of the rotary dial, taps a few of the buttons, waits, taps a few more, then hangs up and walks away without speaking into the phone at all.

What was she doing?

Why, she just paid a department store bill! By tapping the buttons on her TOUCH-TONE® push-button phone she called her bank's computer, gave the computer her personal checking account number, told the computer to credit the department store's account with a certain sum and debit her account by the same amount. That's all she needed to do. There was no check to write, no envelope to address or stamp to lick — nothing to drop in the mail box.

This, of course, is a glimpse of the future—but, as we shall shortly see, a future that may not be very far away.

A few weeks ago, for example, members of the American Bankers' Association, attending a convention in Miami, had the opportunity to see and try out

12-button card dialer as it would be used to "talk" to a bank's computer.

a future Bell System service that one day could bring about major changes in long-established business procedures. A Bell System exhibit at their convention showed how people, using their home and office telephones, may some day communicate readily with computers and other data receiving machines used by banks and other businesses. The conferees used the new TOUCH-TONE telephones to "talk" to such machines, thus demonstrating ways in which tomorrow's banks could improve and broaden their services. They saw four possible uses for the new phones:

- For paying bills.
- For sending billing information.
- For retail billing-accounting.
- For getting a voice answer from a computer-simulator.

TOUCH-TONE Service

The telephones used in the Miami demonstration were special 12-button, automatic card-dialer models of the TOUCH-TONE phone. The new TOUCH-TONE instruments, now being introduced gradually by the Bell Companies have ten buttons. The extra two buttons on the special sets were used for transmitting signals meaning "end of unit within message" and "end of message." On the demonstration sets, one was marked with a diamond, the other with a star, although future markings could be different.

TOUCH-TONE service allows calls to be made by pushing buttons to get a number instead of by rotating a dial. Calls can be made two or three times faster in that way, but the introduction of TOUCH-TONE calling must be gradual because major modifications must first be made in a central office before the new phones can be offered in the community which is served by that office.

The new phones transmit a musical tone signal rather than a dial "pulse" to operate switching equipment. It is this characteristic of the TOUCH-TONE instrument that makes it adaptable for communication with business machines.

Paying Bills

Although it is evident that we must speak of nation-wide banking by phone in the future tense, all the necessary techniques are accomplished fact today. When this service becomes generally available, here is how it might work: the customer, as in the case of our opening example, will be able to pay as many bills as he wishes at any time of the day or night merely by making a call on his TOUCH-TONE phone to the computer at his bank. If his phone is a card dialer model (see illustration on this page), the calls can be made more efficiently and accurately, but the card dialer feature is not essential.

If the customer overdraws his account, the computer can warn of the overdraft. This "warning"—or the reply to a query about current balance—comes to the customer as a voice. By tapping the

BANKING BY PHONE

appropriate buttons on his TOUCH-TONE phone, he sends an "inquiry code" to the computer which immediately finds the necessary information stored in its memory. It then performs a feat of "translation," going to words and phrases pre-recorded on tape, arranging them in the proper sequence and sending them to the customer. At present, the tape has a vocabulary of approximately 100 to 150 words, and the reply comes in a monotone because the pre-recording has no way of knowing where the words will be used in a sentence and therefore how they should be inflected to simulate a human reply. However, a more sophisticated development is under way whereby words and phrases would be pre-recorded *with* various inflections; the computer would then pick out not only the right word but also, within the limits of the recording, the word with the right inflection.

Sending Billing Information

Another use of TOUCH-TONE calling may ultimately work like this: after a patient has visited his doctor's office, the doctor will call the bank's billing center and send in his account number, the patient's account number, the treatment given and the amount to be billed. The billing center would prepare the bill and mail it to the patient.

Doctor: could send his account number and patient's account number to bank's billing center for completion of all transactions.

Retail Billing-Accounting

Eventually, a store clerk might telephone a central computer to record each sale she makes. Using a TOUCH-TONE phone, she would send the account number (if it is a credit sale), the price, merchandise code and her own clerk number. She could also call the computer to check the customer's credit before the sale is completed and the customer leaves. Similarly, the bank's computer could be queried by a teller as to a depositor's up-to-date checking account balance, credit status or loan payment record.

This is the shape of things to come, and the arrival of those things depends on many factors. It depends, for instance, on how quickly, if at all, a local bank converts to computer operation and decides to offer this kind of service to its customers. Several banks already are studying the possibility.

We in the Bell System expect that TOUCH-TONE phones for this use will be available in 1966. Of course, as we have already pointed out, telephone central offices must be modified to handle the new service on a general basis. However, if a bank wanted to install the equipment right now to provide these services, the central office would not have to be equipped for TOUCH-TONE. Auxiliary TOUCH-TONE push button sets could be associated with the familiar rotary-dial phones until such time as the central office *is* modified. In that case, the dial

Retail store: clerk might call central computer to record account number, price, merchandise code, clerk number, credit rating.

phone would be used to call through to the computer, then the TOUCH-TONE phone would take over in feeding data to the computer.

The possibilities of TOUCH-TONE phone-computer service are virtually unlimited. For example, information retrieval systems might be developed for students to obtain facts from a library's computer. (See "Changing Attitudes Toward College Communications," *BTM*, Autumn 1964.) Doctors could get the latest word on treatment of a disease from a medical center's computer. Or it could be possible to literally "shop by phone"—order merchandise directly from a store's computer system. The customer would simply use his TOUCH-TONE phone at home to transmit his identification, credit card number and the quantity and identification number of the desired merchandise. The store would bill him later, probably by mail. This electronic extension of his fingers and feet could do everything except wrap the package for him—and it might even do that.

Telephones and computers will probably never eliminate the need for cash in daily transactions, but the kind of service described here could stimulate wider use of credit systems and thereby reduce the need for pocket money.

"Natural Resources"

Specifically with regard to the banking industry, there are three unique "natural resources" described by R. W. Erlich, then assistant chief engineer of A.T.&T., in talking before the 1964 Savings Automation Workshop of the American Bankers Association:

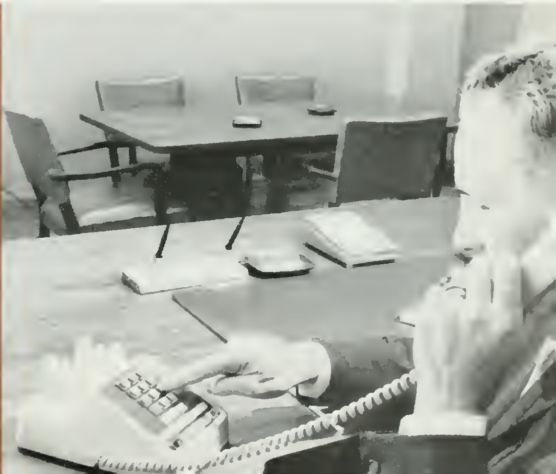
"The first one is that most major banks are well into electronic processing for nearly every major bank operation. This ability to automate your own operations gives you the managerial and technical know how . . . to extend the benefits of these systems to the correspondent banks, businesses and individuals you do business with.

"The second natural resource is the correspondent banking system. It is a system of mutual cooperation, and is based on the theory that small units of similar work can be most economically performed when they are combined and completed at one location as a specialized operation. I might add that this is a theory that works quite effectively in our business too . . . .

"The third natural resource is the excellent relationship you have earned with your customers—from the smallest individual depositor to the largest corporation. This relationship has communications at its core, whether that communication be by means of mail, by personal visits to the bank or by electronic means. It is only natural that better and more direct communications will then serve to enhance this relationship and make your services more convenient and attractive to use."

Bank: computer could be queried as to depositor's up-to-date checking account balance, credit status or loan payment record.

Between banks: could extend the benefits of automated operations to correspondent banks, businesses and individual customers.



Because of recent developments, a bright future looms for this 30-year-old communications medium

Modern Coaxial Cable

Robert F. Latter, *General Methods Engineer, Long Lines Department, A. T. & T. Co.*

■ Ever since the early days when long distance calls were handled over a pair of copper wires, with each pair carrying one conversation at a time, the Bell System has wrestled with three problems:

- How to provide enough circuits to meet the ever-increasing demand for long distance service;
- How to keep improving transmission to satisfy the needs and expectations of customers;
- How to keep the price of these circuits down.

In recent decades, developing technology has made possible the introduction of broadband transmission systems that first utilized coaxial cable conductors and later, microwave radio relay channels. These systems furnish large numbers of high quality long distance circuits at reduced cost. Thus, in 1930 the average Long Lines Department cost per circuit-mile of the long distance facilities was $217. This was reduced to about $29 in 1963 and the figure is still going down. Under these circumstances, it has been possible to reduce our rates materially over the years.

Today, 70 per cent of all Bell System circuits used for long distance service are provided by means of broadband facilities, and for the Long Lines Department the figure rises to 90 per cent. More than a quarter of all Bell System long distance services flow over a coaxial cable network—and the future will see this proportion greatly increased.

About 13,000 miles of coaxial cables now criss-cross the country. Between 1965 and 1972, it is expected that an additional 10,000 miles will be placed in service. In the Long Lines Department—which uses about 95 per cent of the coaxial cable manufactured by the Western Electric Company—expenditures for new cable of all types were only $1.77 million in 1959. In 1964, due to stepped up construction of coaxial cable routes, this figure reached about $40 million, an increase of almost 23 times. (In contrast, in the same period, total Long Lines construction increased about three and-a-half times.) Five years from now it is expected that annual expenditures for constructing coaxial systems will be at least double the present rate.

Scene above shows a coaxial cable being spliced. The cable has been laid in a deep trench in section of "hardened" route.

Broadband Transmission

In principle, broadband systems—using either cable conductors or a radio relay channel—transmit a band of frequencies several million cycles in width. Then, with terminal equipment at each end, this broadband is subdivided into hundreds of narrower bands, each used for one high quality long distance voice circuit. (The frequency bands used for television programs or high speed data transmission are much wider than those used for voice current.)

Broadband circuits produce better quality transmission than earlier types of cable circuits. An important reason for this is speed—broadband transmission approaches the speed of light. Echo effects—whether in a transmission medium, a room, or a hall—only become bothersome when they return so slowly as to confuse the speaker. With broadband, it is possible to transmit voice currents with more volume than was possible over our earlier relatively slow speed cable circuits, because any echo returns so fast that its effects are minimized.

The Coaxial

The coaxial is a copper tube with a copper wire held in the center by small plastic disc insulators spaced about one inch apart. Since both the tube and the wire have the same center or axis, the name "coaxial" aptly describes the arrangement. These tubes are wrapped with steel tape for additional strength, protection, and electrical shielding. Separate tubes are used for each direction of transmission. A telephone conversation is thus transmitted through two tubes. The band of frequencies a tube will transmit, incidentally, is wide enough for the entire radio spectrum from the broadcast band

Modern Coaxial Cable

up through the short wave frequencies used for overseas circuits.

A modern coaxial cable consists of eight or more tubes and a number of paper or polyethylene-insulated wires used for control, maintenance, alarm circuits, and for communicating over relatively short distances—all contained within a metal sheath. The signals transmitted over these wires control the automatic substitution of protection coaxial tubes and amplifiers in case of trouble and send alarms to manned maintenance centers from unattended amplifiers.

The hundreds of individual voice signals transmitted must be maintained at a constant level. Because signal losses or diminution over coaxial conductors change with temperature, most coaxial cables are buried so they may assume the temperature of the earth, which is relatively constant.

The amplifiers which counteract such attenuation are located every few miles in structures either above or below ground. In all modern coaxial transmission systems, these amplifiers operate automatically and are powered remotely from attended stations usually located at communications terminals or interconnecting points.

Early Coaxial Cables

A Philadelphia-New York coaxial cable, which was experimentally demonstrated in October, 1936, was the first long distance broadband transmission system. The following year, in November, a similar cable was used to transmit television between a local broadcasting studio and the Empire State Building in New York.

Coaxial cable was introduced on a commercial basis in June, 1941, over the 195-mile distance between Minneapolis and Stevens Point, Wisconsin. This cable had

Transistorized terminal equipment is seen above; craftsman checks transmission levels of a group of broadband circuits.

four coaxial tubes—two for working purposes and two for protection—and its amplifiers were spaced at eight-mile intervals. This was the first use of the coaxial carrier system known as L-1, which was designed to provide 480 two-way telephone circuits in a pair of tubes. Later, circuitry was developed to obtain 120 additional circuits.

The L-3 System

To meet the rising demand for communication services after World War II, a coaxial cable system of still greater capacity was needed. After six years of development work in Bell Laboratories and more than a year of field trials, a carrier system (coded L-3) was achieved. With this system, one pair of coaxial tubes can furnish up to 1,860 telephone circuits. With L-3, amplifiers are spaced at shorter intervals—four, rather than eight miles.

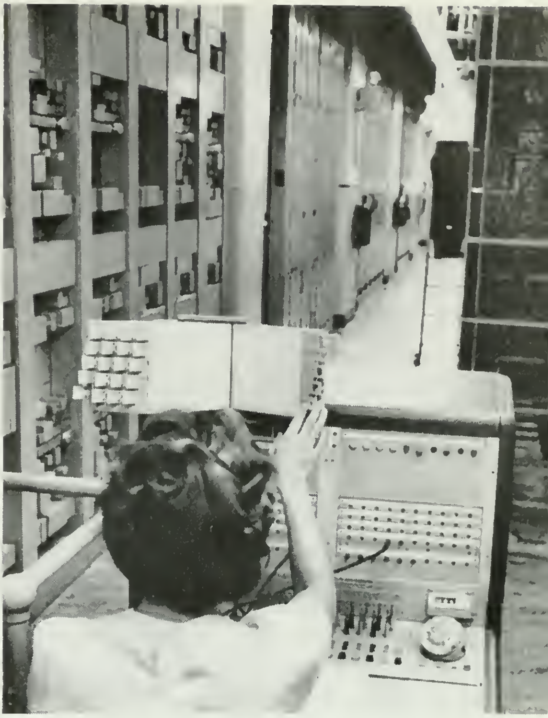
An L-3 system was placed in service in 1953 between New York and Philadelphia. Since then, the use of L-3 has been expanded extensively.

The "Hardened" Route

In 1960, work was begun on a 4,000 mile transcontinental L-3 system with the cable and all amplifiers placed underground. This system is designed to withstand natural disasters, floods, hurricanes, tornados, and crises even to nuclear blasts short of a direct hit. This cable skirts all major cities and avoids possible target areas (see "Continuity of Service," *BTM*, Winter 1963-64).

The California-New York portion of this system was placed in service last November 28. An extension to Boston is scheduled to be opened in mid-1965.

The initial portion of the "hardened route"—a term borrowed from the military—consists of two 8-tube coaxial cables extending from Airmont, near New York City, to Monrovia, Va., in the vicinity of Washington, D.C. From there to its California terminus, the route con-



To speed trouble shooting, a centralized answering position diverts incoming calls to craftsmen in large test room.

A coaxial cable trouble report is spotted on a map in Long Lines restoration center.

Modern Coaxial Cable

sists of a single cable with 12 tubes—the newest and largest in commercial use.

As each pair of coaxials can provide up to 1,860 simultaneous conversations, the cable west of Washington, when fully equipped, will add 9,300 telephone circuits to the existing network. In addition, there are two protection tubes—one for each direction of transmission—which can be automatically substituted for the working tubes in case of trouble.

This cable is buried four feet deep and is capable of withstanding external pressures, such as effects of blasts, of more than 100 pounds per square inch. (A pressure of this type of just one-half pound per square inch could crush the average home.) The construction of this system required the solution of a host of new problems, including the protection of essential electronic equipment against similar pressure as well as shock, thermal, and radiation effects.

Along the route are 900 underground intermediate amplifier stations—all unmanned—and nine intermediate manned communications centers that link the cable with existing communication facilities. These centers are one- or two-story buildings built of heavily reinforced concrete, entirely underground and protected by a thick earth cover.

Small entry buildings are the only structures above ground. Personnel enter the centers through an access vault sealed off by two lead-lined concrete doors, each weighing 3,600 pounds. One door cannot be opened before the other closes.

Ventilation at each center is controlled by a sensing device that would react automatically to a nuclear blast. Under such circumstances, blast valves—huge spring-loaded steel discs—would be triggered into position to provide protection against an initial high pressure shock wave. After a few minutes, these valves would open and filtering equipment would prevent fallout from contaminating the center. Since such a blast would doubtless shake the building violently, the L-3 equipment is suspended in special "shock mounts."

In emergencies, each center can generate its own power and provide living quarters, food and water to operate in a "buttoned-up" condition for at least three weeks.

The New 20-Tube Cable

In 1963, it became evident that a new broadband cable system of increased capacity would be necessary in the near future to meet service requirements—particularly on circuits linking such heavily populated centers as New York and Chicago, and New York and Washington, D.C.

Prior to this time, the largest coaxial cables contained either 8 or 12 coaxial conductors or tubes, all in a single layer. However, it was suggested that it should be possible to construct a 20-tube coaxial cable, using existing Western Electric Company stranding machines. A novel

Coaxial cable in a trench on the hardened route. Trench is about to be back-filled.

Hardened communications center under construction will be entirely underground for protection against nuclear blast. It can provide living quarters, food, water, and its own power and can operate in a completely "buttoned-up" condition for at least three weeks.

two layer manufacturing technique was worked out, and the 20-tube cable is now being produced commercially. It is slightly over three inches in diameter and weighs about nine pounds per foot.

As was the case with the 12-tube cable, this design necessitated the solution of a host of new problems. These included new techniques for splicing a multi-layered coaxial cable, designing it to withstand heavy pressures, production of cable lengths almost 50 per cent longer than those previously used—to reduce the number of splices needed—design of reels to accommodate the greater length, and design of new cable terminals.

The first section of 20-tube cable is expected to be placed in service in the fall of 1965 between Chicago and Norway, Illinois. When fully equipped with the L-3 system, this cable will have a capacity of 16,740 long distance circuits.

The L-4 System

Great as this capacity is, it is still not enough to meet the circuit requirements foreseen for the near future. Therefore, the Bell Laboratories has been working for some time on a new carrier system known as L-4 which will have approximately twice the circuit capacity of L-3, or 3,600 circuits per pair of coaxial conductors. The new system uses transistorized amplifiers spaced only two miles apart, and transmits a top frequency which is about six times greater than that of the original L-1 system.

The first test installation of the L-4 system will be in mid-1965, on the existing coaxial cable between Dayton and Rudolph, Ohio. Among the new techniques to be tested will be the use of pre-cast manholes rather than individually built structures for amplifiers, to en-

Modern Coaxial Cable

One of the new 20-tube coaxial cables is examined by Western Electric engineers.

sure uniform high quality construction at the lowest possible cost.

The capacity of the 20-tube cable, when fully equipped with an L-4 system, will be 32,400 circuits. This will give a route capacity greater than that of any other long distance broadband transmission system, including microwave, available now or in the near future. Studies indicate that the use of L-4 facilities will result in a lower cost per circuit mile in certain areas than any microwave system with comparable transmission performance.

The first 20-tube coaxial cable scheduled to be equipped with L-4 is the Washington-Miami cable, expected to be in service in 1967. Because of the many additional advantages of the new 20-tube cable and the L-4 system, coaxial cable installations being planned are increasing at an extremely rapid rate.

Looking Ahead

Year after year, the average long distance call extends over a longer distance and lasts longer. Again, newly developed services such as wideband data or PICTUREPHONE see-while-you-talk service require extra circuit capacity. Such things will have great impact on the Bell System network of the future.

The tremendous changes and expansion which may be expected in the years ahead are vividly suggested by the studies of the fundamental planning engineers. They believe that in approximately a quarter of a century the present long distance communication network with its associated equipment will only comprise—in type and size—about ten per cent of the plant which will then exist.

In working to anticipate the demands of the future, Bell Laboratories is now experimenting with a high-capacity long distance coaxial cable transmission system radically different from those developed in the past. This is a Pulse Code Modulation System which uses principles similar to the carrier system now used for trunks between offices in the same city where circuit requirements are heavy.

This system samples the voltages present on each of the many signals to be transmitted—some 8,000 times a second in the case of voice circuits. These voltages are then encoded and the codes representing all the samples to be transmitted are interlaced and sent to their destination. Looking at it another way, each individual signal is sent sequentially rather than continuously and therefore occupies the entire bandwidth for only several billionths of a second.

PCM is a system that approaches a transmission man's dream. It has the theoretical ability to eliminate cumulative distortion and the loss of transmission efficiency that lowers the capacity of present systems when, say, television and voice signals are sent simultaneously. It

Pre-cast manholes, a recent development, assure uniform high quality construction at lowest possible cost. Above, a collar is placed on a pre-cast manhole on the new L-4 route in Ohio.

appears likely that PCM will permit the construction of cable routes with greater capacity than anything now possible.

Communication systems using hollow wave guides and laser beams are also being investigated. This follows the Bell System policy that its communication facilities should take diverse forms.

All in all, the entire span of coaxial cable history has been marked by continued and successful efforts to improve and to increase the capacity of this important communication medium. These accomplishments point to an increased role for coaxial cable in the Bell System network of the future.

MILESTONES IN THE DEVELOPMENT OF BROADBAND CABLE SYSTEMS

Year	Cable Coaxials	Carrier Bandwidth	Carrier Rept. Spacing	Circuits Per Route
1936	2 (.270)	1 Mc	10 Miles	224
1940	4 (.270)	3 Mc	5 Miles	600
1945	6 (.270)	3 Mc	5 Miles	1200
1947	8 (.375)	3 Mc	8 Miles	1800
1953	8 (.375)	8 Mc	4 Miles	5580
1962	12 (.375)	8 Mc	4 Miles	9300
1965	20 (.375)	8 Mc	4 Miles	16740
1967	20 (.375)	18 Mc	2 Miles	32400

Telephone and city officials in New York at the opening ceremonies of the first transcontinental telephone line. At center is Alexander Graham Bell, who made the first call.

At the San Francisco end for the historic occasion was Thomas A. Watson, shown third from the left at the table, who was Bell's assistant when the telephone was invented.

Fifty years ago this January the telephone first spanned the continent—

"a singular, astounding accomplishment"

"Hoy! Hoy! Mr. Watson! Are you there? Do you hear me?"

"Yes, Dr. Bell, I hear you perfectly. Do you hear me well?"

"Yes, your voice is perfectly distinct. It is as clear as if you were here in New York instead of being more than 3,000 miles away . . . ."

Thus did the inventor of the telephone, Alexander Graham Bell, and his former assistant, Thomas A. Watson, officially inaugurate the opening of the first transcontinental telephone line 50 years ago. Bell talked from A.T.&T. headquarters in New York and Watson from the offices of the Pacific Telephone and Telegraph Company in San Francisco—a distance of 3,400 miles. The date: January 25, 1915—39 years after Bell, standing in an attic in Boston, had spoken to his associate over a crude telephone, "Mr. Watson, come here, I want you!"

For Bell, the transcontinental achievement was a young man's prophecy come true. As he recalled in 1916 at ceremonies in Boston commemorating his first laboratory: "... it was my belief that, with these crude instruments that appeared here in 1875, by and by, any man in any one part of the United States could talk to a man in any other part . . . ."

Moment of triumph: on June 17, 1914, the last pole was raised at Wendover, Utah and topped with the American flag. Champagne was served in glass insulators.

The remarkable communications services of today—with information traveling via space satellites and cables under the sea — tend to crowd the achievement of 1915 into the forgotten pages of history. But for the world of that time, the bridging of a continent was a tremendous event, and many saw it as ending provincialism and drawing the country closer together. To the men who worked on it, the first transcontinental line remains as a singular, astounding accomplishment.

One such retired employee, who recalls sleeping in a deserted bunkhouse with no fire to keep warm, says, "We were dedicated to this job and went on to finish it and took a great deal of pride in our work."

And another says, "Nothing the Bell System has done since has surprised me . . . I could see that with this accomplishment, anything was possible."

Telephone workers building the last leg of the line 398 miles across Nevada lived in covered wagons like the one shown above.

Survey crew from Mountain States Telephone Company work on route from Denver to Salt Lake. Here the span between poles is measured while the axman stands ready to drive stake.

Route of first transcontinental line. Terrain and weather created real demons: men endured violent blizzards and temperatures as low as –40°; blistering heat and blinding glare of the desert; rock-hard salt flats, spring floods and knee-deep mud.

A pole rises in a salt sink. Holes were easy to dig in mud flats, but often caved in before the poles could be set.

Sandia Laboratory Administration Building on Sandia Base in Albuquerque, N. M.

Through the Sandia Corporation, a Western Electric subsidiary, the Bell System is making a unique and valuable contribution to our nation's nuclear defenses

THE SANDIA STORY

Siegmund P. Schwartz, *President, Sandia Corporation*

THE RECENT signing of a new contract between the U. S. Atomic Energy Commission and the Western Electric Company extended for another five years the highly important national defense assignment of Sandia Corporation, a unique member of the Bell System family.

Security considerations have limited the disclosure of detailed information about Sandia's operations, but there are many facets of the task that can be discussed and as the technology develops, broader applications are being found for the information once narrowly applied to weapons design. Sandia's responsibilities in the field of ordnance extend from the inception of each nuclear weapon to the retirement of that weapon from stockpile.

Sandia operates two laboratories: Sandia Laboratory at Albuquerque, New Mexico, and Livermore Laboratory at

SANDIA

Livermore, California, as well as a test range at Tonopah, Nevada. In addition, small groups are assigned to missile test centers at various locations.

Sandia, Los Alamos Scientific Laboratory (LASL) and Ernest O. Lawrence Radiation Laboratory (LRL) constitute the three principal nuclear weapons development installations of the Atomic Energy Commission.

LASL and LRL, both operated for the AEC by the University of California, are responsible for the nuclear systems in weapons. Sandia has the job of designing, developing and monitoring production of all other components and systems necessary to make a nuclear explosive assembly a useful weapon for the military services. This job is sometimes referred to as "weaponizing" a device developed by the nuclear laboratories.

■ Sandia responsibilities involve basic and applied research; systems, component, and manufacturing development; environmental testing; quality control; reliability assessment, and supporting activities including personnel, computing, technical writing, purchasing, accounting, industrial relations and plant engineering. Sandia also maintains a small field engineering force and trains military instructors in the maintenance and operation of nuclear weapons.

Sinusoidal shaker tests re-entry vehicle as part of SNAP Program safety evaluation.

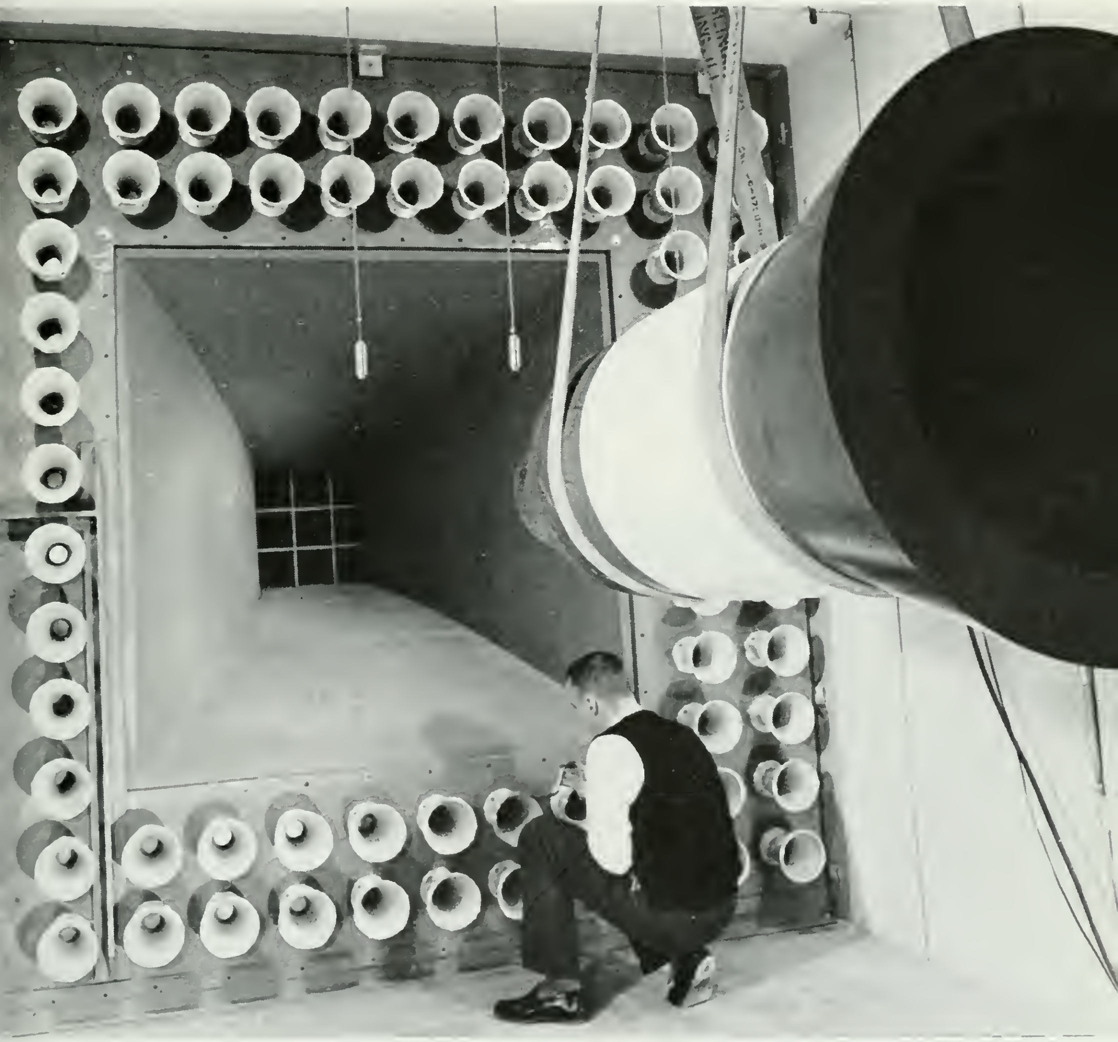
In the course of developing a bomb or warhead around the nuclear systems, Sandia works closely with the Department of Defense's aircraft or missile contractors to assure compatibility of the weapon with the delivery system. The Defense Atomic Support Agency (DASA), a joint Air Force-Army-Navy-Marine Corps organization, with headquarters in Washington, D. C., serves as the coordinating agency between the military services and the AEC and its contractors, on the military requirements for nuclear weapons. Field Command headquarters for DASA is located on Sandia Base. The excellent working relationship between Sandia, AEC, DASA, LASL, and LRL is a major factor in developing and providing nuclear weapons for the defense of the nation.

Turning to Private Industry

The story of Sandia is almost as old as the atomic age itself. Sandia Laboratory had its beginning as part of LASL during the planning phases of the first nuclear detonation in 1945. The operation was expanded in 1946 to provide a better tie with the growing military establishment and airbase in Albuquerque. The Sandia facility continued to grow in both scope and size, and in 1949 the University of California, which was responsible for the laboratory as a branch of LASL, asked to be relieved of the ordnance engineering job.

Convinced that the task should be placed in the hands of a private industrial concern, President Truman asked the Bell System to assume the responsibility for management of Sandia. In a letter to Leroy A. Wilson, then president of A. T. & T., in May of 1949, President Truman said in part: "This operation, which is a vital segment of the atomic weapons program, is of extreme importance and urgency in the national defense, and should have the best possible technical direction. . . . In my opinion you have here an opportunity to render an exceptional service in the national interest."

This was followed by a letter to Mr. Wilson from David E. Lilienthal, then chairman of the U. S. AEC, which outlined the various responsibilities of Sandia Laboratory and stated that these encompassed work normally done by both Western Electric and the Bell Telephone Laboratories. He stated: "I emphasize this point to indicate the Commission's interest in drawing on the managerial and technical resources of the Bell System, wherever they are found, to the extent that they will bring greater strength to the operation of Sandia Laboratory. . . . it is of the highest importance to the atomic weapons program that the organization at Sandia be the strongest organization that it is possible to obtain. It is



Vibrations produced by sound are part of the environment a weapons system might meet: the acoustic chamber creates a high-intensity acoustical field to simulate these conditions.

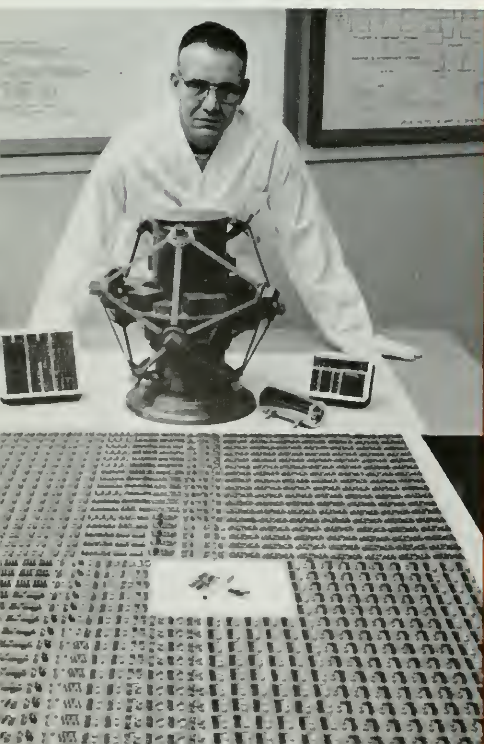
the Commission's belief, shared by our eminent scientific and technical advisors, that your organization is uniquely qualified to bring the needed strength to Sandia."

In July, 1949, Leroy Wilson replied to Chairman Lilienthal, in part: ". . . The Bell System has always stood ready to do its part in the national defense by undertaking work for which it is particularly fitted; and we agree with you that our organization and methods of operation give us special qualifications for the work you have described. For these reasons we are willing to undertake the project."

To handle the assignment, Western Electric created Sandia Corporation as a subsidiary to operate Sandia Laboratory for the AEC as a service to the government, without fee or profit. Although Sandia was a subsidiary of Western Electric, it was to have full access to the technical and industrial know-how of the entire Bell System, particularly Bell Telephone Laboratories.

Component Development

An important part of Sandia's responsibility in nuclear weapons is that of component development. The availability of suitable components frequently sets the time schedules of the development program on a particular weapon. Activity in this area is maintained on a high level in two broad categories—providing components for scheduled weapon programs and anticipating the component needs of future weapons. Many devices and components used in nuclear weapons are available in commercial form, yet they may require extensive modification or redesign to meet Sandia's requirements for reliable operation in severe environments. Other devices are unique to the demands of nuclear weapons systems. For both types Sandia has established demonstrated capability for in-house development, both to prove feasibility and to develop final designs for manufacture.

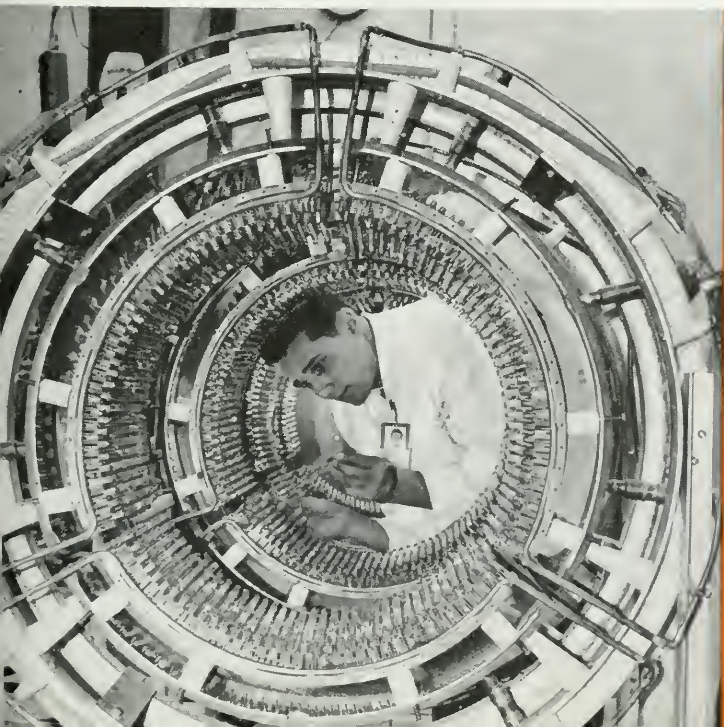


Sandia does not itself manufacture or assemble weapons for stockpile. The laboratories fabricate models or prototypes of components and systems and then, upon completion of the design task, Sandia releases the final designs and manufacturing information for use by various suppliers throughout the country. Thus, drawings, specifications and other manufacturing information may be said to be Sandia's chief product in the nuclear weapons program. Actual manufacture of components and assembly of the weapons for stockpile is done by other AEC prime contractors and by American industry in general.

However, Sandia's responsibilities do not end with the release of these design specifications. A quality-assurance program is maintained to monitor the quality of products as they are being manufactured. Indeed, prior to releasing a design for manufacture, Sandia engineers design and develop all the necessary gauges, inspection procedures, and production testers used to accept the final product. They also prepare spare parts lists and packaging requirements associated with a given weapon.

Quality and reliability of weapons cannot be assured solely by a check and recheck of components and their performance during and after manufacture and assembly. Quality and reliability must be designed-in and built-in—they cannot be inspected-in at the end of the production line. The objective is to attain and improve product reliability through improved product quality. Technical control of quality is achieved through product definition, quality control and acceptance requirements, using the team approach to integrate the total engineering effort in the development of quality and reliability standards. Many of the components are explosively operated and thus expended in one operation; therefore, such an item in stockpile is itself untested. Statistical sampling, coupled with carefully developed in-process manufacturing control, must take the place of individual testing of every unit.

Engineers in every area of design and development at Sandia are keenly aware of the need for extreme emphasis on operational reliability. Hopefully, nuclear weapons will never be used, but if they are, the pressure of the moment for



Far Left: Scores of tiny components make up Sandia - designed logics systems of Vela detector satellite.

Center: Surface condition of a nose cone undergoes extreme low-temperature test in climatic environmental test chamber.

Left: Heating arrays in radiant heat facility are individually designed for each test, can reach 5000° in seconds.

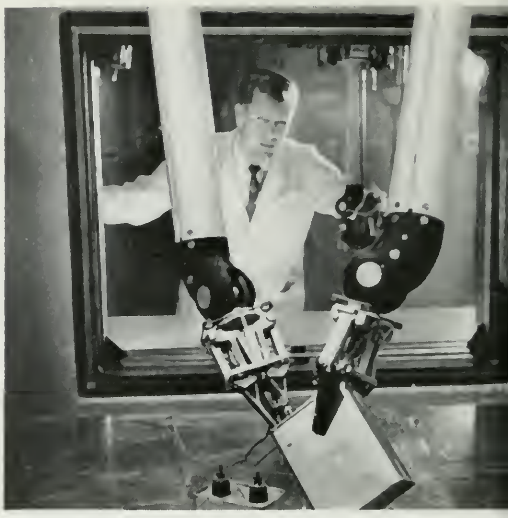
split-second decisions, fool-proof procedures, and one-chance target acquisition, makes reliability the most important design consideration.

Environmental Testing

Because of the vital nature of Sandia's work, all of its designs, during and after development, must be subjected to severe tests simulating all possible physical environments that nuclear weapons might encounter in the hands of the military services. The use of missiles as delivery vehicles, for example, creates severe working environments for warheads. Materials are affected by high temperature, the severity and complexity of vibrations produced by high thrust power plants and by atmospheric re-entry conditions. All these conditions must be anticipated and simulated to insure the utmost reliability. To do this, Sandia has developed one of the outstanding environmental testing laboratories in the country.

These test facilities are located in what is known as Technical Area III, about six miles south of the main Sandia Laboratory on Sandia Base. "Area III," covering three square miles, contains numerous test facilities designed to subject weapons systems and their components to environments more severe than any they would encounter in storage, transportation or delivery.

These test facilities include: two drop towers (300 and 185 feet), two large centrifuges, a rocket sled track, an air gun with a 26 inch bore, a radiant heat facility, a high temperature oven, an altitude and humidity chamber, an acoustic chamber, sinusoidal and complex wave shakers, 155-mm guns, a small-explosives test area, and others. These facilities are constantly being modified and supplemented as necessary to keep up with projected weapon design and operational requirements.



Radioactive materials are handled by master-slave manipulator in Sandia nuclear reactor.

The 3000-foot sled track facility is used to simulate various types of accelerations encountered during missile launch and re-entry. The rocket-propelled sleds reach velocities up to Mach 2.3, approximately 2500 feet per second, which allows testing with high velocity impacts into various targets including wood, earth, metal, water, and concrete.

Of the two centrifuges, the older one can carry test items weighing up to 10,000 pounds to simulate the loads imposed on weapon components and systems by the acceleration of missiles or jet aircraft. The centrifuge arm, with a radius of 35 feet, can subject a 1,000-pound object to 240 times the force of gravity. The newer centrifuge, recently installed, is the largest in this country in terms of dynamic load capacity. It will be used in combined environmental tests — both acceleration and vibration — to simulate forces of rocket launch, re-entry and other field environments.

■ To simulate thermal environments, such as those a missile encounters when it re-enters the earth's atmosphere, components are subjected to rapidly

Sandia men install hydrodynamic gauge to measure nuclear explosion shock wave in Project Shoal experiment to improve ways of distinguishing earthquakes from underground explosions.

changing extremes of temperature. Test items may be placed in the radiant heat facility, which can reach temperatures as high as 5,000° F. in seconds. Or they may be placed in the large climatic test chamber where temperatures can range from 100 degrees below zero to 250 degrees above. Altitudes ranging from 2,500 feet below sea level to 100,000 feet above can also be simulated. Temperature shocks can be imposed on a test sample by rapidly moving it from one compartment in the climatic environmental test chamber (which may be cooled to a sub-zero temperature) to the other compartment (which may be heated).

Equally severe environmental tests to simulate all possible conditions a weapon system might encounter are performed in other facilities in Area III. Test items may be subjected to acoustic, random- and complex-wave vibrations, mechanical shocks, or a variety of impact tests. Adjacent to Area III are two nuclear reactors and a 50,000 curie cobalt 60 gamma-ray irradiation facility, all used in conducting radiation damage studies. These programs principally concern the effects of nuclear radiation on materials, electronic components and electronic circuitry. The Sandia Engineering Reactor has the capability of irradiating very large test assemblies and the additional environments of heat, cold, pressure or vacuum may be applied simultaneously with irradiation for compounding the stresses on materials and assembled units during tests. The Sandia Pulsed Reactor produces short bursts of neutrons, gamma and X-rays and is employed principally in the study of radiation damage effects produced by nuclear explosions.

■ Sandia also has other test facilities at its Livermore Laboratory and at the Tonopah Test Range (TTR) in Nevada. The range is primarily a ballistics range for testing devices dropped from aircraft or launched by rockets. Rockets also are launched at TTR in upper atmosphere research and instrumentation development programs. At missile ranges throughout the country, Sandia participates in missile development tests as a necessary part of warhead development. Sandia field-testing facilities and personnel are located at launch areas such as White Sands and Holloman in New Mexico; Cape Kennedy, Florida; Vandenburg Air Force Base, California; and Dabob Bay, Washington. Sandia also participates in full-scale nuclear test ac-

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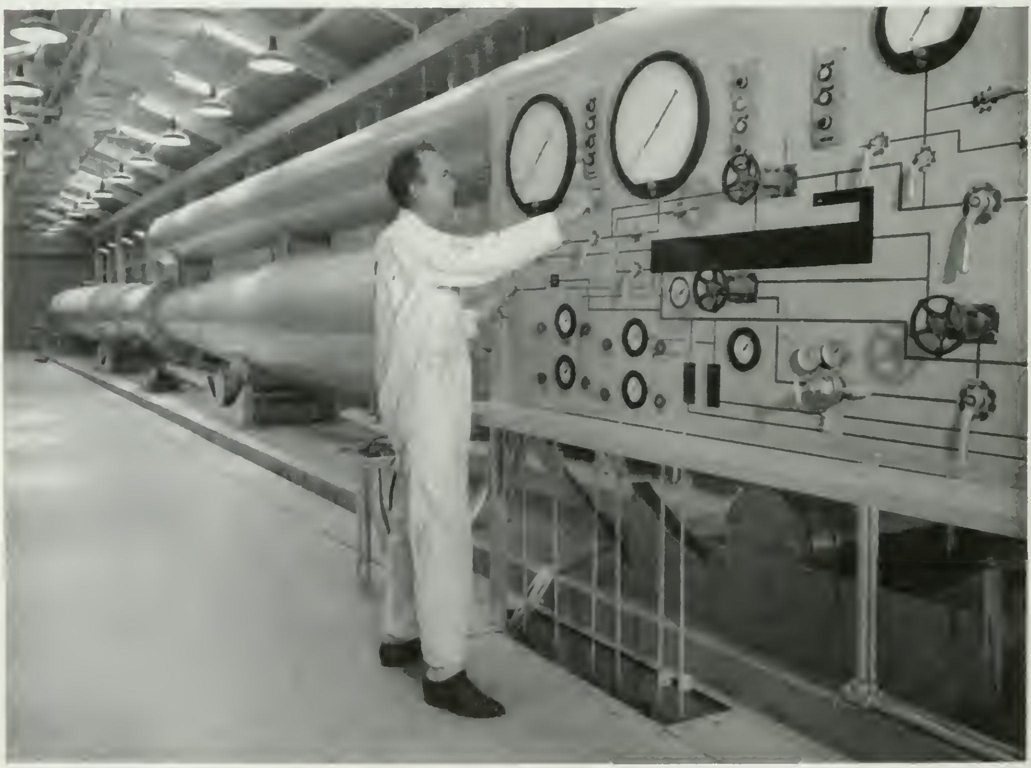
tivities, providing much of the diagnostic instrumentation and assisting in the reduction and analysis of the test data.

Research

Reinforcing the ordnance engineering program and underlying the barrage of testing Sandia performs is the research carried on by the scientific and technical staffs in the laboratories. Research at Sandia is both applied — searching for answers to a specific problem—and basic —a quest for fundamental information which may have future weapons application. This activity covers the fields of physics, mathematics, engineering, physical chemistry and aerodynamics in such fields as physical electronics, solid state physics, theoretical mechanics, plasma physics, radiation effects, high temperature physics, and the many disciplines necessary to understand nuclear burst phenomena. This program provides for the earliest application of scientific advances to weapon programs. It is the key in the all-important job of keeping abreast of the constantly advancing state-of-the-art, and in anticipating changes in weapon requirements and capabilities.

After a given weapon reaches stockpile, Sandia's surveillance organization periodically inspects representative samples and conducts tests to assure continuing operability throughout the life of the weapon. Quality engineering groups test selected samples of weapons and components at manufacturing and assembly locations. They write quality control and



Two 16-inch naval rifles flanged together form air-gun with 92-foot barrel which can produce high-acceleration and high-velocity shocks on test items weighing up to one ton or more.

inspection procedures, gather and evaluate data, and perform destructive and non-destructive tests on the samples. The validity of sampling and testing techniques is constantly checked, to be certain that the results will guarantee an extremely high order of reliability in components and complete systems.

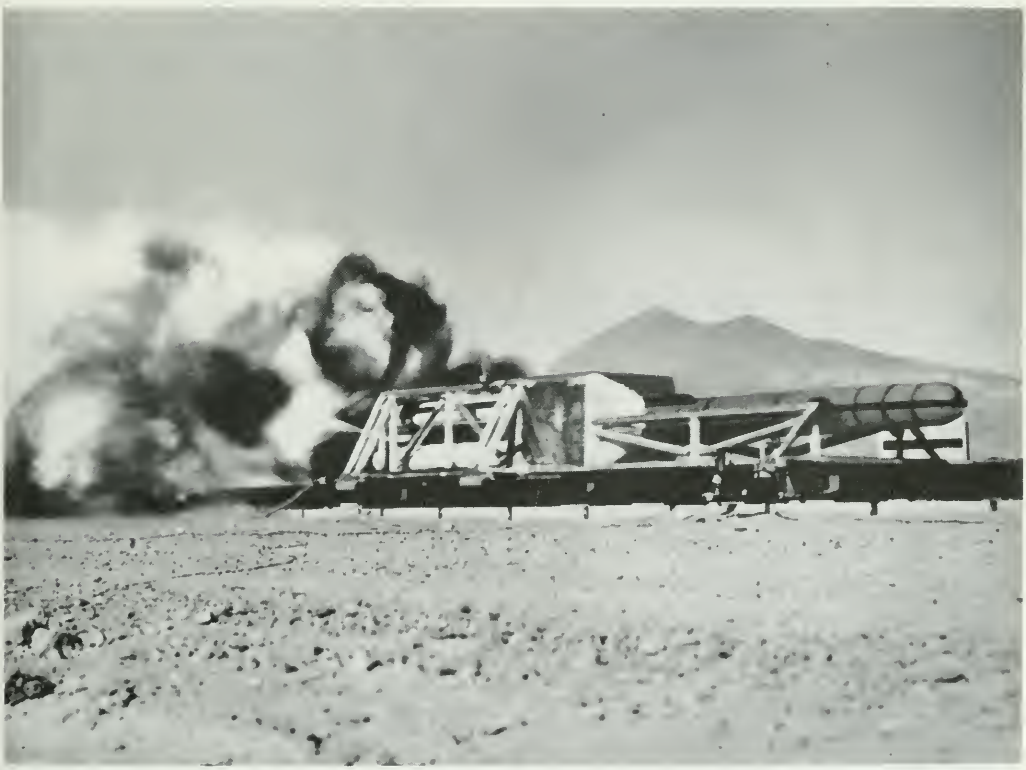
Still another Sandia responsibility is that of training military instructors in the maintenance and operation of nuclear weapons. These instructors then conduct courses for military personnel responsible for field use of the weapons. In addition, throughout the life of a nuclear weapon, its operational use is guided by technical manuals prepared by Sandia.

Non-Weapon Projects

Although weapons development is the primary responsibilty, the techniques, facilities and skills developed by Sandia in 15 years of ordnance engineering experience in the atomic weapons program provide a capability that fits naturally into certain non-weapon projects of current national interest.

Sandia's work in Plowshare (peaceful use of nuclear explosives), primary responsibility for which rests with the Lawrence Radiation Laboratory, has been mainly in the field of cratering research and blast effects. Considerable work has also been done in instrumentation, including earth-motion studies.

The AEC also has assigned to Sandia a task of investigating and evaluating the safety of nuclear power systems being designed by various industrial contractors for use in space vehicles under what is known as the SNAP Program (Systems for Nuclear Auxiliary Power). This task is carried out in cooperation with, but independent of, the work of the de-



On Sandia's vast environmental test area, rocket-powered sleds shoot along 3000-foot sled track facility reaching velocities up to Mach 2.3 to simulate both launchings and impacts.

SANDIA

signers of the systems and involves both ground and flight testing to prove that the safety features of the design function as intended. The systems investigated to date include the SNAP 9A, an isotopic generator and SNAP 10A, a small nuclear reactor.

Sandia's capabilities have also been used in other programs. Recently the Department of Defense launched the Vela satellites to investigate the feasibility of a system for detecting nuclear detonations in space. Sandia designed and fabricated the data-processing system in the satellites, together with special test equipment for check-out prior to launch. This logics system made it possible to record, reduce, analyze and transmit only significant data collected by the detectors in the satellites. After this material is collected by a world-wide network of ground stations, it is sent to Sandia for conversion of the data to digital form prior to final reduction and study. Performance of the logics systems in the Vela satellites has exceeded expectations. Valuable information is being obtained concerning natural radiation in space to aid in the identification of possible clandestine nuclear detonations.

■ For the present, nuclear weapons are Sandia's principal responsibility and major activity. The variety of our nation's nuclear arsenal, in stockpile or under development, is vast, and ranges from subkiloton infantry weapons to multimegaton bombs and missile warheads. Because of steady advances in the state of the art, no nuclear weapon, whether in stockpile or under development, is ever considered to be the ultimate in design. The research and development teams of engineers and scientists at Sandia will continue to be challenged by new demands of the military, new applications for weapons, new concepts by strategists, new weapon developments by potential aggressors, new carriers for bombs or warheads, and refinements and discoveries in such areas as materials, miniaturization and manufacturing processes. Sandia will continue to meet the challenge of its responsibility for helping to provide our nation with the array of weapons which serve both as a deterrent to attack and as effective armament in the event of attack—and, when appropriate, of helping to develop the peaceful uses of this same nuclear power.

Programed training is proving to be a spectacularly successful means of instructing telephone operators in the use of the new Traffic Service Position. Here is a visitor's-eye-view of this new training method in action

Richard O. Peterson,
Training Research Supervisor
Operations Department, A.T.&T. Co.

■ WHEN THE VISITOR opened the door, he was sure he was in the wrong room. A young lady got up from behind a desk and came over to him, saying, "Good afternoon. May I help you, sir?"

"Yes, please. I was looking for the operator training center—the new one for the Traffic Service Position. Can you tell me where it is? I must have turned wrong somewhere."

WHERE'S THE TEACHER?

"This *is* the TSP training center. Please come in. I'm one of the group chief operators."

The visitor looked around for training switchboards and drill tables, but he saw only pairs of desk-like consoles arranged around the room. Girls were seated at each of them, intently working alone.

"These are Traffic Service Positions?" he asked.

"That's right. Actually, these are training positions, but they look just like the operating positions. These are used for operator learning and practice, and also for finding out how the operator is progressing in her training and what help she may need. This training center has been set up just for our TSP cut-over next month. After that, these training positions will be located right within each of the offices for training new operators. We have a few new operators here now, but most of those you see are experienced people."

"If they're in training," the visitor asked, "where are their teachers?"

"The girls at the tables over there are the instructors—their supervisors. They're planning and preparing for their operators' next steps, and they're probably studying the progress records they have made."

"But they're not even watching the students," he pointed out.

"This is programed training, where the student is responsible for much of her own learning and development. The supervisor—well, I'd better start at the beginning. First, why don't you look around for a few minutes while I check with one of my supervisors? Then we'll go back to the beginning. Excuse me."

As she left, the visitor strolled through the training room, listening and watching.

"The line is busy. One moment, please. I'll try again for you." "Thank you for dialing. May I help you?" "Shall I try later, Mr. Cole, or would you prefer to

Dr. Peterson at program cabinet: magnetic tape unit, top; perforated tape unit center; below, some of 117 tapes for training course.

place your call again?" "I'm sorry your call wasn't completed, Miss Edwards."

The visitor was thinking, "They seem to be talking to customers and handling real calls, but where do the customer voices come from and what makes the signals light up on the positions?"

He had seen many switchboards with cords, but here he didn't see a single pair of cords on these positions. Instead, the operator depressed various combinations of keys, sometimes in a rather complex pattern of movements. Occasionally she wrote or made marks on special cards of some kind, and sometimes numbers appeared in a window at the top of her position, apparently giving her some information she needed. It was quite different from any switchboard he had ever seen.

Then he realized, "Why, they're not even working on the same thing!" Each operator seemed to be working at different speeds and on different kinds of calls. And some were not working on calls at all, but were reading from small plastic-bound books and writing in notebooks. This was training?

While he was observing, a student pressed a key on her position, and a signal flashed near one of the supervisors. The supervisor went to the student to give her assistance.

The visitor was impressed with the calm, business-like atmosphere of the training center. It seemed to be conducive to learning; although the operators were not being instructed or supervised every minute, they worked along at an earnest pace, very involved in their work.

"Now then," said the group chief operator, appearing at his side again, "where shall we begin?"

"I've got lots of questions, but why don't we start with programed training? What do you mean by that?"

"To begin with, in 1963, an operator training course was developed by A.T.&T. called a 'programed training course.' It had a lot of research and trials behind it and made use of programed self-instruction (see "Programed Self-Instruction" *BTM*, Spring 1963). But because it was a complete training course for new operators and because it included a variety of training methods, all with some programed features, it was called 'programed training.' That's my understanding of it, but the Administration Guide for that course really spells it out."

"So this TSP course, then, is another 'programed training course'?"

"Yes, and in this course we also have a training position which can be programed along with the printed learning guides

A member of the training staff illustrates how a supervisor assists a student in learning to operate a Traffic Service Position.

WHERE'S THE TEACHER?

that the students sometimes use."

"Those little plastic-bound books?"

"That's right. There are 24 of them in the TSP course. Some of them are used right along with the training tapes."

"Tapes? Is that where the voices come from, and the lights?" he asked.

"Yes, let me show you."

They went into an adjoining area where she opened the door of a tall green cabinet. "At the top of this program cabinet is a magnetic tape unit that plays stereo tapes. . . ."

"Like I have at home for stereo music?" he interrupted.

"Probably, except that this has voices on one track and special tones on the other track which you do not hear. But the equipment hears the tones and uses one of them to keep the magnetic tape in step with this other tape in the cabinet."

She pointed to a blue paper tape threaded across the middle of the cabinet. "This perforated tape is punch-coded to wait for the operator to take a specific action and then when she does, the equipment takes some action, like putting on a signal, starting ringing, or sounding a coin deposit."

"This paper tape does all that?"

"It does, along with all the equipment in this other cabinet." She opened the door of a neighboring cabinet, exposing row upon row of relays.

"And that's how the equipment does so much!"

"But not nearly everything. I'd like you to talk to one of our supervisors, while I find the district traffic manager." She introduced him to the supervisor, explaining that he was interested in programed training and her part in it.

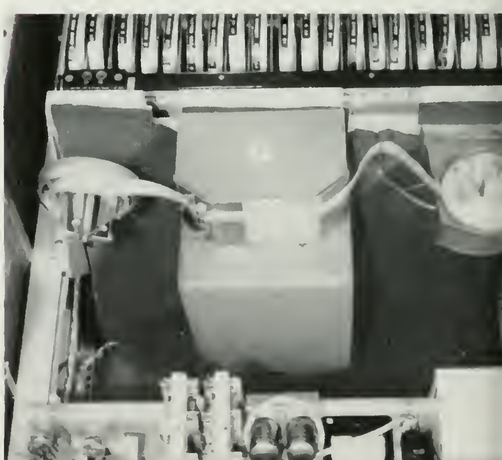
"Well, let's see," began the supervisor. "Of course, one of my main jobs is to coordinate all the different activities of the training course for my student according to plans and procedures in my training guide. Then I introduce each activity to the student; some activities I present through specially outlined learning discussions and review discussions."

"Then you do spend time with your student while she's in training."

"Oh, yes, sir. I'm with her about a quarter of the time—to present a discussion on conditions just local to this area, or to demonstrate some special skills, or to have her discuss procedures and principles of operating with me when we review. Then, of course, I'm always available to help her, and I look in on her every once in a while to see how she's getting along on the self-instructional materials."

"But most of the time, then, the operator works on her own. How do you know she's really progressing?" he asked.

"I have evaluations to conduct periodically to make certain the student gets



Close-up of perforated tape unit; each is programed to operate one training position.

any special help she needs before she goes on. I think this is one of the most important responsibilities I have."

"You're certainly enthusiastic about it," the visitor said.

"In all my years of service—and that's a good many—I've never worked with anything so satisfying! In fact, even when I'm not conducting training, I think I do my regular job better since I've worked with programed training."

"And to think that I wondered where the teacher was! All the time you were right in the center of it."

"Excuse me, my student needs me. Nice to have met you."

The group chief operator returned with the district traffic manager. After the introductions, the visitor said, "I'll let you all get back to work very soon now, but would someone please explain what you mean by the Traffic Service Position and TSP service? What does it do for our customers?"

The district manager took him to one of the positions momentarily vacated. "First of all," he began, "the customer can get faster service, with accurate billing, through automatic accounting procedures. He dials his complete call, even if he wants special service like a person-to-person call, a collect call, or a credit card call, but he begins his dialing with the digit 'zero' if he wants that service. One of these signals lights on an operator's position, showing what type of call the customer has dialed. She can also display the number he dialed and the number he's calling from and, in the meantime, his call is advancing."

"And the operator then helps him get the person he wants or records the credit card number or whatever," concluded the visitor. "Really she seems to handle segments of calls then, the less routine parts."

"That's right. The equipment can only do the routine part of the call handling. The operator must do everything else. You can see how varied her TSP job is then, and rewarding, because it gives her the best opportunity for using her own judgment and initiative in helping the customer."

A portion of the TSP training center in Boston; supervisors are available if needed.

"Pardon me, may I use this position?" It was the student returning.

"Certainly. By the way, I'd like you to meet our visitor. He's here to see our training center in action."

"I'm glad to meet you, and isn't it great? If you'll excuse me, I want to get started again. Glad to meet you, sir."

"Well, you certainly have an enthusiastic group here," said the visitor.

"Yes, and I understand it's like this in all the offices where TSP is going in," said the district manager.

"You know, everything begins to fit together in my mind now," said the visitor. "As I see it, your programed training has taken the best from a lot of different training methods and put them together in a kind of blend. And really this blend uses a variety of teachers—programed materials, training equipment, and supervisors—all working together. And to think I wondered where the teacher was!"

Time tyrannizes us all, and especially the salesman who spends more time in traveling and waiting than in selling. The telephone can help him defeat the clock and the calendar

PHONE POWE

Stanley F. Damkroger, *Assistant Vice President Marketing Department, A.T.&T. Co.*

■ THE PROBLEMS of distribution are the opportunities of communications. The high cost of market coverage, wasted sales time, the marginal customer, the lag in cash receipts—all of which are basic to meeting and beating competition and that ever-present profit squeeze — these problems are being solved by "Phone Power."

Phone Power is one of the ways in which business is using communications to solve those vexing problems. But, to cover the whole interplay of distribution and communications is beyond the scope of these pages, so let's concentrate on the selling function.

Modern marketing demands that all resources and techniques be used where appropriate. Communications in the selling function is not a panacea, but it can be a very effective tool when it is fitted properly to the total sales program.

■ Only one third of the average salesman's time today is spent in actual selling—the balance is spent in traveling, in waiting, and in paper work. One simple, effective and courteous way to increase selling time is making opportunities by phone. We've heard salesmen and sales managers say, "It won't work." I have heard it in dozens of cases—but it does work, and once convinced, the salesman never goes back to old, wasteful habits. In our own selling activities, we demand that an appointment be made for every business sales contact. We have doubled selling time and more than doubled productivity by this one simple and, I repeat, courteous technique—courteous because the prospect does appreciate it and says so. Also, and importantly, it builds the salesman's image in the prospect's eyes. When appropriate, some salesmen arrange to have the prospect make an inventory check prior to the salesman's visit. Most prospects are quite willing to do this because usually it saves them time in the end.

The telephone, judiciously used, helps combat two of the salesman's oldest and most persistent enemies: time and distance.

N ACTION

Whatever time the salesman spends in actually selling, can be made more productive by timing the contact to the inventory cycle. It surprised no one that a recent study made by the Sales Executives Club of New York found that the best time for a salesman to contact the customer was when the customer's inventory had reached two-thirds depletion. By contacting him at that time, the salesman protects his customer from out-of-stock conditions and protects himself from the inroads of competition.

■ But inventory cycling demands wide coverage as well as proper timing. Unfortunately, these two factors —timing and breadth of coverage—invariably conflict.

If customers are few and close by and the salesman is fast enough, he can probably handle inventory cycling through visits to the customer. But as the number of customers grows, as they become scattered and far flung, proper inventory cycling becomes a problem. With judicious use of the phone the salesman can time his premise visits to the optimum opportunity. In many instances this timing of the inventory cycle has led to a pattern of alternate visits and phone contacts or some other mix of the two. A recent example of the success of this approach is the experience of one of the country's largest paint companies. Its problems of coverage and timing were serious. To solve the problems, their sales department programed telephone calls to complement their visits. Every other contact to a retail outlet is made by a trained saleswoman by phone. This plan has given this company better market coverage, significantly greater sales at less sales costs. One saleswoman, in ten weeks, made 995 telephone calls, resulting in 438 sales worth $49,420.

Marginal accounts—those where the size of orders is so small that the sales costs alone eat up practically all the

The salesman's time can be made more productive by timing his contact to the customer's inventory cycle.

profit—are ideally suited to coverage by phone. One example, a major candy manufacturer: the problem was rising sales expense involved in selling marginal accounts on a face-to-face basis. Should they drop these accounts, suffer loss of exposure, and leave a vacuum for the competition to fill? Or, should they just live with the problem, recognizing that these marginal accounts were not profitable but were necessary from the standpoint of mass distribution and future potential? Or, was there another, better answer?

■ They took their problem to a Bell System communications consultant. Working with the customer's sales management, he developed a Phone-Power program for telephone coverage based on inventory cycling. The result: better market coverage, significantly higher sales, and sales expense cut in half.

Appointments, inventory cycling, marginal accounts and many other applications of the use of communications in the selling process have resulted from the Bell System salesman working with business. Here are a few more examples of Phone-Power in action:

The Gates Rubber Company of Denver is the world's largest manufacturer of V-Belts—with distribution problems to match. They have learned that wasted sales hours can be recovered and made available for productive selling by using the telephone to prepare for personal visits, to supplement them, and in some cases to replace them.

Many of Gates' West Coast dealers were widely scattered and frequently quite small. Gates discovered it was costing more and more to keep up personal sales visits every month or two with these dealers. Volume of sales was barely meeting costs. These dealers were definitely

The PHONE-POWER Program concerns itself not only with training our own Communications Consultants as specialists, but also includes a comprehensive customer training package consisting of six PHONE-POWER Programs as well as a complete management training course.

Although our plans call for 18 PHONE-POWER Programs, the following six are currently available:

Opening New Accounts
Reactivating Accounts
Inventory Cycling
Credit and Collection
Making Appointments
Sales Opportunities in the Service Call

Each Program consists of a universal introductory text, a demonstration film and a self-instructional text.

To insure management understanding, control and direction, there are available to the customer the following management training units:

1. The Program
2. The Basics
3. The Procedures
4. Market Organization
5. Quarters and Work Group
6. Principles of Coaching and Evaluating
7. Coaching and Evaluating by Program
8. Personnel Selection and Induction
9. Planning, Organization and Controlling

Power belt manufacturer: "Some of our older accounts preferred doing business by phone. It cut down that long parade of salesmen."

marginal accounts. At first, Gates felt they might have to let some of these accounts go. But they decided to try something first—fewer personal visits, substituting phone calls instead. Not "now and then," but calls every two weeks on a regular basis.

Results—sales costs were sliced in half, without loss of sales volume. And Gates didn't have to drop a single dealer. Telephone costs came to less than four per cent of telephone sales. What's more—quite a few old accounts who had stopped buying, came back to them. These accounts preferred doing business by phone. It cut down that long parade of salesmen.

Many a business firm is faced with a large mass of potential customers who have to be screened or qualified. The prospects must be separated from the suspects. Communications can do the job.

In the case of the New York Central Railroad System, it was a question of finding out which steel companies handled a big enough volume to warrant going after their business. Within the broad area served by New York Central, there were some 9,000 different firms dealing in steel. The New York Central planned to have their salesmen make random checks as they passed through each territory. But that's a lot of territory to cover by personal contacts; it would have taken months. A Bell System salesman studied the problem and recommended using the telephone to qualify the market. He helped New York Central lay out a program. In 90 per cent of the cases, the New York Central was able to get the exact information they needed.

New York Central not only uses the telephone for qualifying prospects, but they find it helps to supplement visits to smaller accounts and to handle service problems for the very biggest ones. This releases field men for face-to-face selling. The phone does save time and money for New York Central.

■ Another major innovation in the use of the telephone is for the thoroughly-planned, expertly-guided promotional campaign, such as the one that in a single week sold 84,000 dresses for Sunnyvale industries.

Sunnyvale had planned a series of ads in national magazines; they had originally intended promotional follow-up with lunches, direct mail, and all the trimmings. But they ran into mechanical delays and found their whole schedule had gone haywire, leaving them with a beautiful campaign—that nobody would know about. A consultant from the telephone company heard about the problem and suggested beating the time squeeze by using the telephone. He worked out a selling plan and trained Sunnyvale's sales people in it.

Mac Kaplan, president of Sunnyvale, says the telephone promotion resulted in nearly ten times as many sales as would have been made by in-store visits.

Sometimes a completely new market can be opened up by telephone—for example, a market cut off from the manufacturer only by the barrier of distance. Gilbert Merrill, who heads his own steel corporation, found a way to crack that barrier: he runs what's known as a "steel warehouse," providing high-grade metals on a relatively small-order rush-service basis—normally within a hundred mile range.

Mr. Merrill reasoned that the telephone ought to give him a longer reach. He started cold-canvassing out-of-town prospects by long distance. Within months, this became the backbone of his operation. Annual sales jumped from $500,000 to over $3 million.

We could go on and on with example after example: cases of the use of communication to reactivate old accounts, to sell on service calls, to coordinate credit and sales; but let us leave it that the phone is a sales tool which, when properly evaluated and applied to many marketing problems, can help reduce costs, expand markets, and increase profits.

But its effective use doesn't come about by magic—it can solve problems or it can create problems—it must be used but not abused. The benefits of telephone selling must be mutual—to buyer and seller alike. A thoughtless, badly-timed program may not only fail to sell, but can injure customer relations so badly that there is no recovery.

There are five key principles (see below) that must be religiously followed if this tool of management is to be truly effective.

In other words, as with all sales activities, the use of the telephone must be thoroughly planned and programed.

We have looked at examples of the use of the phone as a tool of selling within the channels of business and have avoided even mentioning selling by phone to the

FIVE KEY PRINCIPLES OF TELEPHONE SELLING

1. Because telephone selling reflects on the character and reputation of a business, the goals must be firmly defined and must be coordinated with the total sales program.
2. The products or services offered must have intrinsic value that will appeal to the prospect.
3. Prospects must be chosen on the basis of probable need.
4. Personnel assigned to selling by telephone must have aptitudes for the job and must be trained in its techniques.
5. Sales calls must be timed to the prospects' convenience. They must always be courteous and informative without deception or pressure tactics.

Maj. Gen. L. J. Fields, Director of Personnel for the Marine Corps, presents certificate of appreciation (see below) to Mr. Damkroger, who accepted it on behalf of A.T.&T. At left is Col. A. F. Lucas, Director of the 1st Marine Corps District.

ultimate consumer. I have avoided this because such use, all too frequently, does far more harm than good. There are, of course, exceptions, when the five principles are carefully followed, where the consumer appreciates and even welcomes a call to his home. A department store calling established customers and offering a product of known interest to the housewife is one type of call that may be welcomed. But much—too much—of telephone selling to the home is thoughtless, downright discourteous, and definitely harmful to the seller.

Yes, communications is a valuable tool of distribution today and increasingly so tomorrow. We call it Phone Power—because Phone Power, properly planned and implemented, can:

- increase productive sales time
- improve the sales opportunity through inventory cycling
- make marginal accounts profitable
- reactivate old accounts
- qualify prospects
- speed inventory information
- speed deliveries
- speed collections
- and it can, in numerous other ways aid business in all of the many functions of distribution.

■ As we go to press, Major General Fields U.S.M.C., has this to say about a rather unusual application of one of our Phone Power programs:

". . . Before any enlistment can be made, the recruiter and the prospect must meet.

". . . the telephone company pointed out to our recruiters . . . that this could best be done in terms of time and money if the recruiters would use the telephone to make appointments.

". . . Since April 1964 we have, with the help of A.T.&T., done just that . . . Undoubtedly this technique has helped us achieve our current excellent recruiting record.

"The Telephone Company has . . . shown us a better way of doing our job. . . ."

in this issue...

■ The author of "Modern Coaxial Cable," beginning on page 20, has an extensive background in engineering, particularly in its transmission applications, and has been a licensed Professional Engineer of New York State since 1949.

Now general methods engineer in the Long Lines Department of A.T.&T., he is responsible for building, equipment, outside plant and transmission engineering methods. Prior to that, he was transmission engineer at Long Lines. For many years he has been concerned with transmission methods, important among which are the coaxial cables and carrier systems discussed in his article.

Mr. Latter graduated from Michigan State University with a B.S. in Electrical Engineering. He joined Long Lines after serving with the U. S. Army Signal Corps in this country and in Europe. He has been a member of the American Institute of Electrical Engineers since 1940 and is also a member of the Institute of Radio Engineers (now combined with the IEEE). One of his amateur radio activities is literally quite far from buried cables: he has made radio observations of satellites as a hobby since the launching of Sputnick I.

■ Sandia Corporation's president, S. P. "Monk" Schwartz, who is also a vice president of Western Electric Co., provides a revealing look behind the scenes in one of the Bell System's little-known operations, in the article beginning on page 32.

Sandia Corporation is an important factor in Albuquerque as the largest civilian employer, and Sandia's president sets as fast a pace as a community leader as he does in directing the atomic energy projects of Sandia. He has been a director of the Chamber of Commerce, the American Red Cross in Albuquerque, and the United Community Fund. He is also chairman of the UCF Advisory Committee and a member of the Armed Forces Advisory Committee. For years he has also been active in Boy Scout programs.

Mr. Schwartz got his nickname, "Monk," because of his agility in pole climbing when he started work as an engineer with the Public Service Electric and Gas Co. of New Jersey in 1926 after graduation from Lehigh University. He joined Western Electric in 1927 as a test engineer and filled a succession of engineering and administrative assignments. In 1954 he joined the Defense Projects

Robert F. Latter

Siegmund P. Schwartz

Division and was assistant project manager, operations and programing, for the Division when he was transferred to Sandia in 1957 as vice president and general manager. He became president in 1960.

■ Although a regular employee of A.T.&T. only since July, 1964, Dr. Peterson has worked with the Bell System as a research consultant since 1960, having made the training of operators a specialty. The programed training course for Traffic Service Position operators, described in his article on page 43, is the product of two years of research and development and is being used in all nine of the Operating Companies currently converting to TSP. Before that, two years of research had produced the programed training approach for operators working on outward service—a course now in use in all Bell System companies.

Dr. Peterson has a B.S. degree in mathematics and M.S. and Ph.D degrees in industrial psychology, all from Carnegie Institute of Technology in Pittsburgh. Prior to joining A.T.&T., he was a research program director with the American Institute for Research in Pittsburgh, where he worked in such varied areas as electronic maintenance training, missile crew proficiency measurement, test development, research on fighter aircraft accidents, foreign language training and vocational rehabilitation of the mentally retarded. As a member of the research staff of Psychological Service of Pittsburgh, he participated in early work with Dr. Fred Herzberg on motivation to work, the results of which are used extensively in Bell System management training programs.

■ Despite that middle initial, the word "Sales" has been Mr. Damkroger's middle name for many years. In writing about the problems of distribution, selling and the salesman's eternal fight against non-productive time (page 48), he is on familiar ground. As assistant vice president—Sales in the Marketing Department at A.T.&T., he is head of an organization which is directly engaged in a contest for a share of the customer's dollar.

Mr. Damkroger's career in the sales end of the telephone business includes a position as division sales manager in San Francisco for the Pacific Telephone and Telegraph Company, and later, as general sales manager there. Since he came to A.T.&T. in the spring of 1956, he has been assistant vice president in Merchandising, Commercial, Operation & Engineering, later the Operations Department, and then in the Marketing Department.

In the context of the present article, Mr. Damkroger discusses the problems of selling and distribution as they relate to use of the telephone—or rather, as the telephone relates to them; for, as he says, "The problems of distribution are the opportunities of communications."

Richard O. Peterson

Stanley F. Damkroger

in the news...

Interstate Rate Cuts

U. S. Virgin Is. Cable

Guam Philippines Cable

Hardened Cable Route

Laser Mirrors

World Telephone Growth

Interstate Rate Cuts

■ Reductions in the cost of interstate long distance telephone calls, totaling $100 million annually, were announced in November by the Federal Communications Commission. Cuts amounting to $75 million are to be made February 1, and the remainder about April 1.

Principal changes as of February 1 are: The $1 maximum rate now in effect every night after 9 p.m., for a three-minute station-to-station call anywhere in the continental United States, will apply all day Sunday and on weekday evenings starting at 8 p.m.

Rates will be reduced for many station-to-station interstate calls between 6 p.m. and 8 p.m. on weekdays, and these reductions will also apply all day Saturday. For example, a three-minute station-to-station call between New York and the West Coast, made during the evening hours from 6 to 8, will be reduced from $1.75 to $1.50 Monday through Saturday, and the daytime rate on Saturday will also be $1.50 instead of $2.25 as at present.

Station-to-station rates will be reduced between the U.S. mainland and Hawaii with the lowest rates applicable all day Sunday and after 8 p.m. on weekdays.

Commenting on the reduction, A.T.&T. Board Chairman Frederick R. Kappel said:

"Earnings on interstate business have continued to show healthy improvement. The Commission has had the situation under continuing review and extensive discussions have taken place regarding the appropriateness of existing rates. The Commission has now insisted on rate reductions larger than we think justified at this time. This insistence, in our belief, is out of step with the Government's effort to encourage economic growth.

"We have agreed to the reductions, however, in view of the marked upswing in interstate earnings and on the Commission's assurance that its action does not establish a ceiling for future interstate earnings. In fact the Commission itself, in its public notice, anticipates that growth in the economy, plus telephone operating efficiencies, will result in renewal of the upward trend.

"These expressions by the Commission support our confidence that improving technology and increasing usage will produce profits that will continue to make our business attractive to investors.

"Telephone technology has been especially effective in reducing the costs of long-haul service. Repeated advances in the art have brought about progressively better service and lower rates over the years. We shall continue these efforts unabated."

U.S.—Virgin Islands Cable

The first deep-sea telephone cable that provides direct circuits for communications between the U.S. mainland and the Virgin Islands—with added facilities for communications with Puerto Rico—was opened for service December 22.

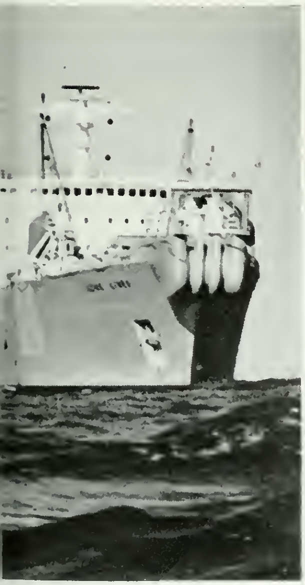
The 1,200-mile cable, which has a capacity of 128 high-quality voice circuits, extends from Vero Beach, Florida, to St. Thomas in the Virgin Islands. The cable connects at St. Thomas with Puerto Rico by way of a new 60-mile, high-capacity radio relay route to give Puerto Rico additional communications facilities with the United States.

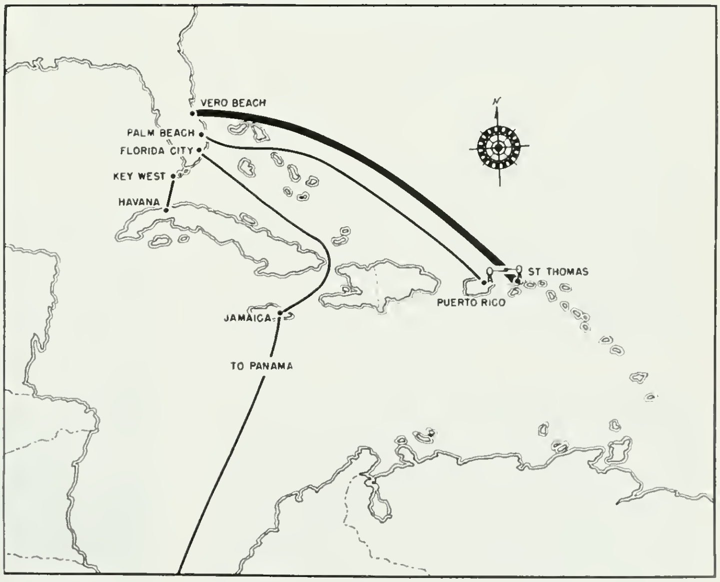
Construction of the $20 million system was a joint undertaking of the Long Lines Department of A.T.&T.; and ITT Communications, Inc.-Virgin Islands and Radio Corporation of Puerto Rico, both subsidiaries of International Telephone and Telegraph Corporation.

The Bell System's cable ship, C.S. **Long Lines**, placed the new cable in eight days. The route of the cable avoids the extreme depths of the Puerto Rican Trench, a gaping trough that runs along the ocean floor north of Puerto Rico. Here, the Milwaukee Deep sinks 30,246 feet to form the deepest abyss in the Atlantic.

U.S. telephone service with the Virgin Islands and Puerto Rico has been handled over high frequency radio circuits and a telephone cable system to Puerto Rico laid in 1959. But these existing facilities had reached their maximum capacity; additional circuits were needed to handle the soaring volume of telephone calls to and from Puerto Rico and the Virgin Islands.

The cable is part of a growing network designed to provide improved communications to key points in the Caribbean and South America. Late this year, a 550-mile cable will be laid from St. Thomas to Venezuela. It will connect with the Virgin Islands-mainland system to furnish "all cable" circuits be-





Above left: C. S. Long Lines, *Bell System cable ship, about to pick up shore end of new telephone cable linking mainland U.S. and Virgin Islands. Right: map of cable route.*

tween the U.S. and Venezuela.

Plans are also underway for an over-the-horizon radio relay system that would link St. Thomas, Antigua, St. Lucia, Barbados and Trinidad. A.T.&T. and ITT joint cable and radio facilities now in service to the Caribbean area connect the U.S. mainland with Cuba, Puerto Rico, Jamaica, the Panama Canal Zone and the Virgin Islands, as well as A.T.&T. facilities direct to Nassau.

Guam—Philippines Cable

■ A deep-sea telephone cable providing better communications between the United States and Southeast Asia was placed in service December 15, linking Guam and the Philippines. At Guam, the cable dovetails with other cables to California, Hawaii and Japan. The new system, with a capacity of 128 high-quality voice circuits, is a vital link in an expanding network of undersea cables in the Pacific.

Partners in the $24,000,000 Guam-Philippines project are the Long Lines Department of A.T.&T.; The Philippines Long Distance Telephone Company; and Kokusai Denshin Denwa Company, Ltd., of Japan. The 1,500 nautical mile cable was laid by the C.S. **Long Lines,** the Bell System's cable ship.

Telephone service between the U.S. mainland and the Philippines formerly was furnished over six radiotelephone circuits. These will now be used to back up the cable circuits.

The cable system, designed by Bell Telephone Laboratories, uses a single cable equipped with amplifying repeaters capable of transmitting voices in both directions. Each 500-pound repeater, spliced into the cable every 20 miles, boosts voice currents 100,000 times.

Hardened Cable

■ The final leg of an underground transcontinental cable route that is blast-resistant and adds 9,000 telephone circuits to the 15,000 now spanning this country was opened for service December 2.

The hardened cable system, the first of its kind, was built to withstand hurricanes and cyclones and nuclear attacks short of a direct hit. The $200 million system includes 4,000 miles of coaxial cable for carrying telephone conversations, data and other specialized communications. It has 11 manned communications centers and more than 900 intermediate repeater stations—all buried deep underground (see "Modern Coaxial Cable," page 20).

The cable runs from New York to California, skirting all major cities and potential target areas. It was under construction for five years.

Design for Bell Laboratories' New Center

■ Bell Telephone Laboratories has made public the design for its Indian Hill Laboratory to be constructed near Naperville, Illinois.

The new communications development center will house Bell Laboratories' Electronic Switching Division, now located at its Holmdel Laboratory in New Jersey. Approximately 1,500 people will occupy the new laboratory. These will include engineers and scientists, technicians and supporting staff and a group of Western Electric engineers.

A building of about 500,000 square feet will be constructed on an approximately 200-acre site. The project is expected to cost $7,000,000 to $9,000,000.

Architect's rendering of Bell Laboratories' new Indian Hill Laboratory in Illinois.

The architectural concept for the proposed office and laboratory building was prepared by Holabird and Root of Chicago.

The design shows a four-story square building, measuring approximately 400 feet on each side, attractively faced with architectural concrete panels. A portion of the first floor is recessed about eight feet. At each side, two external towers enhance the architectural form of the building and will house stairs, airshafts and freight elevators.

The visitors' entrance in the center front will open directly to the reception area. A 300-seat lecture hall will be situated centrally between the reception area and an open court at the center of the building. At the southeast corner of the first floor, a cafeteria-type dining area looks out through large windows upon a pleasant view of the landscaped grounds.

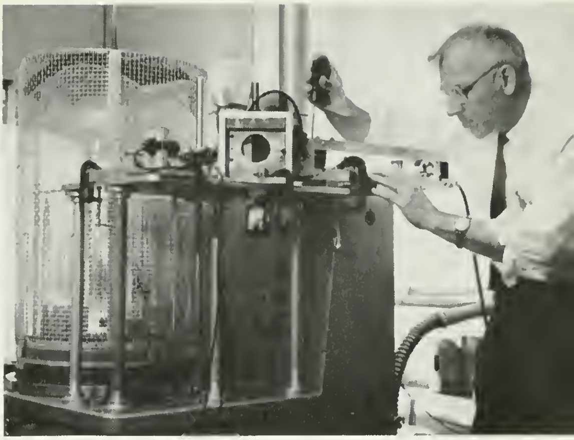
The three upper floors will have offices and laboratories located along cross aisles that connect to main corridors around the inner and outer perimeters of the building. Separation from main corridors reduces distraction caused by corridor traffic and contributes to the quiet, creative environment desirable in a communications development laboratory.

The exterior of the building will be of precast concrete and glass. The center one-third of the front and rear of the building will feature two-foot wide wedge-shaped concrete pilasters rising from the second floor to the roof and separating four-foot wide panes of glass. The balance of these elevations will be faced with a flat expanse of concrete interspersed with four-foot wide windows.

Near-Perfect Laser Mirrors

A major advance in mirror-making technology has resulted in almost perfect laser mirrors; that is, mirrors that reflect nearly 100 per cent of the light that hits them. Bell Telephone Laboratories has developed a technique of coating a mirror blank with many layers of optically transparent dielectric material in a way that virtually eliminates light scattering from the reflective surface. Reflectivity is so close to complete that the amount of loss is, as yet, unmeasurable.

A laser using these mirrors will emit several times more light than one using conventional mirrors. Because mirrors made by this technique are so highly reflective, they could conceivably be used as efficient light-focusing elements in a laser communications system.



Laser coats mirror with transparent material. Result: near 100 per cent reflection.

World Telephone Growth

More telephones were added throughout the world in 1963 than in any previous year. There was an increase of 9.9 million, bringing the world's total to 171,000,000. Previously, the largest gain recorded was in 1962 when 9.5 million telephones were placed in service.

These figures are included in the 1964 edition to **The World's Telephones,** published by A.T.&T. All figures are as of January 1, 1964, inasmuch as it takes a year to obtain and compile the data.

The United States ranked first in number of telephones, with 84,453,000. Japan was second with 10,682,492. The United Kingdom followed with 9,345,000.

Japan had the largest percentage gain in 1963, 14.4 per cent, followed by India and then the U.S.S.R.

With the addition of Hungary in 1963, 28 countries now have as many as half a million telephones each. Twelve of these 28 countries have more than two million telephones. In addition to the United States, Japan and the United Kingdom, they are: West Germany, Canada, Russia, France, Italy, Sweden, Australia, Spain and the Netherlands.

The past decade has witnessed tremendous growth in telephones. The 28 nations with more than one-half million telephones have nearly doubled the combined count of their telephones in the last ten years. On a comparable basis, Japan has more than quadrupled and India has more than trebled their counts of telephones in this period. Countries with less than one-half million have more than quadrupled their total since 1953.

Telephones continued to increase more rapidly than total world population. At the beginning of 1964, there were 5.3 telephones for every 100 people in the world. This represented a slight rise from the 5 telephones per 100 people reported the previous year.

The United States, with 44.26 telephones per 100 people, maintained its lead in that category. Sweden followed with 42.25. New Zealand had 35; Canada had 34.89, and Switzerland had 33.95. In places with less than half-a-million telephones, Monaco had a percentage of 48.18 per 100 people; Bermuda had 38.94, and Midway Island had 41.

Phone Numbers on Letterheads

■ A new Bell System booklet, "How to Show Telephone Numbers on Letterheads," illustrates various methods of showing telephone numbers on business letterheads and personal stationery. The booklet is intended for people who design, order or print stationery and letterheads such as art studios, stationers, printers, advertising agencies, etc. to stimulate the use of complete telephone numbers as well as provide a guide for their proper display.

Scanning Electron Beam for Analyzing Crystal Defects

■ A scanning electron beam is the basis for a new technique in microscopy developed at Bell Telephone Laboratories. The technique enables scientists to study internal crystal defects in semiconductor diodes without damaging the specimens or using special treatments.

The basic equipment used is a standard scanning electron microprobe. It produces a finely-focused electron beam that probes the specimens at a depth determined by the energy of the beam—the greater the energy, the deeper the beam penetration.

When the scanning electron beam probes the p-n junction of a semiconductor diode, the diode produces a response current. This current is amplified and fed to a cathode ray tube that displays it as a map-like picture. Crystal defects usually cause a reduction in response current and appear as dark regions in the picture.

It is believed that this technique will be a valuable tool in microanalysis, supplementing present scanning electron microprobes.

Photomicrographs showing crystal imperfections made possible by new Bell Laboratories technique.

We dug and refilled a 4000-mile trench to protect 9300 communications circuits against disaster

We split the continent with a trench four feet deep to give the United States its first blast-resistant coast-to-coast underground communications cable system.

More than four years ago when the first of 2500 giant reels of coaxial cable started unrolling in New York State, we began an important project that will give added protection to the nation's vital communications.

Today, 9300 circuits—available for voice, data, teletypewriter, telephoto—are included on this route. It stretches across 19 states and has 950 buried reinforced concrete repeater (or amplifying) stations.

Spotted strategically along the route about 50 feet below ground level are 11 manned test centers. Also of reinforced concrete, they have automatic air filtration and ventilation and living quarters stocked with emergency food and water.

This vital transcontinental link will serve the needs of government agencies, businesses and individuals.

This is a job that needed the Bell System's unified research, manufacturing and operating capabilities. It is another implementation of a basic Bell System policy: "In communications, the defense of the nation comes first."

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BELL TELEPHONE MAGAZINE

SPRING 1965

Making Sensor Coils for ESS

A U.S. Navy gun director far inland in Winston-Salem, N. C., gives a what-is-it look to some important research now being carried on by Bell Telephone Laboratories and Western Electric. The objective: to convert presently installed Navy gun control systems into dual systems that can simultaneously and independently control both a ship's guns and its missiles. Here, an engineer atop the gun director gives the signal to release an experimental target balloon at the start of a tracking exercise.

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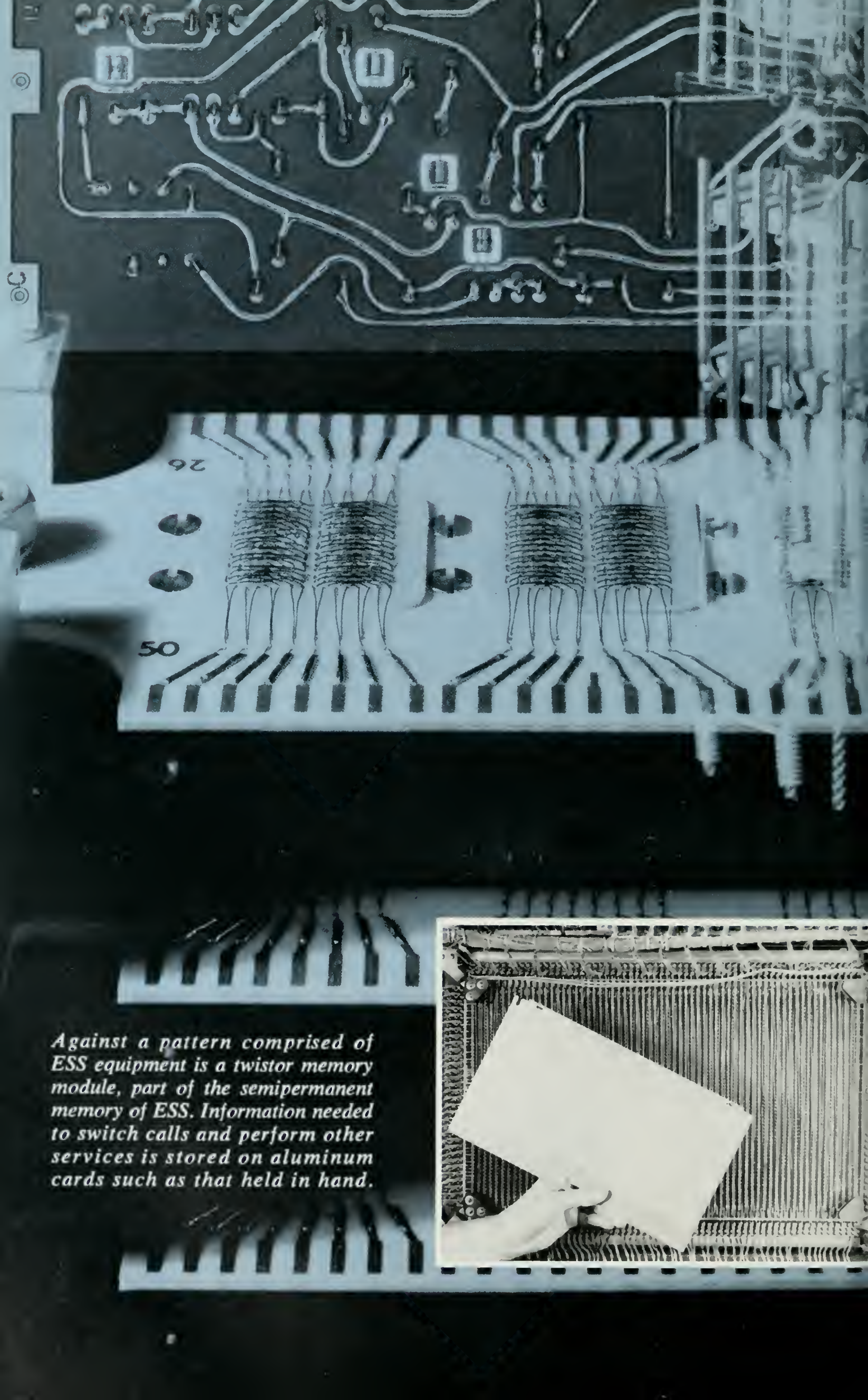
VOLUME XLIV ■ NUMBER ONE ■ SPRING 1965

A non-technical review, published quarterly to give Bell System management people a broader view of the history, objectives, operations, and achievements of this business than they might attain in the course of their day-to-day occupations, and an added sense of participation in the problems and accomplishments of our nation-wide public service.

Cover:

Solenoid coils, one of the hundreds of components that make ESS (electronic switching system) work, are assembled at a Western Electric plant. The coils are part of the ferrod assembly, a magnetic current sensing device which is the building block for the scanners used in ESS to determine whether a telephone line is on or off hook. The task of creating ESS is described in "Bell Laboratories' Biggest Job," on page two.



Against a pattern comprised of ESS equipment is a twistor memory module, part of the semipermanent memory of ESS. Information needed to switch calls and perform other services is stored on aluminum cards such as that held in hand.

The biggest change to come to the Bell System in recent years is electronic switching. And it took the biggest effort in the history of Bell Telephone Laboratories to bring it about. The story of No. 1 ESS shows why it takes multiple disciplines, working closely with Bell Operating Companies and Western Electric, to bring such an advance to the communications art

BELL LABORATORIES' BIGGEST JOB

Theodore B. Merrill, Jr.

This is the concluding part of Mr. Merrill's article on Bell Telephone Laboratories. Part I appeared in the previous (Winter 1964-65) issue.

■ IF YOU SAY "Pennsylvania-6" a surprising number of people almost automatically think of "5000," thanks to an old Glenn Miller Band hit of the 1940's. But to most Bell Laboratories engineers, Pennsylvania-6 has another meaning. It happens to be the name of the first large metropolitan telephone exchange that will be cut over to electronic switching. And for the last few years, the development of electronic switching has been the largest project Bell Laboratories has ever undertaken for the Bell System.

The equipment being installed in Pennsylvania 6 is called No. 1 ESS (for electronic switching system). ESS promises to bring a lot of very basic changes to the Operating Companies of the Bell System—and to their customers in the form of new and improved services.

Usually, the telephone customer isn't particularly aware of changes in the telephone system unless they change the appearance of the telephone in his home. But there is little doubt that many will notice a difference with ESS because the new system will be able to give customers such services as "abbreviated dialing" of numbers they use frequently; "automatic transfer," so they can have incoming calls temporarily diverted to another nearby number; and up to four-party dial conference calls without the aid of an operator. Within the exchange, connections will be set up much faster, and further services can be added, such as automatic "call waiting," so telephone calls to a busy number are automatically put through when the line is free.

Even though the first ESS exchange will not go into service in Succasunna, N.J. until mid-1965, Bell System companies already have plans to start up a dozen others. These new offices will serve almost the entire spectrum of central office traffic patterns.

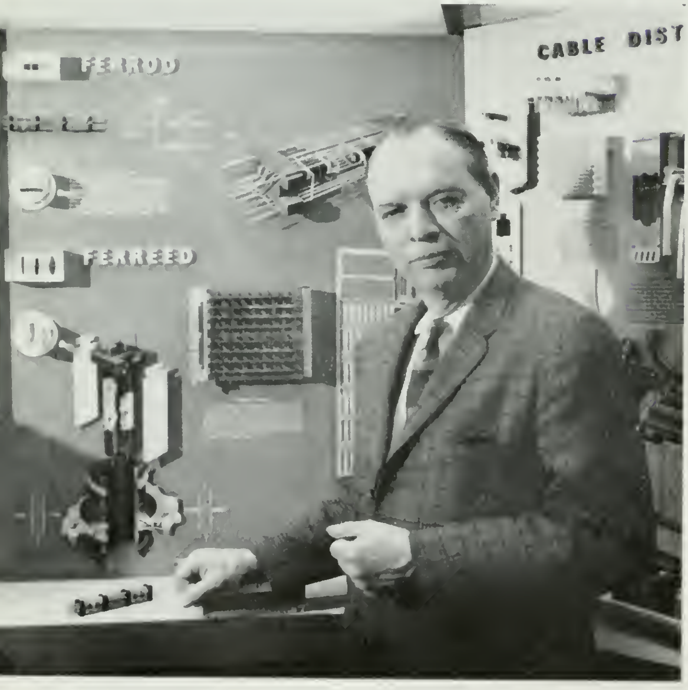
Succasunna is typical of the small town and rural areas, for example, and Pennsylvania-6 is a big metropolitan exchange with the very different characteristics of heavy business traffic. Other systems are going into long distance trunk switching jobs and government communication centers.

There is a lot of excitement in the air around Bell Laboratories as installation of the first ESS offices gets underway. This is the big one. This is the future.

■ There is probably no better example of how Bell Laboratories fits into the Bell System and how the various divisions of the organization work together than the story of electronic switching. It simply could not have appeared without a number of basic advances by BTL: the new electronic logic and memory devices that resulted from research and development in solid-state science; the ferreed switch, which came from the invention and continued development of relays and switches and basic investigation of the nature of magnetic materials. Pioneering development of computer programing techniques, quality control methods and theory, mathematical simulation methods to prove design ideas, and even error correcting codes developed for digital transmission were necessary contributions. It took a lot of different scientific disciplines, many inventions and innovations, and close cooperation between the various units of the Bell System to develop and perfect ESS.

■ The telephone switching network is, after all, the world's largest machine and the world's most complex one to boot. One of its characteristics is the requirement that it must grow and change while it is operating—it can't be shut down. Consider, for a moment, how the telephone system grew.

The first switching systems were manual switchboards. Operators used plugs and jacks to interconnect lines. As the



Four men who have led in the development and perfection of ESS. Left to right are: William Keister, director, Electronic Switching Systems Engineering Center; Raymond W. Ketchledge, director, Electronic Switching Laboratory; H. Earle Vaughan, director, Electronic Switching System Center; William H. C. Higgins, executive director of Bell Laboratories' Electronic Switching Division.

number of customers grew, the job got too complex for such manual operation, and the first automatic switching centers were developed. Early dial offices used pulses from the telephone dial to activate a series of stepping switches in the central offices. Such systems, which are still in wide use, are called step-by-step.

While step-by-step switching is relatively inexpensive and reasonably reliable, it is also relatively slow and inflexible, and it does not use the switching network at top efficiency. Because of its inflexibility, it cannot conveniently handle some of the newer services which customers may want. Also, it cannot handle the high traffic densities of metropolitan areas efficiently.

Panel switching and the next major development in telephone switching, the crossbar system, brought a subtle, but very important change to central offices. Step-by-step systems use the dial pulses directly to set up the series of interconnections that connect two telephones together. Panel and crossbar offices store the dial pulses, then set up the interconnection very quickly—much faster than you could dial the numbers. The storage device used in No. 5 crossbar is called a register and the control for establishing interconnections is called a marker. The register stores the dial pulses while the marker searches out connecting paths through the crossbar switches.

The registers and markers are associated with a particular telephone call only for the very short intervals of time required to receive the dialed digits and establish the connecting path. They are then free to serve other calls. Therefore, a modest number of them suffice to handle a very large volume of traffic. Because of this shared use of control equipment, such systems are called "common control" systems.

The common control concept also permits introduction of a technique called

"translation." The customer's telephone line no longer needs to be connected to specific physical terminals in the switching network. The common control equipment can "translate" the telephone numbers into an arbitrary terminal number. It can also translate the dialed digits to provide alternate connecting paths within the central office or between central offices—something step-by-step switching cannot do.

These two concepts—common control and translation—have made it possible to make major advances in nationwide and worldwide direct distance dialing.

Crossbar switching is very successful. Its reliability is almost legendary—about 11 minutes down time per 40 years of operation for a central office. And because the crossbar system is made up of small, nearly identical sections, it is economical to produce because of the large production volumes of its individual parts. The market for crossbar systems is broad, too, since it can serve economically all but the very smallest exchanges. Furthermore, it is easy to expand a central office by merely adding modular sections.

But even though the crossbar system is made up of similar parts, the parts are seldom hooked up in the same way. Every office is different because of traffic patterns and service mixture variations. So, while parts for a crossbar system can be made inexpensively, it is still a costly matter to specify and install the specific wiring required for each office or for each new service.

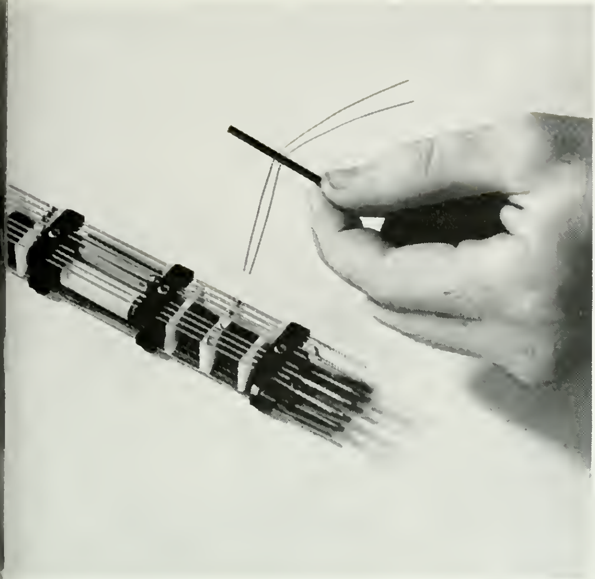
■ Electronic switching systems bring the idea of common control and translation a giant step further than crossbar. The high speed electronic switching circuits can do all the jobs crossbar registers and markers can do and still have time left over for many other duties. They are so fast that one

Ferreed switch makes talking connections swiftly and silently. Above two reed contacts are seen enclosed in glass envelope.

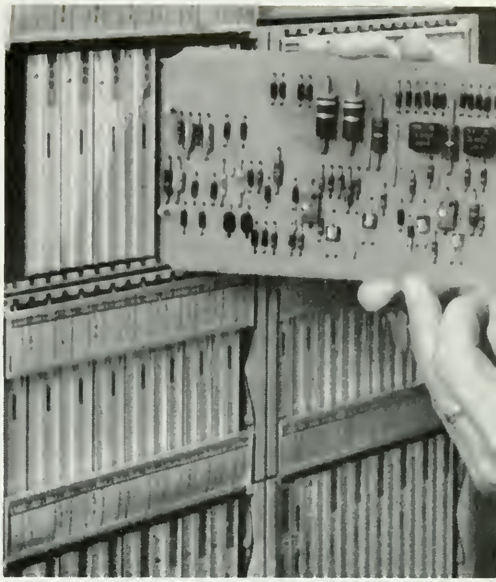
central processor—a computer-like-device—can keep tabs on up to 100,000 telephone calls during a busy hour. That's twice the number that large electromechanical offices can handle.

ESS is much more responsive, too. Its line scanner "looks" at every line five times each second, and if it finds a receiver off the hook, its master scanner then looks at that particular line a hundred times a second until all the dial pulses or TOUCH-TONE® signals are in. Once it has collected the dial pulses, its high speed memory and logic circuitry figure out the best switching path to make the connection and send instructions to the switching network to activate ferreed switches that actually make the connection. While the call is in progress, the central processor remembers that this particular switching path is in use and will not use it for other calls until the path becomes clear again.

It takes only a few millionths of a second for the ESS processor to figure out what connections to make, and the



'errod assembly, shown above, is a mag- ietic current sensing device which determines vhether telephones are on or off the hook.



This circuit pack, containing transistors, diodes, etc., is being plugged into central processor.

witching path is completed in a few hun- lreths of a second. To the telephone customer, making a local call, it appears he telephone he's trying to reach begins o ring the instant he has completed lialing the last digit.

From an operating standpoint, such speed is most desirable. It means that he central office will not be tied up for so long for each switching sequence it's called on to complete. But speed alone s far from the reason for ESS's poten- ial. Physically, ESS central processors are almost identical, regardless of the ype of central office for which they are ntended. That leads to production econ- omies and reduced complexity of instal- ation. But most important of all, the major function of the central office— operating the switching network and per- forming the translations between tele- phone numbers in the directory and the equipment numbers of the actual wires that are connected to each telephone— is not wired in, as it is in step-by-step and crossbar offices. Rather, both operating instructions and translation information are stored in a semipermanent memory in the form of patterns magnetized on memory cards.

Information stored this way is relatively easy to change by remagnetizing the memory cards. As a result, many changes in operating methods and in telephone numbers and classes of service can be made without changing a single wired connection. When a customer moves within an exchange area and wants to keep his same telephone number, all that has to be done at the central office is "tell" the central processor, through a teletypewriter, that the subscriber has moved from one set of wires to another. No central office wire change is involved at all.

■ Using a central processor separate from the switching network brings new problems along with new benefits, however. If each central office had but one central processor, it alone would be responsible for processing all calls. In crossbar offices, there are a number of markers, or common controls, and if one breaks down, it doesn't affect the operation of the others. With a single central processor, however, all service might stop because of a small failure in part of the system.

Obviously, a new order of reliability was required in all the transistors and other individual components which make up ESS. Fortunately, the development groups at Bell Laboratories responsible for understanding and designing these devices had years of experience they could bring to bear on these problems. The result was that the transistors, diodes and the many devices used in ESS (and largely manufactured by Western Electric) have set a new standard in reliability and dependability in electronic components.

As an additional line of defense, the ESS developers put two identical central processor units in each office, using the high speed data processing ability of the equipment to do constant troubleshooting. The ability to switch from a defective processor to an operating one without interruption in service was demonstrated in the first developmental trial at Morris, Illinois, in 1960.

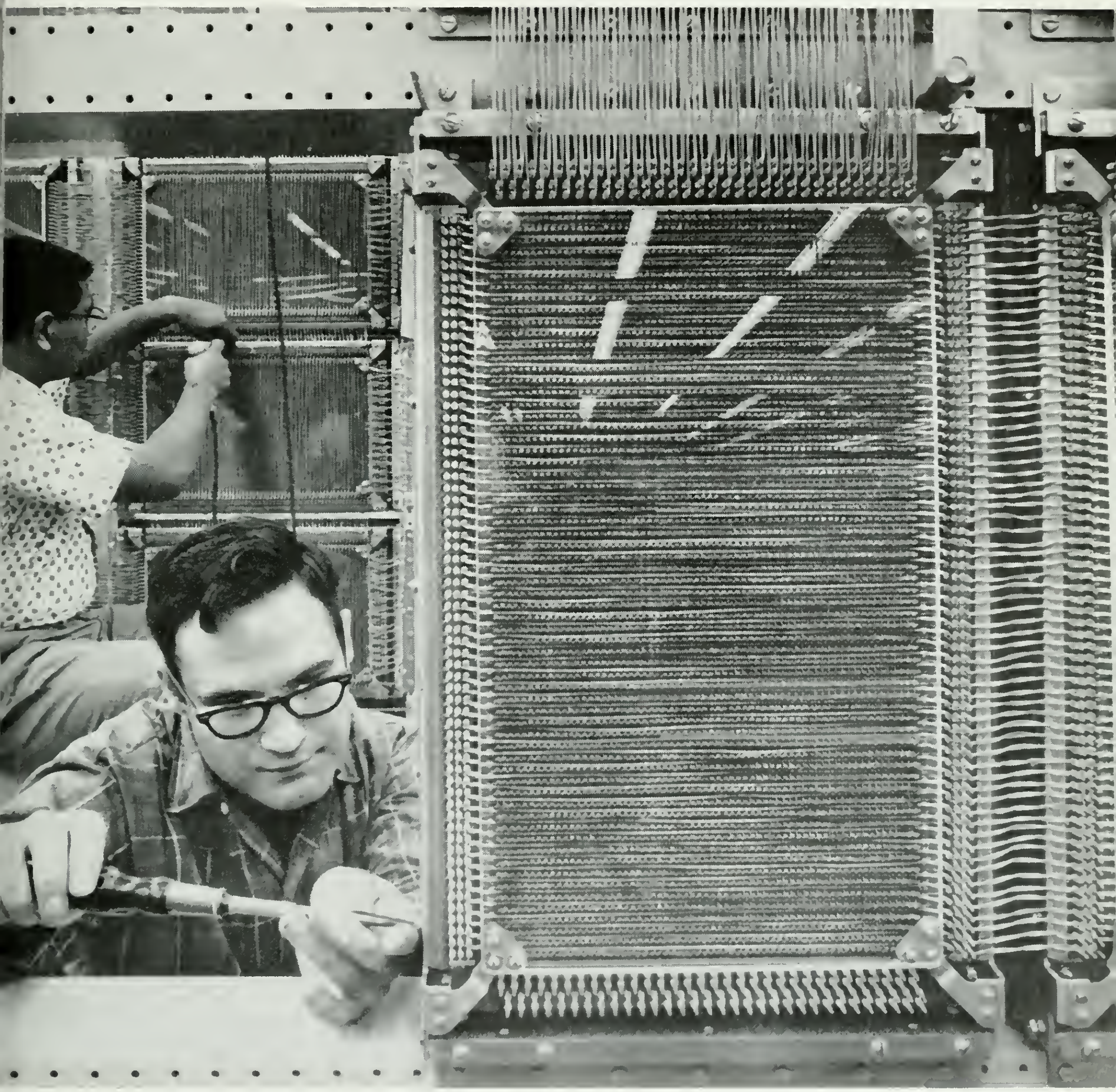
No. 1 ESS not only has the talent of automatically switching from a bad processor to a good one, but each of its central processors is made up of a number of subsystems, and the processor can put these subsystems together in any combination to make an operating unit. Systems engineers predict that the unusual talent of No. 1 ESS for reorganizing itself into an operating system will result in a higher degree of reliability than crossbar offices have recorded. That means an average time between failures of over 40 years.

The likelihood of an office being out of service is further reduced by using the logical power of the central processor to reduce the time it takes to repair a part of the unit that breaks down. If one of the 13,000 or so transistors in the logic circuit were to fail, for example, the processing job would be taken over by the duplicate unit. Then the system identifies the defective circuit. Immediately, warnings go out to maintenance men in the form of a Teletype message that gives a diagnosis of the trouble and the location and identification of the circuit that's in trouble. Warning lights light up that lead maintenance men to the proper bay, just in case they don't have a map handy. Says one development engineer, "No. 1 ESS does everything to repair itself except actually replace the parts." The central processor also indentifies troubles in the switching network and will locate and identify such things as defective switches, grounded lines, open lines, and defective trunks.

■ So there is much more indeed to ESS than just a faster way to switch telephone calls, or provide customer services not available before. When new customer services are developed, and Bell Laboratories engineers are certain a lot of them will be, it will be possible to put many of them into operation at ESS offices without changing a wire. Copies of the stored program that instructs the central system will simply be sent to each central office and entered in the equipment's semipermanent memory. ESS is not just a single revolutionary development—it is going to be the source of a continuing evolution in telephone technology and service.

To create ESS, it took over 2000 engineering man-years of work at Bell Laboratories—400 to write the stored programs alone. And it required the closest kind of cooperation between Bell Laboratories, the Operating Companies, and the Western Electric Company, the manufacturing and supply unit of the Bell System. Bell Laboratories couldn't sit back and design an ideal electronic switching system. It had to design one that would operate in the environment of the telephone network that exists today. It had to be a system that would work along with step-by-step, crossbar and panel systems. And it had to be able to react correctly to any signal it might receive from the outside world, whether it is a dial pulse, a TOUCH-TONE signal, a high voltage surge from a lighting bolt, shorted wires, or spurious signals from defective equipment. Furthermore, it must handle gracefully all the mistakes telephone customers can make.

■ ESS is a job Bell Laboratories has been working on for many years, and its roots go back to the late 1930's when Bell Laboratories researchers first began to investigate methods to process



Completed twistor memories are connected to frames in the Western Electric Columbus, Ohio plant where the Bell System's No. 1 Electronic Switching systems are assembled.

digital information by electronic means. World War II interrupted that work temporarily, though Bell Laboratories did continue to employ its electronics capabilities through its work in radar and microwave transmission.

From the first investigations of electronic switching, there was little doubt that speeds could be hiked at least a thousand-fold over electromechanical systems. So after World War II, Bell Laboratories set up a formal program to bring electronics technology to bear on switching problems. The work was done by relatively small groups in research—some working on techniques and structure that an electronic system might use, others on new devices. In a parallel project, solid state research on the behavior of electrons in solids was leading to the discovery of the transistor effect. Picked up by development engineers, transistors and diodes were soon demonstrated in a variety of forms and their potentialities as low-power, efficient, reliable and inexpensive logic elements made electronic switching no longer seem to be a research dream but a real possibility.

By 1954, electronic switching was far enough along so that systems planners were able to sketch out a practical switching system competitive in both performance and economics with existing electromechanical systems.

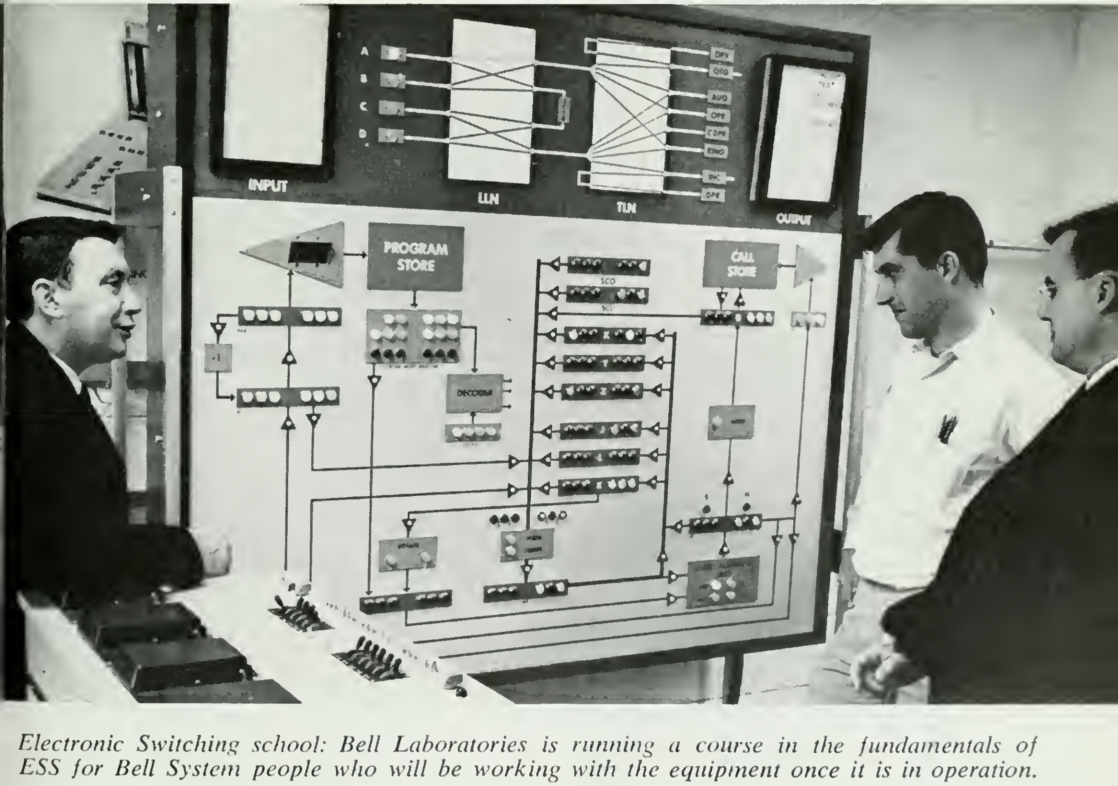
"It was relatively easy to dream up a system that could interconnect wires," recalls Walter A. MacNair, vice president of transmission and switching development, "but solving the problem of what to do about signaling voltages for ringing telephones, and fitting these into the rest of the system, really complicated the project."

One of the essential keys to the development of ESS came in 1955 when the idea of storing the system's logic in memory took shape. Called SLIM, for *s*ystem *l*ogic *in* *m*emory, the concept a year later became the central idea behind ESS development.

Under Clarence A. Lovell, now retired,

Western Electric girl above is working on solenoid coils, part of the ferrod assembly.

New Jersey Bell Telephone Co. building in Succasunna where ESS office is located.



Electronic Switching school: Bell Laboratories is running a course in the fundamentals of ESS for Bell System people who will be working with the equipment once it is in operation.

and Raymond W. Ketchledge and William Keister, an electronic system took shape for the first trial test. That test took place in Morris, Illinois from 1960 until 1962.

Keister, now in charge of switching systems engineering for No. 1 ESS, recalls that during the development of equipment for the Morris test, it became clear that contributing technologies were moving so fast that any system they tested would not resemble the final production version in any great detail.

"We went ahead developing Morris to get the structure and principles right, even though we knew that the device art was changing fast. We got Morris operating, even though by the time it was ready we knew that we didn't have the right memory system and that we would certainly end up using silicon transistors instead of germanium," says Keister.

The Morris test exchange was expensive—it cost about $25-million to develop, build, install and test. But even though it was obsolete before it was tested, it was well worth the expenditure. "The service experience clinched it," says Keister. "The Morris exchange had a better service record even with all the experimental customer services it provided than the Bell System average."

None the less, it took courage on the part of the management of the Illinois Bell Telephone Company and of Bell Laboratories and A.T.&T. to make the test. Customers were switched over to the new system and there was no provision for instantaneous backup if the system should fail.

The Morris trial showed the Bell Operating Companies what they could expect from electronic switching and it drew from many of them invaluable participation in setting up overall system objectives—part of the systems engineering effort.

At the end of the trial, engineers were sure they had the right system organization and logic. But the battle was far from over. Long before the trial ended, development projects were well along to take advantage of new devices as they emerged. Bell Laboratories engineers working with Western Electric perfected the silicon transistors for use in the production version. Other groups came up with the twistor memory in a form that could be manufactured at reasonable cost. But ESS still had its biggest hurdle to jump: the production cost barrier.

■ At first, things looked grim for ESS. Bell Laboratories engineers, working closely with Operating Companies and A.T.&T., established a clear goal: ESS would have to meet or better all the service and reliability standards of No. 5 crossbar, at substantially the same first cost. The new services ESS could offer were definitely secondary considerations when it came to committing a system for production.

Asking a new and untried system with no service or production history to compete on an even basis with the system that is the present backbone of the Bell System network is about like asking a high school baseball team to take on the New York Yankees. No. 5 crossbar has been engineered and reengineered and has years of production experience and cost reduction behind it. Its costs are still declining.

At Western Electric's Columbus, Ohio, plant two big engineering groups worked side by side. One was totally committed to cost reduction and redesign of No. 5 crossbar. The other was working on production engineering of the No. 1 ESS. ESS developers were shooting at a moving target, and every six months they submitted revised cost estimates on ESS, only to find that the costs of No. 5 crossbar had declined. One Western Electric engineer recalls, "By the time we had one set of cost estimates

The Bell System's first commercial ESS office being installed at Succasunna by Western Electric.

Master control of No. 1 ESS office. Teletypewriter at left is means of communication with and from the equipment.

on ESS ready, they were out of date, so we would submit interim reports."

To make ESS competitive with the established No. 5 crossbar in terms of cost for switching offices, the Bell Laboratories development group continually sought less expensive hardware—transistors, diodes and memories. Western Electric and Bell Laboratories engineers worked hand-in-glove to get the most economical designs.

By early 1963, ESS was close enough to the cost of No. 5 crossbar to get a green light on production. It still is somewhat more expensive. "We know," says a Bell Laboratories systems engineer, "that No. 5 crossbar has been pretty thoroughly mined out for cost reduction. And we are equally certain that ESS is not. The next decade will bring a lot of changes in technology that we expect will result in substantial cost reductions for ESS. While we can't make a decision based on what is likely to be, we are now sure that the large capacity of the common equipment together with extra services and the potential savings in maintenance and floor space make ESS competitive with No. 5 crossbar in large size offices."

Charles M. Mapes, assistant chief engineer at A.T.&T., agrees. "But of course," says Mapes, "ESS will have to come gradually. It would be simply impossible, either physically or economically, to replace all at once the billions of dollars worth of electromechanical equipment we now have in service. In the meantime we are applying electronic devices to present switching systems to give many of the services that ESS provides. These 'appliqued' systems work very well—particularly with No. 5 crossbar. So I think we'll see No. 5 around for a good long time."

■ With ESS cleared for production, Bell Laboratories is confident its biggest project is successful, even though the last few months of production engineering was a real horse race. "We're getting a lot better reception from Operating Companies with ESS than we did with the first crossbar system," says McNair. "It took years before No. 5 caught on, and one reason was that it was purely a Bell Laboratories project that had to be pushed. In contrast, ESS has been a Bell System job from the beginning, with a lot of interplay between Western, the Operating Companies, A.T.&T. and ourselves." Because of this close cooperation, ESS came out at a cost nearly equal to existing electromechanical systems, too—which puts it far ahead of crossbar systems at the same stage of development. When the crossbar systems first came out, they were quite a bit more costly than step-by-step.

William H. C. Higgins, executive director of electronic switching systems development, believes that Bell Operating Companies will be cutting over to ESS at the rate of a new office every day by 1973.

H. Earle Vaughan, in charge of programing for ESS agrees and predicts that the Bell System will be installing 3 million lines a year of electronically switched telephone equipment within seven years. "I think the biggest problem we have with ESS right now is that it is such a hit there may be a problem of meeting demand for it," says Vaughan.

If these men are right, and the chances are that they are, it means that the Bell System is entering a period of great change—a period that will bring new manufacturing methods to Western Electric, new efficiencies in central office operation, and many new services to business and residential telephone customers. And it will bring new challenges to the research, development, and systems engineering staff of Bell Laboratories. ESS is a huge job well executed. But it is not the end of the road. For Bell Laboratories, as well as the rest of the Bell System, it is the beginning of an exciting new era.

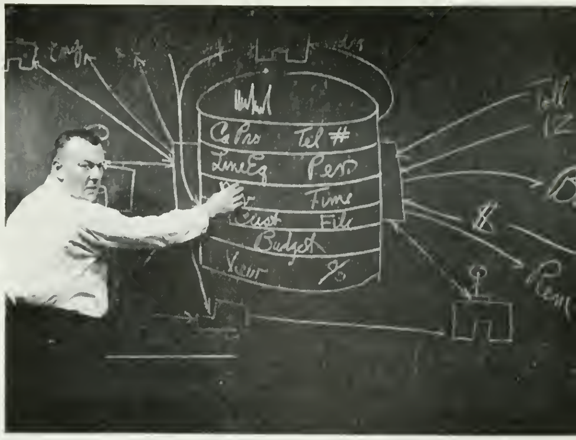
A new seminar is helping Bell System executives prepare for the great changes the computer is bringing

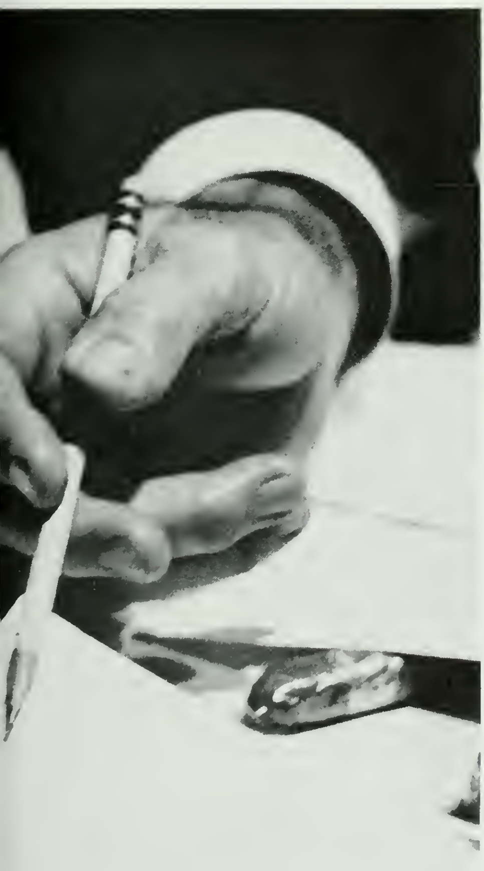
FACING THE FUTURE

What is the face of the future? The emotionless electronic façade of the computer? Or the face of a confident man—confident with the knowledge of new and hitherto unimagined tools at his disposal, tools which will vastly enhance his own abilities.

To make very sure that Bell System executives see the latter face, a Bell System Executive Management Seminar has been established to enable

them to learn about the world of the computer. At the 150-year-old Cooper Inn in historic Cooperstown, New York, the Seminar focuses on the effect of computers on the internal and external operations of the Bell System, including information systems. The participants wrestle with such questions as: How will computers affect service? What will they mean to us as people responsible for managing the business?

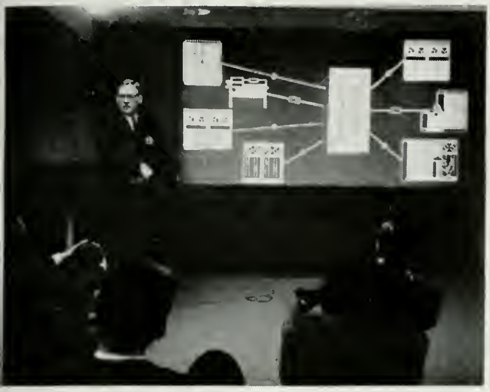


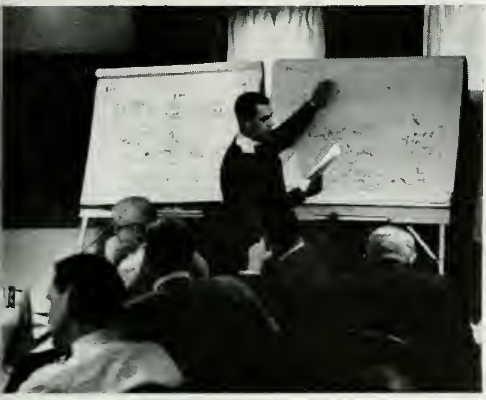


The Seminar runs 4½ days, was launched in February with the first group of executives, mostly operating vice presidents. Left, in a unique approach—to gain an understanding of the complexities of systems analysis—executives roll up their sleeves and program a computer. Above top, a view of the telephone company of the future is outlined for the conferees. Below, they hear about Business Information Systems, a many-faceted program that the Bell System plans to introduce internally over a period of years.

FACING THE FUTURE

Querying computer 3000 miles away: conferee taps out data on business machine in 'talk mode' with computer in Los Angeles.





Computers are creating a revolution in the art and science of business management. Theodore L. Simis, who heads the Seminar program, adds: "Perhaps no other industry or institution in the U.S. has been or will be as deeply affected by the computer revolution as the Bell System. One reason is the increasing use of computer and information systems by our customers and their needs for moving data over our network. Another is the growth and change taking place in our own business. To continue to progress, we have to keep up with the times. Consequently, it behooves us to carefully study and evaluate computerized systems and work into our corporate planning those things which are significant."

Top: conferees hear about data switching, an important part of computerized systems.

Center: by 'guided discovery' they learn to prepare flow charts for computer program.

Below: in nearby laboratories of the Bell System's Data Communications Training Program they check high-speed printout machine.

Above: filmed interview of Seminar leader and Westinghouse Electric officials tells of information systems in other businesses.

The staff does not propose solutions to problems or make suggestions in the realm of policy. The discussion leaders only *present* what is happening in today's business world so that the conferees can appreciate the dimensions of the computer age and what they mean to the telephone business of today and tomorrow. In sum, the Seminar is designed to give the executives a broad understanding of the computer field so that they can *selectively* apply those systems in their own companies.

The whole atmosphere of the Seminar is charged with creative involvement and lively, thought-provoking discussions by these men who are responsible for coping with the great changes that modern technology has fostered. And, says Ted Simis, "The Seminar is not only 'output.' There is plenty of 'input'—from the conferees who bring a wealth of knowledge and experience to the sessions."

Below: intent executives review printout after running their programs on computer.

Lost in concentration, conferees work on flow chart in preparing computer program.

The high school dropout—one out of every three students—is a grave and growing social and economic problem. Here are some of the ways the Bell System companies are trying to help solve it

the SCHOOL DROPOUT PROBLEM

William C. Mercer, *Assistant Vice President, Personnel Relations Department, A. T. & T. Co.*

Kenneth P. Wood, *Assistant Vice President, Public Relations Department, A. T. & T. Co.*

■ James Sawyer and Alberto Manzo are two able, intelligent seniors in a high school near Kearny, New Jersey. Although the names used are fictitious, their experiences are true and current. Until recently their high school education was in jeopardy; they were potential dropouts.

The reasons: economic, in Jim Sawyer's case; he must work to provide much of his own support because of his family's economic situation. In Alberto Manzo's case the reason is simply lack of motivation, paired with a strong compulsion to "make it on his own." A decision to quit school and earn a steady paycheck was almost inevitable on the part of both of them.

They did not realize that the "opportunity" of a full-time steady job is a tragically deceptive one. Without a high school diploma, they would be at the bottom of the employment barrel, competing for a decreasing number of jobs with the rest of the annual crop of more than 700,000 school dropouts. They would be just two more youngsters without minimum educational background in an era when, on one hand, there is increasing demand for greater skills, and on the other, a swift decline in the number of unskilled jobs. By one estimate, 40,000 jobs in the unskilled and semiskilled categories are becoming obsolete every week.

But there was another alternative—a new hope—for Jim and Alberto. And they took it. They agreed to take part in a school-industry cooperative venture known as the work-study plan. They now attend classes at their high school each morning and check in at Western Electric's Kearny Works for a 1:15 to 4:45 p.m. "work day." They get that Friday paycheck which helps at home, but more important they're working for their high school diplomas, too.

Several features of this story are representative of the very serious school dropout problem and of school-industry efforts to beat it:

- Economic pressures to quit school

Pacific Telephone and Telegraph Company employment manager tells . . .

in order to earn money.

- Many who leave (70 per cent) are clearly educable students with I.Q.'s above 90. Some studies show that 13 per cent have I.Q.'s above 110.
- Most dropouts come from families and neighborhoods where the value of education is not appreciated.
- The greatest number of dropouts are members of minority groups, for whom education has long been an undependable key to opportunity.
- This particular work-study plan is an example of one way a Bell System Company, working with a local high school, has helped head off the dropout disaster—in this case by enabling the students to get both education and work experience.

The Problem

High school dropouts have been called "social dynamite" and "an American calamity." According to one economist, they are "the real minority group of tomorrow." The plight of the dropout should be of concern to all of us.

Certainly, the dropout is of concern to any businessman. Today's youth are tomorrow's employment market and tomorrow's customers. Whether they are well-trained, well-qualified, and capable of self-support, or whether they are unemployed and possibly tax-supported is of obvious importance.

The high school dropout is not a new phenomenon. As a percentage of the total student population, dropouts have decreased. But the total school population

. . . potential dropouts about the importance of staying in school, emphasizing his point with a chart which relates the amount of education to the amount of expected monthly income.

has, in the idiom, "exploded;" thus, the number of dropouts has greatly increased. And the problem has increased therewith.

Staying in school is, after all, a means to an end—not an end in itself. A few years ago, the school dropout could find work because unskilled jobs were plentiful. Times have changed. Application of new knowledge to industrial processes is remaking the economy of the United States. The depth and speed of this economic change are having heavy impact on the labor force and on the need for education.

The real calamity about dropouts is that they are creating a vast pool of not only unemployed but mostly *unemployable* young people. In a country that desperately needs skilled, well-trained workers, this waste of undeveloped talent is a grave problem as well as a personal tragedy to the young people themselves.

High school dropouts are indeed everybody's business.

A Concern of Business

Business' responsibility does not stop with the sale of goods or services. Businessmen are recognizing that business has the responsibility of citizenship in the community, just as each of us does as an individual. Our communities today have bigger problems than they have had before—problems so big that the efforts of all citizens, individual and corporate, are needed to help solve them. Businesses often have talents, physical facilities, and job opportunities to help communities solve these problems.

The Bell System has always had the goal of providing good service—and of being a good corporate citizen. For many years we have aided in the field of education in areas where we have a particular competence that is of value to teachers. This has taken such forms as the "Aids to High School Science Program" (*BTM*, Summer '63), the "Telezonia" program for elementary schools, tours of Bell Telephone Laboratories by outstanding high school students, the college series of technical films, and a large number of other films and publications for schools at many levels.

Our effort to help prevent dropouts is another example of recognizing a citizenship opportunity and doing something about it.

Bell System Effort

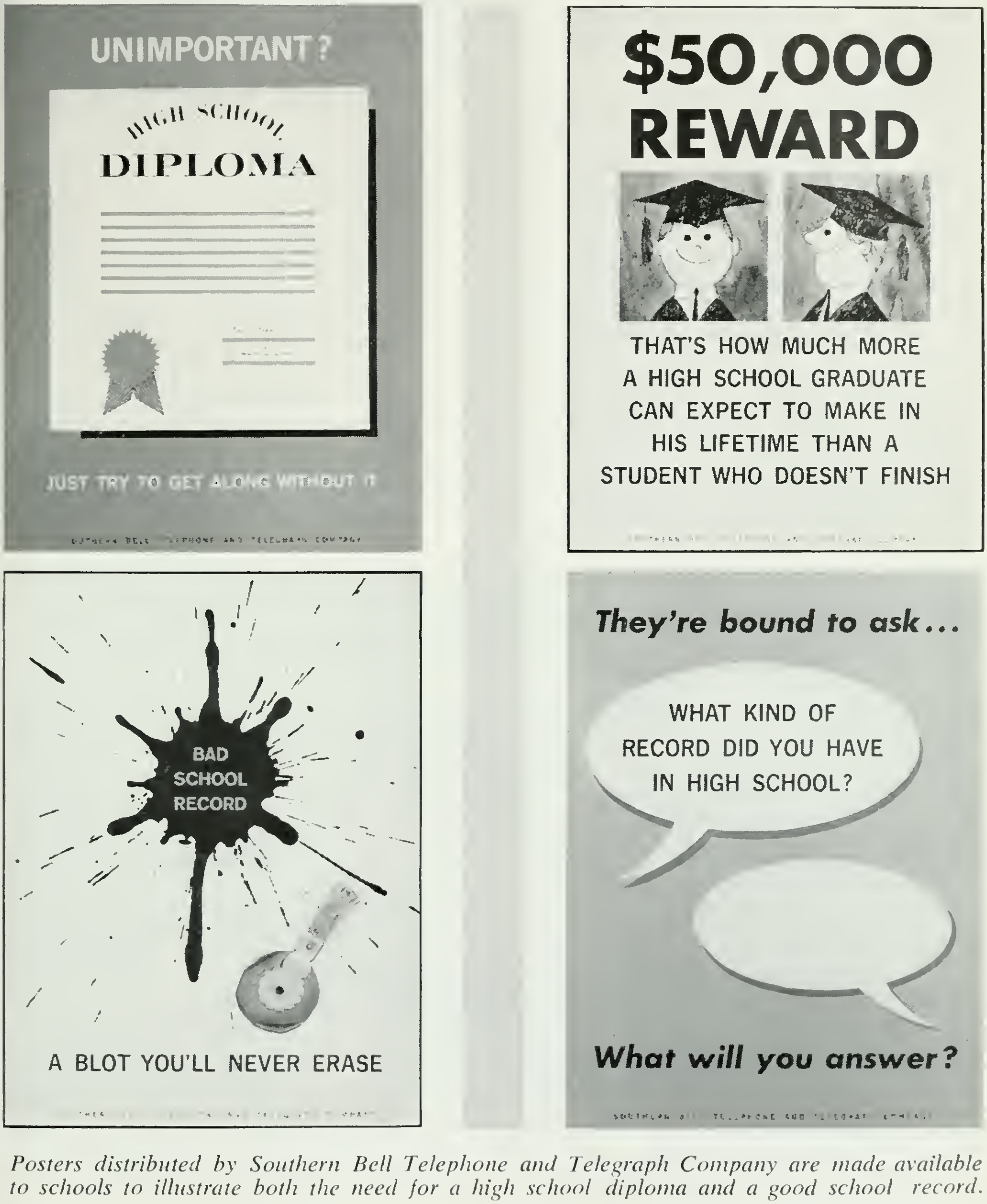
A number of Bell System companies are working constructively today on the prevention of dropouts. First the companies make it known to civic and educational leaders in the community that they are willing to help. This is best done on a local basis, for what will work well in one community may not in another.

Working With Students

One approach found effective by various Bell System companies is to encourage and help employees who volunteer to work with students on a "face-to-face" basis. At Bell Laboratories in Holmdel, New Jersey, for example, BTL people are working as volunteer tutors, teaching children English, reading, science and mathematics, in cooperation with the local NAACP and the local school administration. The tutoring is done on a one-to-one basis in weekly seminars. This program is in its second year and proof is already in that it is filling a need. Some 50 students asked for help early this year; 25 Bell Laboratories employees have volunteered. In several places, the Telephone Pioneers are also working as volunteer advisors to individual dropouts or as instructors for special classes.

Another program started within the last year is the Volunteer Corps, an out-of-hours employee group sponsored by the Illinois Bell Telephone Company. Open to all active and retired employees, the Corps' purpose, as stated in its constitution, is ". . . To bring together telephone men and women who are interested in doing volunteer social work, place them in volunteer programs conducted by local social welfare agencies, keep them informed about the needs and opportunities in volunteer work, and provide them with a means of sharing their interest and experiences with other people in similar work."

Illinois Bell provides staff assistance; training of the volunteers is accomplished through group discussions with sociologists, psychologists, agency personnel and police officials, as well as by exchanges of information among the volunteers themselves. The volunteers' activi-



Posters distributed by Southern Bell Telephone and Telegraph Company are made available to schools to illustrate both the need for a high school diploma and a good school record.

ties fall into four general categories: Tutoring, cultural (including arts and crafts), recreation, and positive image-building (creating situations where young people of minority groups are placed in contact with successful people of their own minority).

The Volunteer Corps program is based on the idea that the most effective work is the result of *direct contact* between the young people it seeks to help and the *volunteer* adults who can provide useful and meaningful guidance and assistance over a sufficient period of time. Although the program will in time expand throughout Illinois Bell territory, its initial efforts are concentrated in the Chicago-Cook County community with its inherent big-city social problems.

Still another variation of this employees-working-with-students effort has been taking place at the Merrimack Valley Works of the Western Electric Company in Massachusetts. Here, potential dropouts visit the plant in groups of ten (five from each of two schools) two hours each Monday for ten weeks. While there, they spend time with different individuals who have jobs requiring high school educations, learning about the kind of work these people do and the abilities required (such as report writing and mathematics)—a visible and realistic demonstration of the importance of a high school education in being adequately prepared for a job. The students also hear talks on this subject and fill out job applications to see just where their own experience fails and, importantly, how their performance in school is related to performance on the job.

After the meetings, the local superintendent of schools has interviewed the students to determine the value of the experience. Their interest in the jobs they have seen is very high, and their motivation in continuing school *and doing well* has increased dramatically! An additional result has been that the students themselves have been able to view, critically, aspects of the high school curriculum which do not prepare them well

Group of potential dropouts hear Western Electric representatives speak on the necessity of an education to compete in the job market with today's increasingly complex technology.

Telephone company pre-employment test questions illustrate the need for education.

for jobs. The local schools are now considering revisions which would make the curriculum more useful to youngsters not going to college, such as adding a refresher course in practical mathematics and an English course emphasizing practical writing ability prior to graduation. The program is considered so worthwhile that two more high schools are planning to participate, and the schools are encouraging other nearby industries to follow Western Electric's example.

Informative Methods

Another contribution being made by various Bell companies, to help in the dropout problem, is in the "informative methods" category. Posters (page 25) put out by the Southern Bell Telephone and Telegraph Company have been made available for distribution in the schools. Illinois Bell produced an award-winning television documentary, "The Dropouts." Telecast in November, 1962, and again in September, 1963, the film has been viewed by almost two million people on television and by an additional 40,000 at high school assemblies and service clubs. Illinois Bell has recently completed another film, "The Winners," intended to motivate non-white potential dropouts to apply themselves in school and in other ways so that they will be equipped to lead useful and rewarding lives. Schools, churches, neighborhood clubs and various action groups will promote the film and help in its distribution. The New York Telephone Company and two other organizations have also produced a film, "The Road Ahead," for the National Urban League which demonstrates the value of a high school diploma in getting a job.

Cooperative Education

Several Bell System companies have worked in the area of cooperative education, such as the work-study plan which is helping James Sawyer and Alberto Manzo. This type of plan is set up so that the student goes to school part-time and works part-time, and the company agrees to employ him only so long as he continues to go to school. An essential part of the plan, of course, is the joint participation of the school system and the employers involved. In addition to providing an inducement to stay in school, this type of plan also provides the potential dropout with a partial satisfaction of the desire to go to work, helps him build a record of success in a work situation, and puts him in an environment which underscores the need for education in order to both get and hold a job.

A variation is the Everett Plan of Everett, Massachusetts, in which the New England Telephone and Telegraph Company is one of the sponsoring firms. This plan is designed to help students make the transition to the world of work,

In cooperation with NAACP, local schools, Bell Labs man tutors child in Holmdel, N.J.

select the kind of work best suited to them, and find a good starting point for continuing progress, growth and achievement. It operates as an association of different occupational interest groups, called "Prep Clubs." The clubs meet twice a month in the evening during the school year under the direction of adult leaders from the sponsoring firms in the community. These firms also supply keynote speakers for discussions which may cover career information, career planning, job applications and interviews, how a business operates, etc. The sponsoring firms also hire club members for work after school hours, some of whom will qualify for full-time employment after graduation. This program has had a highly favorable response. Students participating feel their future has been brightened, and they are motivated to complete their studies and graduate.

Other school-industry cooperative educational programs have been participated in by the Bell Telephone Company of Pennsylvania and the Ohio, Illinois, Chesapeake and Potomac, New Jersey and Southwestern Bell Telephone Companies.

Curriculum Changes

Some school systems are interested in obtaining business' help in modernizing the vocational and business-oriented courses in their curriculum. Several Bell System companies are helping educators in their communities develop new, up-to-date courses. This is a valued and constructive aid, for many such courses are so behind-the-times that they cannot possibly prepare the student for today's jobs. If the potential dropout can see no practical value in staying in school, his chances of becoming a dropout statistic are infinitely greater.

Illinois Bell and Bell of Pennsylvania have developed special school assembly programs to counter the dropout problem. Other Bell companies are building strong anti-dropout messages into their existing school appearances as extensions of their recruiting efforts. Even when the talk is not about career selection, Telephone Company speakers in Ohio and Southwestern Bell territories, for example, take every opportunity to point out the fact that only the young people with adequate educations—a minimum of a high school diploma—can compete in today's labor market. The Northwestern Bell Telephone Company was one of the original sponsors of high school "career day" programs emphasizing job opportunities for minority groups.

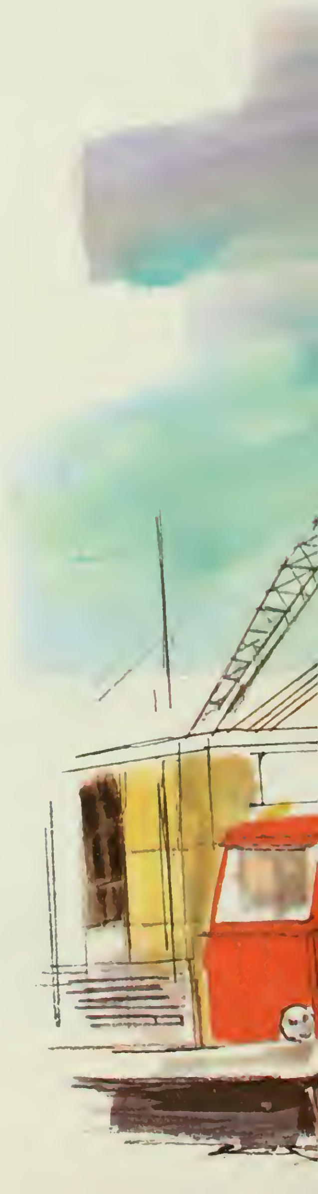
These are just some of the ways Bell System companies are helping to do something about the dropout problem. Making known the company's willingness to help, participating in school-industry cooperative educational plans and encouraging volunteer employee efforts have produced good results.

To return briefly to Jim and Alberto—they *will* be able to compete in today's labor market—they stayed in school. Not all potential dropouts are that fortunate. The Bell Companies—along with other good corporate citizens—are helping bring this kind of opportunity to as many as possible—in short, are doing what they can to help the potential dropout finish high school and to help motivate him to perform well while he is there.

The Telephone Company In Action

A portfolio of sketches, first of a series done by well-known artists, on the Bell System, its people and their many-faceted job. On these pages, the trained eye and skilled hand of artist and illustrator Frank Lacano give us a graphic impression of a typical Bell Telephone Company.

Growth is a mighty force in the Telephone Company — growth to keep step with burgeoning demand for service; growth to provide new, better services. Growth is the drawing on the draftsman's table, the new building going up, new cable going underground or on pole lines and many other things, all part of the overall Bell System multi-billion dollar construction program.



It is difficult to see a telephone company in perspective. So much of what its people do, so much of what happens as each call goes through, occurs behind the scenes. But of the variety of jobs telephone people have, here are three the customer knows well: the operator (above), who handles long distance, person-to-person and other special calls, the service representative (right), link between the customer and other telephone company departments and the installer (top right), who puts the instruments themselves in the customer's home or office.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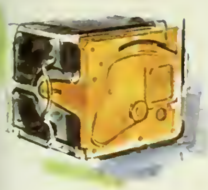
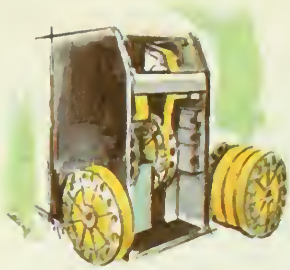
3999





Telephone service has many forms. Some are familiar, like the coin collector (above, left) making his rounds of public telephone booths, and, quite literally, bringing in the money. Many are less visible, like the necessary operation of counting the daily inflow of coins (above) and maintaining and repairing the coin boxes themselves. Some are a voice in your ear, like the information operator (left), who is equipped to help you find, quickly and efficiently, numbers not covered by your local directory.


Lacano



The telephone company is an entity. It is also an integral part of that incredibly complex and responsive machine, the total Bell System network. But most of all the company, and indeed the System, is the sum of many different human skills. The job at hand may be the splicer repairing a cable, underground, at midnight; a switchman feeling the pulse of the central office, testing the lines, around the clock, as the calls go through; the girl watching the print-out of bills from computer tape for fast and accurate billing. Or it could be any one of many other people performing scores of other jobs all of which have one thing in common — the strong seasoning of human dedication which makes the word "service" so meaningful, so much a part of the way of life of telephone men and women.

In a time of growth and change, training is more than ever basic to the daily routine. It may be the training of new people in established skills such as the linemen (left). It may be a discussion of electronic switching, a new phase of the telephone art (right), or it may be indoctrination in an entirely new technique, such as the operator learning to master the new Traffic Service Position (below).

Tomorrow looms large in the Telephone Company. The swift change of today's technology points the way. Here, we stand on the threshold of a new era with the installation of the equipment for the first Electronic Central Office which will go into service later this year.

Efforts to balance the United States' gold reserve with foreign claims against it are much in today's news. Here is a brief examination of the problem and some of the suggested solutions

The Balance of Payments Dilemma

Thomas Sowell, *Economic Analyst, Business Research Division, A.T.&T. Co.*

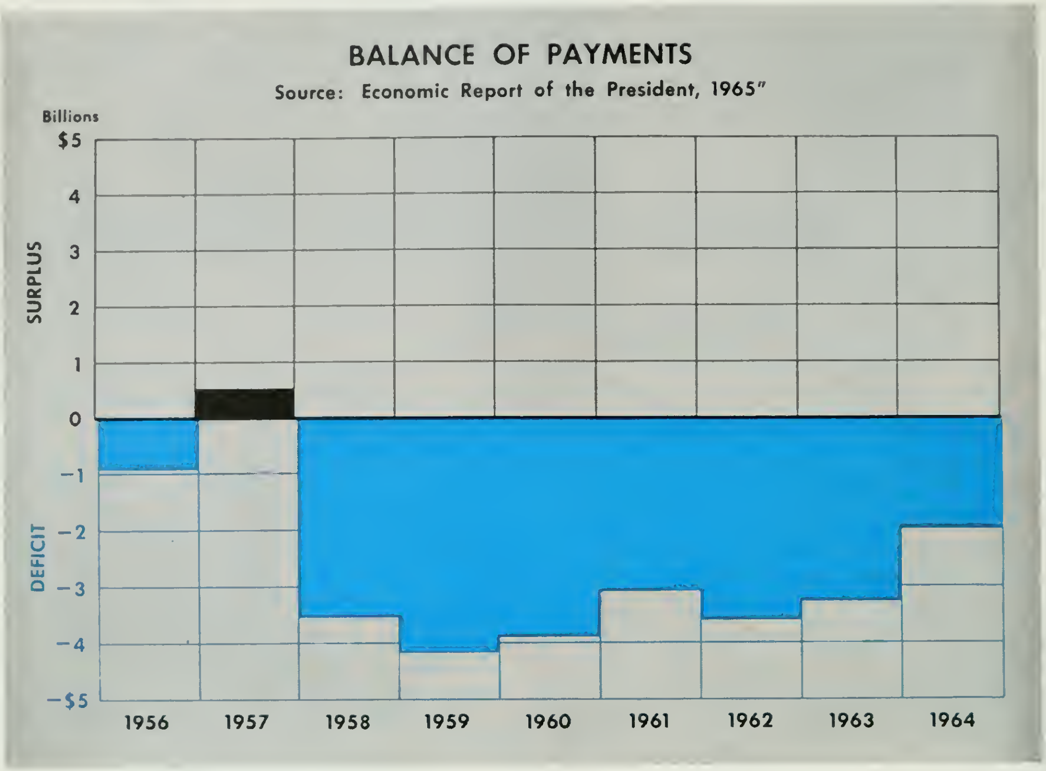
The international balance of payments of the United States, like any form of double-entry bookkeeping, will always balance in theory, and with minor statistical discrepancies it balances in practice as well. The balance of payments "problem" lies in the particular method by which this balance is achieved, and in the further consequences of these methods. Currently the outflow of American gold helps balance U.S. payments and receipts with foreign countries, and the problem is that this particular method obviously cannot continue indefinitely. Besides the actual shipment of gold, there is also a transfer of claims redeemable in gold—dollars, debts, etc.—which similarly cannot continue to accumulate abroad indefinitely.

The total foreign claims against American gold already exceed the total value of the gold available to meet these claims. In addition, the law requires that Federal Reserve notes (the bulk of American currency) have one-fourth their value in gold on reserve with the Federal Reserve System. A sufficiently large run on American gold could force suspension of that requirement and cause default on the long-standing international pledge of the United States to redeem dollars in gold at the legal price of $35 an ounce.

Seeking "the" cause of the balance of payments problem is largely meaningless. Obviously if any of the items requiring payments abroad were smaller or if any of the items bringing in receipts were larger, the balance to be settled in gold or indebtedness would be lower. However, it is meaningful and helpful to note the kinds of items on which there is an over-all payments surplus and those on which there is an over-all payments deficit. American goods and services, for example, earn more receipts from foreign countries than the U.S. spends on foreign goods and services. This so-called "favorable" balance of *trade* has persisted throughout the period in which the U.S. has had an "unfavorable" balance of *payments*. The inflows of payments caused by the export surplus are more than outweighed by the net outflow of payments caused by foreign aid, military expenditures overseas, investments made in foreign countries and similar items. Of course, it does not necessarily follow that these are the items which must be readjusted in order to reduce the gold outflow. Anything which increases American receipts or reduces American payments abroad will contribute equally to solving the balance of payments problem.

Domestic and International Ramifications

In the absence of a payments problem, monetary and fiscal policies could be suited to the current condition of the economy, whether this required high interest rates, low interest rates, mone-



tary expansion, a balanced budget, etc. But since foreign holdings of claims against U.S. gold exceed the gold supply, the American government must avoid policies which might cause foreigners to liquidate their claims and transfer gold elsewhere—even if these policies would otherwise benefit the economy at the time. For example, American interest rates cannot be allowed to remain too far below foreign interest rates, for fear that foreign-owned capital (and some American-owned capital as well) would transfer abroad for the better earnings. Some economists have argued that credit has been kept too tight for the maximum performance of the U.S. economy because of fear of a gold outflow.

Since foreign governments can have American dollars redeemed in gold, many of them have used dollars as equivalent to gold as a reserve "backing" for their own currencies. By the mechanics of fractional reserve banking, the increase in foreign money supply exceeds in value the increase in their holdings of American dollars. (Banks usually keep only enough funds to cover a fraction of their deposits. Under this arrangement, an increase in reserves leads to an even greater increase of deposits. Where national central banks use dollars as fractional reserves, the expansion of domestic currency is several times the value of the dollars involved.) Thus the increase in dollar holdings abroad represents not merely a transfer of money but a net increase of the international money supply by some multiple of the dollars involved. Conversely, the repatriation of these dollars would contract the international money supply by some multiple of the dollars repatriated.

While gold is still the primary reserve against money issue, foreign exchange—

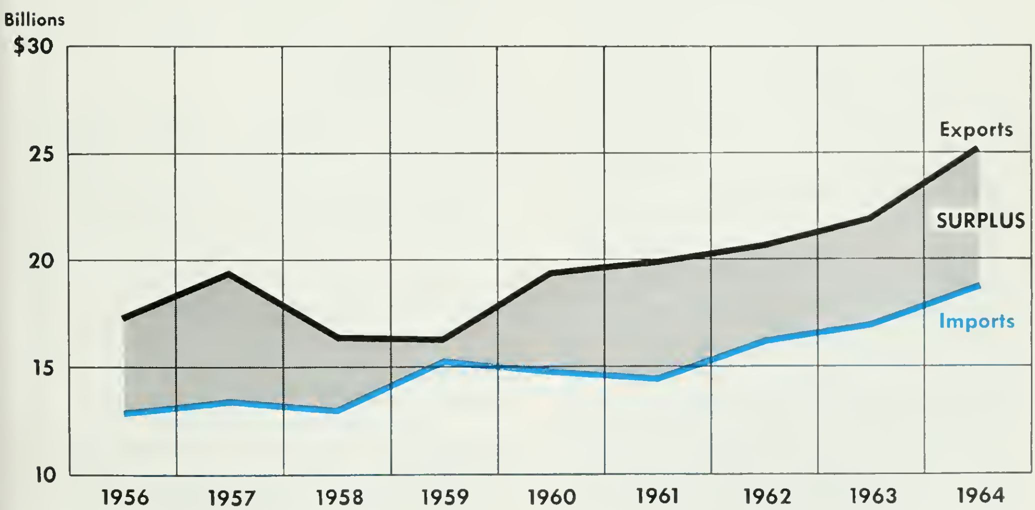
usually dollars but sometimes sterling and other currencies—increasingly supplements gold, the supply of which does not increase in proportion to world liquidity needs. This creates a major international monetary problem. Increasing production and international trade require increasing amounts of money in which to conduct a growing number of transactions. Using foreign currencies as reserves has been one expedient by which some countries (not including the U.S.) have dealt with the international liquidity problem.

The U.S. dollar, in addition to serving as an official reserve for foreign currencies, is also used directly in private transactions as a medium of exchange within and between foreign countries. In recent years there has been an increasing use of such "Euro-Dollars," so-called because Western European countries have led in the use of American dollars as an international currency, although Japan and the Soviet bloc have done so as well. The crucial difference between American dollars (and dollar claims) held abroad and American dollars at home is that those held abroad are subject to redemption in gold under the "gold exchange standard," whereas domestically held dollars have not been redeemable in gold since this country abandoned the full "gold standard" in 1933.

To the extent that foreign dollar holdings can be repatriated without redemption in gold (through increasing the American export surplus, for example) the existing gold holdings become more adequate for fulfilling claims against them, and this adequacy itself becomes a factor which reduces the claims actually made.

While the general principles involved in the balance of payments problem are widely agreed upon (though policy prescriptions differ), the actual magnitude of the deficit is a matter of controversy. Since the balance of payments statement necessarily balances in accounting terms, the "deficit" consists of selected items in the statement which are regarded as reflecting a basic economic imbalance or unsustainable trend (gold outflow being the most obvious example). There has not been universal agreement on which

BALANCE OF TRADE



items should be regarded as autonomous transactions and which should be regarded as compensatory or derivative results of the payment problem (though all include gold outflows). As a result, there are different "deficit" figures for a given year, depending upon the definitions used. Thus, the average U.S. deficit in the 1958-63 period was $1.8 billion per year by one approach and $3.1 billion by a different one.

In Summary

What is referred to as "the" balance of payments problem is in fact three problems: (1) the balancing of current American payments and receipts without further gold drain, (2) the reduction of existing foreign claims against the U.S. which exceed our gold redemption capabilities and (3) the Western world's growing liquidity needs which have been met to a substantial extent through the growth of dollar reserves acquired via U.S. payments deficits. Since the solution of the first two problems would obviously tend to aggravate the third, the simultaneous solution of all three is a complex question, and one which has led to a variety of proposals and considerable controversy.

The one eventuality which all agree must be avoided is a redemption crisis in which the United States would be forced either to openly default on a portion of its financial obligations or to suspend gold redemption and reduce the gold content of the dollar, in order to formally meet its obligations, but in a devalued currency representing partial default to all. The magnitude of the losses and the bitter repercussions extending beyond the economic sphere make this situation unthinkable. One of the psychological problems in dealing with the payments imbalance is that it does not produce immediate, clearly discernible problems for the ordinary citizen, though its neglect would ultimately threaten sudden disaster to the nation's credit and its economic and political ties to its allies.

Actions Taken

American Policies—A variety of American policies have attempted to reduce the outflow or increase the inflow of international payments. These policies include the tying of foreign aid to requirements to use the money for purchases in the United States, the reduction of Defense Department expenditures for foreign purchases, programs to attract foreign visitors to the United States, restrictions on the purchases of American tourists abroad, and inducing friendly nations to make advance payments on their debts to the U.S.

Various measures have been devised to deal with the outflow of dollars caused by foreign interest rates which tend to be higher than domestic interest rates. The interest differential encourages American investors to send funds abroad for a higher return and encourages foreign borrowers to obtain low-cost funds in the U.S.—both actions tending to cause outflows of dollars. The well-known "Regulation Q" which limited American bank interest rates has been amended to allow higher rates to be paid on foreign official time deposits. Preferential tax treatment of some foreign investments in the United States has also tended to reduce the net difference in earnings. In addition, monetary and fiscal policies have raised American interest rates somewhat.

The recently passed "interest equalization" tax is intended to make the cost of long-term borrowing in the American market more comparable to the cost in foreign markets so as to reduce the incentive for foreign borrowers and American investors to transfer American dollars abroad. The need for a curb on American investments in foreign countries is a matter of controversy, and the interest equalization tax is equally so.

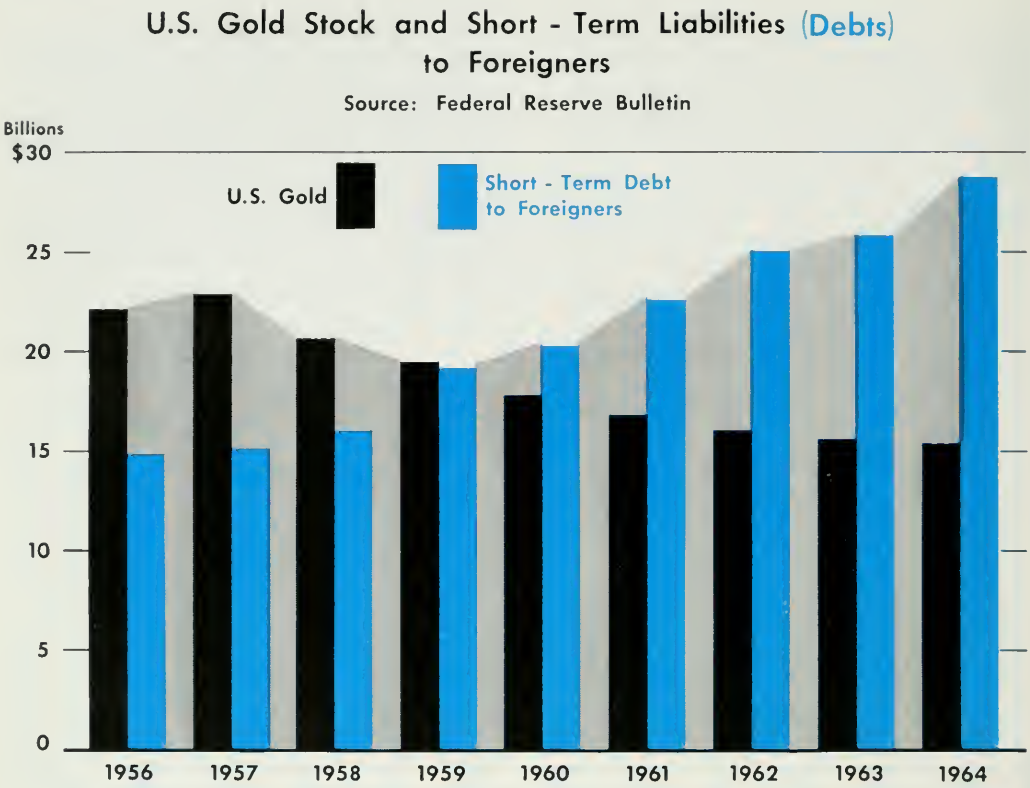
Foreign investments have been growing rapidly during the recent period of increasing payments deficits. These investments have been greater than the deficits, which means that they were of sufficient magnitude to swamp favorable developments in other payments items (for example, reductions in foreign aid). Despite this, there is considerable opposition to the view that foreign investments are hurting the U.S. payments position. The fact that incoming dividends, fees, etc. from foreign investments have been nearly as large as outgoing investment funds in most recent years is regarded as showing that the net effect of foreign investment is not very large. It should be noted, however, that the bulk of incoming returns is on investments made in previous years, and that the recent sizeable outflows of investment capital have been offset by less than 10 per cent in returns associated with the new investments. The continuing returns may well add up, over the years, to much more than the original investment, but future inflows do not show up in current balance of payment figures.

International Monetary Fund. In contrast to *ad hoc* methods of dealing with international monetary problems, the International Monetary Fund is a formal, continuing institution for handling international exchange and balance of payments problems. It is an international rather than a supranational organization. Member nations agree to follow IMF rules designed to avoid competitive exchange depreciation, eliminate foreign exchange restrictions and help correct basic maladjustments in member nations' payments balances. Each country subscribes a certain quota to the IMF in gold and in its own currency. These funds are then made available, under the rules of the IMF, to countries needing short-term credits for dealing with temporary payments problems. A member country can borrow its quota to deal with these problems with little difficulty. But where the payments problems are not temporary, but are deemed to be due to fundamental economic disequilibrium, and require extensive borrowing, loans are not to be advanced to enable a country to continue living beyond its means at the expense of other nations. In such cases the member nation is expected to take appropriate monetary and fiscal measures to remedy the situation.

Nations belonging to the International Monetary Fund agree to maintain the international value of their currencies within a narrow range of market fluctuation. Substantial devaluations (more than 10 per cent) require approval by the IMF. The central banks of member nations are required to buy and sell the currencies of other member nations in response to exchange rate changes within their jurisdiction which threaten to exceed permissible levels.

For example, if speculators in the London market begin for some reason to prefer pounds sterling to dollars at the official rate of $2.80 to the pound, the price of the pound will tend to rise. When the price of a pound sterling reaches $2.82 the British central bank (the Bank of England) is obliged to begin buying dollars (selling pounds) so as to keep the market price within acceptable limits. This is an obligation of membership in the IMF, even though it may involve acquiring unwanted stocks of a depreciating currency. Conversely, if dollars are preferred to pounds sterling in the New York market at the official $2.80 rate, the Federal Reserve System is obliged to begin selling dollars (buying pounds) when the exchange rate falls to $2.78. Since these requirements may strain the resources of the countries complying with them, other procedures are also instituted for dealing with speculative stresses.

International Cooperation. When speculators feel that a particular currency is going to decline in value relative to gold (devaluation) or relative to other currencies (depreciation) they convert their holdings from the suspect currency into other currencies or into gold. By the familiar mechanics of supply and demand this tends to reduce the value of the cur-



rency being traded away, relative to the currencies (or gold) being sought. But the value of money is not allowed to fluctuate beyond relatively narrow limits. The interests of a nation and the rules of the International Monetary Fund require a stability in the value of currencies. Therefore speculators must be supplied with the gold or foreign exchange they desire, at or near the official exchange rate. There are a number of possible ways of doing this.

Political pronouncements ("We shall maintain the value of the dollar," etc.) and administrative rulings are sometimes sufficient to discourage speculation. Governments may also directly enter the money market to counter speculative trends by their own sales and purchases of domestic and foreign currencies for future delivery. These "forward exchange operations" are designed to add to the supply of currencies whose prices are rising and add to the demand for currencies whose prices are falling. Support of the official exchange rate prevents its temporary speculative downturn from becoming cumulative in the manner of a speculative stock market collapse. Sometimes the large amounts of foreign currency necessary in these forward exchange operations is made available as standby credits from a cooperating government. If the operation is totally successful, the accumulated obligations to deliver foreign currency may be liquidated in the market before their maturity dates, making use of standby credits unnecessary.

Such international cooperation as this has been particularly important in defending and supporting the dollar, the collapse of which, as an international currency, would severely injure other nations as well as the United States.

Plans and Studies

While various aspects of the balance of payments and world liquidity problem have been dealt with by national and international authorities on a short-run basis with a degree of success, longer-range studies and plans have also been undertaken by these authorities and by academic economists. In general, the officially sponsored plans have tended to be relatively moderate. More sweeping institutional changes, or greater expansionary potential, or both, have been suggested in the Triffin Plan, the flexible exchange rate proposal and the plan to revalue gold, to mention only some of the more prominent of many suggestions.

The Triffin Plan. Perhaps the best-known plan for simultaneously solving the U.S. balance of payments problem and the world liquidity problem is that proposed by Professor Robert Triffin of Yale. Under the Triffin Plan, the use of key currencies as reserves would be eliminated. Replacement of these reserves and expansion of future international liquidity would take place through IMF issuance of an international currency for reserve purposes. The International Monetary Fund would become an international central bank holding the reserves of member nation central banks and engaging in credit and open-market activities. This would remove the constraints on the internal monetary and fiscal policies of key currency countries while providing the necessary increase of world liquidity under IMF guidance and without danger of a gold crisis.

Critics of the Triffin Plan have objected to the proposed enlargement of the role of the International Monetary Fund on various grounds: (1) the political pressures on the IMF would incline it towards inflationary policies to satisfy the desire for credit of as many members as possible; (2) the diversity of national monetary needs makes any single international monetary policy of ease or stringency potentially very harmful to a number of national economies; (3) it would encourage ready resort to IMF credits to finance payments problems whose real solution requires the national discipline to deal with difficult wage, price and exchange-rate imbalances; (4) the IMF as an international central bank would not have the power analogous to a national central bank, since there is no parallel international government capable of enforcing its edicts.

Flexible Exchange Rates. A more drastic change in international monetary practices and institutions would be required under flexible foreign exchange rates. The leading current exponent of this scheme is Professor Milton Friedman of the University of Chicago. Under flexible exchange rates the government would not establish any rate of exchange between its currency and that of other nations. The relative values of currencies would be determined by supply and demand, and would of course fluctuate with changes in the current market, anticipations, etc.

There would be no balance of payments problem as we know it under such a plan. Foreign exchange rates, like other prices, would simply fluctuate until a price was established which cleared the market. Since international trade would be continuously in balance (at varying exchange rates) a growing international trade would not require a greater international liquidity to settle imbalances. All the current expedients and projected remedies for dealing with the payments problem or international liquidity needs would be superfluous. Internal monetary and fiscal policy would be independent of the need for maintaining the international position of the currency. Governmental control on trade and payments would be unnecessary and the rigidities and misallocation which they entail could be avoided.

Objections to this plan have centered on the degree of uncertainty which it would introduce into international transactions. International purchases, sales and investments would have to be initiated without knowing the precise value which the money involved would have at the time the transactions were consummated. This uncertainty might also tend to increase the danger of de-stabilizing speculation.

The peculiar position of the United States as the leading key currency nation would create additional transitional problems. To allow the dollar to fluctuate in value would be to abandon a long-standing pledge to redeem dollars in gold at the official rate, and would involve huge losses to friendly nations and disrupt the whole monetary reserve system of many nations. For the United States these transitional problems must be weighed as seriously as the question of the long-run merits of flexible exchange rates. Even a one-time default on the U.S. redemption pledge would have long-run consequences for American financial credibility.

Revaluation of Gold. A number of economists have suggested that the price of gold be raised as a means of solving both the U.S. payments problem and the world liquidity problem. The American and world gold stocks would immediately increase in value, just as if more gold were added physically. Existing American gold holdings would be sufficient to meet all outstanding international claims, and the gold available to foreign governments and international organizations would be sufficient for financing international liquidity problems. The gain, moreover, would not be simply a "one-shot" affair. The higher price of gold could be expected to encourage the expansion of gold mining, thereby leading to a continuing increase in the supply of gold to meet future liquidity needs. Some supporters of revaluation also expect the increased value of gold reserves to make the current use of foreign exchange as monetary reserves unnecessary, thus avoiding the risk of redemption crises.

The most obvious danger in raising the value of gold is that of inflation. Increased monetary expansion becomes possible with an increased value of gold reserves. This could be avoided by demonetizing some of the gold but political pressures might prevent this in many countries. On the other hand, if revaluation led to anticipations of further upward valuing, this would tend to increase gold hoardings and would therefore be deflationary. Public discussion of the possibility of revaluation by responsible monetary officials would also tend to increase gold hoarding. Thus while the increased valuation of gold contains the danger of inflation afterwards, discussion of the possibility tends to be deflationary before the event.

Prospects

In evaluating either the current policy disputes or the various comprehensive plans which have been suggested, a useful distinction might be made between the relative merits of the plans themselves and their implementation by existing monetary authorities with their existing ideas and values. Conceivably the "best" plan may not enjoy sufficient confidence from the monetary authorities to be implemented in the best way. A "second best" plan which they thoroughly understand and support may be administered with a skill and insight which produce results that are the best attainable under existing conditions. This is of course only one possibility among many. There may be plans whose margins of superiority insure better results than others and which may turn doubters into supporters as they operate in practice. In any event, however, the monetary views of the people who are to administer any plan must be recognized and weighed, even if they are not to be decisive.

For the immediate future the continuation of *ad hoc* measures, nationally and internationally, seems more probable than the adoption of any comprehensive scheme of monetary reform.

More and more often, telephone management people are being asked to represent their companies in radio and TV interviews. This workshop, set up by A. T. & T. and the New York Telephone Company, is designed to help such people "perform" at their best

You're on CAMERA!

E. Robert Mason, Jr., *News Service Supervisor, Public Relations Department, A. T. & T. Co.*

Henry Senber, *News Manager, Radio and TV, New York Telephone Company*

■ THE TECHNICIAN wearing a telephone headset raised his hand for quiet. "Video tape is rolling," he called.

Another technician swung a television camera toward a small stage and picked up the image of a slender, balding man who was seated before a microphone. The technician then turned the camera lens and a closeup shot appeared on the TV line monitor.

"This is Tom Costigan of WMAD. Tonight my guest is John Whitborn of the XYZ Telephone Company," Costigan said into the microphone. "Mr. Whitborn is going to answer some questions about the telephone company's new all-digit dialing plan."

Such a scene opened the television session of a training workshop for Bell System people—a workshop designed to familiarize them with the world of radio and television and to prepare them for possible appearances on radio and TV on behalf of their companies.

A number of developments that have come about in recent years made such a workshop seem desirable.

The outstanding characteristic of radio and TV in the 1960's has been the greatly increased emphasis on news and news feature programing. For instance, since 1960 one network has doubled its news staff, increased its news budget from $20 million to $33 million and by the end of 1964 was devoting 30 per cent of network programing time to news or news feature material. Other networks and individual radio and TV stations throughout the country have taken similar steps.

Another fact of interest is that TV and radio editors have found their programs are more effective when viewers or listeners can learn about a new development from a man who has first-hand knowledge. Today's electronic reporters, therefore, armed with portable audio tape recorders or highly mobile camera and sound crews, go to where the news is being made, whether that be the scene of a fire, or a murder, or the annual meeting of the Committee to Preserve Historic Sites.

Another factor in the decision to try training people for radio and TV appearances has to do with the way Americans are being informed. Last year the Elmo Roper organization reported that a majority (55 per cent) of us said that television and radio were our primary sources of news. Most of us also read papers, of course. But we are getting the news first (and our primary impression of what it means) from radio and TV.

One important result of all this has been a sharp rise in the number of requests by stations for telephone people to appear on the air to represent their companies' positions in matters of current interest or controversy.

These developments had been duly noted by many Bell System press relations men and women. Among other places, they were discussed at meetings of the Metropolitan Radio-TV Committee, a press relations group representing Bell Companies with headquarters in the New York City area. Out of these discussions emerged a joint New York Telephone Company-A.T.&T. radio-TV training workshop.

The workshop proved that professional guidance, exemplified here by Tom Costigan, noted radio and TV reporter, can be of great help to those who may be asked to appear on the air.

There are some basic differences that should be noted between the "printed" press and the "electronic" press. One concerns the different impressions received by readers, hearers and viewers. Consider for instance, what happens when a telephone man is interviewed for a story by reporters from newspapers, radio and television.

First, the newspaper story which subsequently appears will have been influenced by a whole series of "third parties" —the reporter who wrote it; the city editor who handled it; the copy reader who read it for grammar and style; the news editor who decided where in the paper to place it, and even the linotype operator who set the type and made the typographical errors (if any).

The radio story, on the other hand, will, if aired live, bring to the listener the telephone man's exact words, spoken with all the force and persuasion, or lack of these, at his command. If taped and edited, the words and voice are still his, although the editing factor now has been introduced.

The television story adds the visual elements of personal appearance, poise, presence and sincerity. Despite any editing that is done, the viewer at home will receive a firsthand impression of the man on the screen. This firsthand impression is the most remarkable attribute of electronic journalism, particularly television. It is unique.

As soon as we began planning the workshop, we knew that we needed help — *professional* help. Luckily, we found two men who had been thinking about the kind of problem which faced us. One man was Tom Costigan, a radio-TV reporter who has covered thousands of news stories during a long career. The other was A. Burke Crotty, a radio veteran who had moved to TV direction in the 1940's and who directed many of the early television "remote" news and sports broadcasts. Mr. Crotty also had experience in coaching men in public life for their first TV appearances.

Realism in every detail was stressed. Here we see workshop studio as cameras are about to roll and the simulated interview begins.

Also needed for the workshop were pupils, students, trainees—we never did settle on a satisfactory designation. The reason was that the men we chose already had had considerable experience in appearing before the public. We did not envision a basic course in public speaking. Rather, we looked for people who had been on their feet before an audience; men who had the basic tools of articulation already and who could profit more deeply and quickly from the kind of intensive introduction to a new environment which we visualized.

We saw the workshop as a two-day job. On the first day we introduced our students to the problem we faced by presenting factual material similar to that

You're on CAMERA!

just discussed. We also enriched it with TV kinescopes and audio tapes of telephone people who had already appeared on radio and TV, as well as examples of praise and criticism of our business which had shown up on news broadcasts and also on the so-called "conversation" or "personality" shows.

Also on the first day, a review of public speaking fundamentals was presented, but tailored particularly to the special needs of radio and TV. Studio layout was explained; duties of personnel and studio etiquette detailed. An example of the kind of information in this session is the following explanation from Mr. Costigan on the role of an interviewee on television: "In an interview, the interviewee never speaks to a microphone, a camera or an audience. He is speaking to one person, the interviewer. The broadcast from this conversation will have the effect of person-to-person rapport, not between the phone company and a huge audience, but between John Telco and Mr. Customer, sitting in a room many miles away."

Before leaving the first day, we should note that some of it was devoted to informal discussion among the staff and the students, some of whom had had previous experience with the electronic media. Later we were to decide that we probably had devoted too much of the

A typical workshop TV interview is shown under way. Tom Costigan is asking pointed questions of one of the participants who responds by showing a chart to the "TV audience."

first day to pedagogy and too little to factual information and to the kind of practical, personal experience which the students underwent on day number two.

At the end of the day the students were given packets of information which they were to study in preparation for the radio and TV workshop sessions which followed. These sessions took up all of the second day.

Basic Bell System role-playing techniques were used in the workshop for both radio and television. Here is one example from the TV session and how it was carried through.

- A basic situation was postulated. Criticism—wry, humorous, satirical, serious—has been appearing in newspapers and on radio and television about the XYZ Telephone Company's plan to introduce All-Number Calling in Centerville. Tom Costigan of WMAD-TV conducts an evening interview show and has invited the phone company to send a representative to explain ANC.
- Costigan was provided not only with information about ANC but also with examples of every kind of criticism of it that could be found in the files at A.T.&T. and the New York Telephone Company. The authors added a few of their own. A sample list of questions also was included.
- The student to be interviewed was given *all* the factual and policy material on ANC available at A.T.&T. and the New York Company—a considerable amount. He was also given a list of questions which Costigan would ask, but was warned that Costigan was not restricted to that list and, in fact, would probably go far beyond it.

■ Let us now set the scene. The auditorium of the New York Telephone Company's headquarters. On a small, low stage, brilliantly and balefully illuminated by studio lights, is a small table with two chairs and two microphones. At one mike is Costigan, who is in animated conversation with a television cameraman some ten feet away. A technician at a control panel is talking to someone via a telephone headset. Thick cables snake across the stage. Staff members walk back and forth, talking to Costigan and the technicians. Outside the pools of light are about 20 spectators—watching the proceedings closely.

This is the scene which confronted each student as he stepped into our simulated studio. As he sat down next to Costigan, a staff member outlined the situation for the camera and introduced Costigan. The cameraman swung the camera toward the student until its glittering lens pointed directly at him. With

After each interview, a critique was given by A. Burke Crotty, radio-TV veteran who has similarly coached many public figures.

a somewhat crooked, but not unfriendly smile, Costigan opened the show:

"Welcome Mr. Whitborn. I want to ask you tonight about this all-digit dialing plan you're about to inflict on us poor customers."

And so the questioning was under way. Each student was interviewed in this manner for an average of eight minutes and, as we found out, a professional like Costigan can ask a lot of questions in eight minutes. As the interviews progressed they were video-taped and when our nine students had completed their stints, the tapes were re-rolled and played back immediately. At this point Mr. Crotty took over.

■ As each man's interview was played back on a 24-inch TV monitor, he sat next to Mr. Crotty and was given a blow-by-blow critique of his performance. Among points covered by the veteran director were personal mannerisms ("Keep your hands out of your pockets."); diction ("Open your mouth."); aggressiveness ("Don't be nasty to the man. It's *his* audience."); lack of aggressiveness ("Don't let him get away with that. You've got a good answer."); footwork ("His question was off-target. You should have changed the subject to more favorable ground.").

It should be noted quickly that, while the comments above were samples of criticisms (that was Crotty's job), all of the students comported themselves very well, considering the realism of the situation and the thoroughness of the questioning. And, as Crotty remarked, each would have done immeasurably better on a second try.

We asked each student to answer a questionnaire on the workshop and we

During the critique of an interview, A. Burke Crotty, the participant and the audience observe a playback of the performance by means of the TV monitor (center) and a taped recording.

Members of the audience watch the interviews while awaiting their turns "on camera." The consensus of the participants was that the workshop technique is very valuable in many ways.

particularly asked that they be candid. In summary their answers told us:

- The workshop was valuable to them, both personally and in their work. (Unanimous)
- The role-playing sessions were most valuable. (Unanimous)
- Too much pedagogy and formal instruction. Could be cut severely. (Three to one)
- The use of professionals was absolutely necessary. (Unanimous)

In addition several of the students and observers at the workshop commented that it was useful not only for radio and TV appearances, but also in preparation for any public appearance, particularly where controversy was involved. Others said they would be helped in internal communications, with their superiors, their peers and their staffs.

Several of our former students have gotten that second try which Mr. Crotty mentioned—on both network and local radio and television. They reported afterwards that they felt both effective and comfortable, and the results bear them out. They all did well. We believe that workshops like this—tailored to local needs and conditions by other Bell System Companies—will help Bell System people do even better. The New York Company certainly thinks so. It has run two such workshops this year—for vice presidents and general managers—and is planning more.

This new equipment will bring greater capacity—and efficiency—than has ever been possible before to one of the Bell System's biggest customers, the nation's telephone answering services

GOOD NEWS for the ANSWERING SERVICES

John R. Clark, Jr., *Staff Representative, Marketing Department, A. T. & T. Co.*

There may be some question as to when the first telephone answering bureau began operating—it is generally agreed that it was about 1917—but there is no question about the importance of the role that answering services play today. By taking the "no" out of "no answer," they not only fill an urgent need so far as telephone subscribers are concerned, but they are also responsible—directly or indirectly—for almost a billion calls a year.

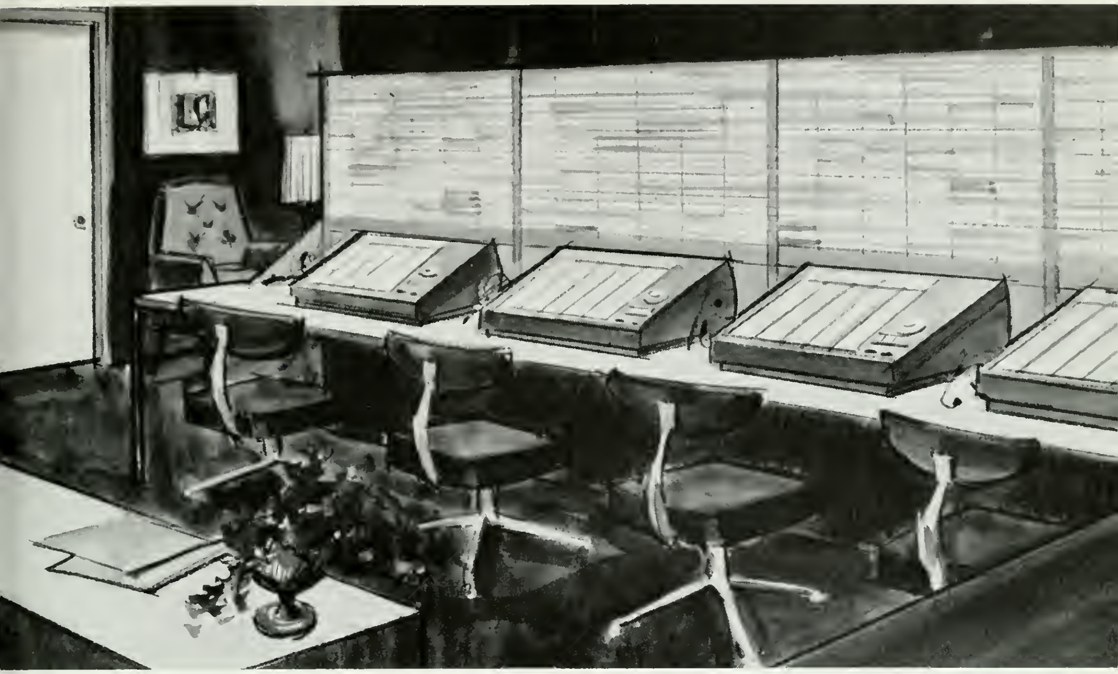
The Bell System, well aware of the importance of the telephone answering services, set up a task force early in 1961 to study the industry and find ways of helping it improve its operations through changes in existing practices and equipment. The study showed that there were several areas in which the existing equipment could be improved.

For instance, there is a good deal of variation in the instructions given to answering bureaus by their clients. Some want their telephone answered on the first ring; others want them answered on the third ring, or, on certain occasions, not at all. With the switchboards now in use, the answering bureau secretary has to count the rings visually on each line. If this process could be eliminated, it would ease her work load and increase her efficiency tremendously.

Another area in which improvement was desirable was that of design: an attractive, compact switchboard with push-buttons instead of cords, was indicated.

After evaluating these and other needs, Bell Laboratories went to work and developed what is called the 1A Telephone Answering System for small and medium-size bureaus.

A major advance in answering service equipment, the 1A consists of an answering console, an equipment cabinet and the appropriate connecting cable. The



The new 1A consoles are colorful and are adaptable to good, modern interior decoration.

cabinet, about the size of a five-drawer file cabinet, contains the power plant and all the switching equipment. It can be located remotely as much as 50 feet from the console. Or, since it is noiseless, it can be installed in the work area.

■ The compact console is of the direct line type—which means that the clients' lines which terminate on the consoles are direct extensions of those lines from the central office; *i.e.,* the same lines which serve the clients' own telephones. Each console can accommodate a maximum of 100 lines.

All of these lines, of course, handle only *incoming* calls to the clients' telephones. The answering bureau must be able to call *out* to the clients and make other outgoing calls, and for this purpose there are administrative central office lines on the consoles, up to ten of which can be accommodated at each position. These lines for the bureau's own use can be duplicated—or multipled—at each console.

The console operates with non-locking buttons which are used to answer and hold calls; lamp signals—a flashing lamp indicating an incoming call, a steady lamp indicating that the call is answered and a winking lamp when the call is held; and an audible signal to alert secretaries to incoming calls.

■ Several significant improvements have been incorporated in the new 1A System. A "ring control" permits each answering button to be turned so that the lamp does not light at all, or lights on the first or third ring. This eliminates the need to count rings for each call. Each button on the console terminates a specific line which is clearly identified, since the designation strip is right beside the button. This provides instant and easy line identification. The

Operating room of an answering service bureau today. These switchboards function well, but the 1A Telephone Answering System will enable many bureaus to do the job more efficiently.

new system has a mutual assistance arrangement whereby a "grouping teamwork" button permits an answering bureau secretary to take calls on adjoining consoles without moving from her position. It also groups up to six consoles so that a single secretary can operate them during slack periods.

Quiet operation is another advantage of the 1A System. The only sound heard from the equipment is the tone signal of an incoming call. The volume of the signal is automatically reduced when the secretaries are handling more than one call—as, of course, they do during busy periods. On present switchboards the caller must wait for the ringing cycle before the secretary can answer; with the 1A System, a call can be answered any time after the lamp lights. Simplicity of operation is an important feature of the new system. New secretaries, with no previous experience, have learned to operate the console quite acceptably after only one hour of training. The average telephone answering bureau can presently handle 80 to 85 clients on a single switchboard. It is entirely practicable to handle from 95 to 100 clients on a 1A console.

Attractive design may not be directly functional, but indirectly it is certainly so. The 1A console comes in four colors,

The 1A Telephone Answering System in trial installation: a quiet, pleasant place to work. The new, compact consoles are easier to use and more attractive than present equipment.

and its compact good looks adapt it well to modern interior decoration. This not only enhances the appearance of the answering bureau, but also—in conjunction with the 1A's silent operation—actually helps increase the secretaries' efficiency by making the operating room a quiet and pleasant place in which to work.

■ The 1A has, of course, been tested in the field. On July 30, 1963 a system was installed in Wes Steele and Paul Rohrich's Answering, Incorporated, in Silver Spring, Maryland. In this trial installation, three consoles replaced the four switchboards formerly used. When the field trial period was over, Mr. Steele said he considered it a major step forward in answering service equipment, and that he intended to have it installed, wherever practicable, in his other offices.

The telephone answering service bureau has come a long way since it started nearly 50 years ago. It has the proportions of a major industry today—and is still growing. New developments such as the 1A Telephone Answering System will help this industry move forward by helping the thousands of answering service bureaus fulfill their commitments to their clients more efficiently and more easily than ever before.

in this issue...

■ The problem of the school dropout is by no means a new one, but it is growing almost daily. Growing, too, are public consciousness of it and the determination of many organizations to do something about it. Specifically, the doing of something about it has become a lively concern in the Bell System. Helping the Bell Companies implement that concern with action is part of the job for William C. Mercer, co-author of the article beginning on page 22.

Mr. Mercer began his Bell System career as an auditor with Western Electric in 1947, and subsequently served in various posts in accounting and sales work. In 1956 he was appointed comptroller of Western's Merrimack Valley Works, and, in 1957, superintendent of the equipment shop. The following year he joined the New England Telephone and Telegraph Company in Boston, served as New Hampshire general manager in 1959 and as vice president—personnel in 1960. In 1962 he was elected vice president—operations of Indiana Bell Telephone Company and at the close of 1963 assumed his present duties at A.T.&T.

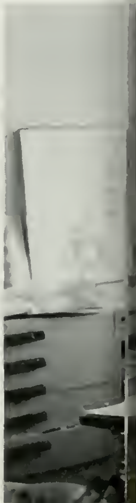
■ The co-author, with William C. Mercer, of "The School Dropout Problem," on page 22, is directly concerned with the public relations aspects of the developing Bell System effort to solve that problem. As assistant vice president in A.T.&T.'s Public Relations Department, Mr. Wood has responsibility for the customer and community relations division, which in turn is responsible for advice and assistance to the Operating Telephone Companies in the important areas implied in its name.

Mr. Wood began his Bell System career in the Illinois Bell Traffic group. After working in various capacities there, he transferred to Illinois Bell's public relations department, where he served as general information manager and general news service manager. In 1948 Mr. Wood came to New York as assistant vice president in charge of the Long Lines Department's public relations, and two years later became assistant vice president in A.T.&T.'s Public Relations Department.

■ Frank Lacano, who has contributed "The Telephone Company in Action," first of our portfolios on the Bell

William C. Mercer

Kenneth P. Wood



System as seen through artists' eyes, has had a distinguished career as artist and illustrator. He entered the Trenton School of Industrial Arts in New Jersey with a two-year scholarship, going on from there with top honors and further scholarships to the American School of Art and Design in New York. Upon completion of courses there, he entered upon a successful career in illustration, which was interrupted by World War II. Three and a half years later he was back at the drawing board, where he has been ever since.

Mr. Lacano, who has studios in both New York and New Jersey, has done illustrations for most major advertisers and is constantly called upon for book and magazine illustration and design. He is a fine arts painter in his own right, having exhibited widely; in April he represented New York City with a one-man show at an annual arts festival in the South. He is a member of New York's Society of Illustrators, where he has served, among other offices, as vice president, and where he plans another one-man show this fall.

■ In writing on "The Balance of Payments Dilemma," page 41, Mr. Sowell again demonstrates his knowledge and his competence in readable exposition on economic matters. We say "again," because our author has done considerable writing in this specialized field; previous articles of his have appeared in *American Economic Review*, *Economica* and similar academic and scholarly journals. As economic analyst in A.T.&T.'s Comptroller's Department, he is involved daily in examining problems of the national and international economy.

Mr. Sowell holds a B.A. from Harvard, an M.A. from Columbia University and is working on his doctorate *in absentia* from the University of Chicago. He has taught in the economics departments of Rutgers and Howard universities.

■ "You're on Camera!" is a very familiar phrase to E. Robert Mason, co-author of the article starting on page 49. Since the beginning of 1961, at A.T.&T., he has worked in press relations in the Public Relations Department, with special responsibility for radio and television liaison. He has had a hand in the production of film clips for TV release and works closely with TV and radio news personnel. He has also handled many contacts with TV program producers, supplying telephone props for sets and telephone people to participate in special programs. From this experience he knows at first hand the importance of training non-professionals for appearance on the air.

Frank Lacano

Thomas Sowell

E. Robert Mason

Mr. Mason also had long experience as a professional newsman before joining the Bell System, having been with the *Newark Evening News* for 15 years. While there he worked as a reporter; on general assignment; on special assignments in medicine and science; as bureau manager and as suburban editor.

■ Henry Senber, co-author with E. Robert Mason of "You're on Camera!" (page 49), has, like Mr. Mason, been closely concerned for many years with television, the world's newest information and entertainment medium, as well as with some of its older ones. His experience as news manager (radio and television) for the New York Telephone Company has made Mr. Senber acutely aware of the need for articulate, informed spokesmen for the company in this day of the "electronic press." That experience, too, was partly responsible for creation of the Radio-Television Workshop program described in his article.

Prior to joining the New York Company, Mr. Senber had a wide range of experience in newspaper reporting, radio writing and in theatrical production and publicity. In the latter capacity he worked with such footlight notables as Orson Welles, Tallulah Bankhead, Ethel Barrymore and Maurice Evans. Mr. Senber recently was nominated vice president of the Society of Silurians, an organization of veteran New York City newspapermen, and is an associate member of the Radio Television News Directors Association.

■ In writing about "Good News for the Answering Services" (page 56), John R. Clark, Jr. is on familiar ground. As staff representative in A.T.&T.'s Marketing Department, he is responsible for the introduction of the new product—the 1A Telephone Answering System—to the Bell Telephone Companies.

A graduate of Texas Christian University, Mr. Clark joined Southwestern Bell in 1956 as a staff assistant in the Commercial Department. Since then has held various positions in that department in Houston, McKinney and Amarillo, Texas. In January of 1964 he came to New York to assume his present duties in the Marketing Department.

Henry Senber

John R. Clark, Jr.

in the news...

Rate Reductions

W.E. Price Cuts

Gemini Network

Lasers Locked in Phase

World's Fair '65

Magnetic Dialer

Infra-Red Bonding

Daytime Interstate Rate Reductions

Since April 1, a daytime interstate station-to-station telephone call anywhere in the continental United States costs $2 or less for three minutes. The previous maximum for such a call was $2.25.

Rate reductions, ranging from five to 25 cents in the initial three-minute charge, have been made in all daytime interstate station-to-station telephone calls of 601 or more miles. Reductions have also been made in the charges for additional minutes beyond the initial period. Based on 1964 telephone volumes, the new daytime rates are expected to result in savings to the public of about $25 million annually.

The rate changes, filed by the Bell Telephone Companies with the Federal Communications Commission, represent the second step in the $100 million reduction in Bell System revenues announced last November, $75 million of which was made effective on February 1.

The April 1 reduction is primarily of benefit to business since most daytime long distance calls are made by business customers. The $75 million cut of February 1, on calls made in evening hours and on weekends, is of primary benefit to residence customers.

W. E. Price Reductions

The Western Electric Company has reported to the Federal Communications Commission and the National Association of Railroad and Utilities Commissioners a general revision of its prices for the products it manufactures for the Bell Telephone Companies. Effective March 1, the revision will result in an aggregate reduction of $33 million a year at current business levels.

Paul A. Gorman, W.E.'s president, attributed the company's ability to cut prices to increases in volume resulting from expanded telephone company construction programs and to Western Electric's continuing program of cost reduction engineering.

"As a unit of the Bell System, we have a responsibility to our telephone company customers and to the public to keep costs down," Mr. Gorman said. "Our ability to do so has contributed significantly to the growth and improvement of telephone service over the years. The current reduction will help sustain this progress."

Last July, following discussions with regulatory officials, W.E. reduced its prices to the Bell Telephone Companies by some $44 million on an annual basis. The March 1 revision brings the price level of Western Electric's production for the Bell Companies to 16 per cent below the level of 1950—despite increases of 88 per cent in wages and 36 per cent in raw materials costs since then.

Worldwide Network Aids Gemini Flight

Although the successful flight of Gemini astronauts Virgil Grissom and John Young took them far into the vastness of space it could hardly be called a lonely experience.

Backing up the flight of the Gemini astronauts was a 225,000-mile network of communications facilities. This global network helped the National Aeronautics and Space Administration keep constant tabs on the capsule, its equipment and occupants throughout the flight.

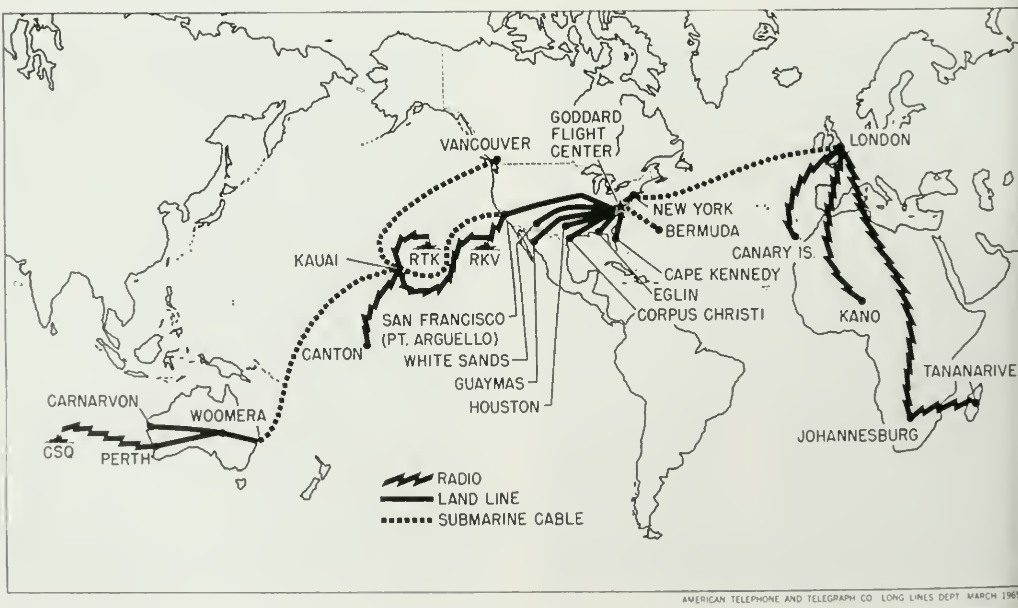
The Bell System is the major supplier of Project Gemini communications support facilities and services, and assists in the overall coordination of the network. Just about every known form of electrical communications is involved: voice, data, video, telemetry, telephoto and teletypewriter.

Within the U.S., the network is a combination of microwave and cable. The overseas portion consists of deep-sea cables and high frequency radio links. The hub of this vast tracking and communications complex, called NASCOM, is NASA's Goddard Space Flight Center in Greenbelt, Md.

The network ties together 18 communications and tracking stations around the world, including three ships on the high seas. At these stations, radar and telemetry equipment track the Gemini spacecraft and acquire data on the performance of its components and its occupants. Radio, telephone and teletypewriters funnel this information to Goddard. High-speed computers at Goddard, each with realtime capability, use the raw data to make constant flight contingency recommendations, predict flight path, and determine the time to initiate re-entry—all on a near-instantaneous and continuous basis throughout a mission.

Project Gemini's global voice network is

PROJECT GEMINI GROUND COMMUNICATIONS



controlled from Goddard through the SCAMA (Station Conferencing and Monitoring Arrangement) system, developed for NASA by the Bell System. Through this system, the heart of the entire network, pass messages between operators around the world. At the touch of a button, the system reaches instantly into overseas support stations such as Woomera, Australia; the Canary Islands; and Johannesburg, South Africa.

The entire network "homes-in" on a large SCAMA console at Goddard. The console provides push-button voice contact with as many as 220 worldwide stations . . . every station needed to handle any contingency can be instantly called upon. It also allows for unlimited conferencing—operators can set up simultaneous conference calls with any or all of the network stations.

In addition, television films about the recent flight were carried by the TELSTAR® communications satellite to Europe. The films, showing part of the pre-flight briefing and scenes of the astronauts climbing into their capsule, were transmitted from Andover, Maine to the TELSTAR satellite and then to a ground station at Raisting, West Germany.

Lasers Locked in Phase

Two lasers have been locked together in phase for the first time. Scientists at Bell Telephone Laboratories have opened up a new era in optical communications by designing a feedback loop that holds the phase difference between the waves generated by two single-frequency helium-neon lasers to within a third of a degree.

Two laser beams at same frequency and with constant phase difference combine and interfere with each other causing rings on screen.

Phase-locking at optical frequencies will permit the use of homodyne detection—a technique that makes it possible to halve the transmitted power—in experimental light communications systems. In such a system a transmitter laser would be phase-locked with a receiver laser some distance away. Other applications might include the combining of several low power lasers to produce one high power beam. The Bell Laboratories' experiments also will enable scientists to study the interactions of light waves from separate sources.

World's Fair '65

Loudspeakers again airing medleys of "Come To The Fair" at New York's Flushing Meadows this spring might well add "There've Been Some Changes Made."

At the Bell System exhibit's big "floating wing" pavilion, visitors will be able to see and try a variety of new displays, electronic devices and improvements.

Under brightly colored tents in a new "Telefair" area, Bell System visitors will find a playground of the latest telephones and electronic devices to intrigue young and old.

In three special telephone booths, children will be able to listen to Goofy, Mickey Mouse and other Disney creatures by dialing a number under their pictures. In another tent a "voice mirror" will play back to the visitor the unfamiliar sound of his own voice on the telephone. Light, focused on solar batteries, will power an amazing array of pinwheels, while a ten-cent local call will put an entire family group on the line at once, in one of four new family phone booths.

Elsewhere in the pavilion, visitors will see a three-step demonstration of "electronic shopping." This glimpse into the future shows how Picturephone, Data-Phone service and a computer might be combined to ease a housewife's chores, as well as expedite order-delivery problems for business.

Fair visitors also will learn about crystals and their use in communications in an expanded exhibit elsewhere in the Bell System building. The display shows how Western Electric grows and processes quartz crystals.

A diamond-edged cutting machine will slice quartz into seed plates—the starting elements in the process.

Magnetic Dialer

A new electronic magnetic dialer is going into Bell System service to provide telephone customers with a built-in memory for 400 or more phone numbers, and automatic dialing at a single touch of a button.

Named the Magicall (registered trademark of the DASA Corporation), the new device is being supplied to Bell Telephone Companies by Western Electric, which has put through a purchase contract with the manufacturers of the device, DASA Corporation.

Compact styling, the convenience of a personal directory with unlimited capacity plus speed, efficiency and accuracy are offered by the Magicall, which stores up to 400 numbers on a single magnetic tape. For extra capacity, 1,000-number interchangeable cartridges are available.

The Magicall set consists of the dialer; a power pack, which plugs into the nearest electrical outlet; and a dial-in unit, for recording numbers on the tape. The dial-in unit is used only when recording numbers and is unplugged afterwards.

Magicall may be connected to any telephone set. It is expected to have its greatest use among businessmen who make frequent calls to the same numbers. It also has a number of military applications. For military use, a special Magicall set comes equipped with an illuminated index window, for use in dimmed or blacked-out alert areas.

Magicall electronic magnetic dialer dials numbers automatically at push of a button.

Infra-red Bonding

Infra-red radiation—similar to solar energy—is being used by Western Electric to bond glass to metal in the production of sealed contacts. These are small switches that set up telephone talking paths in the Bell System's new electronic switching networks (see page 2).

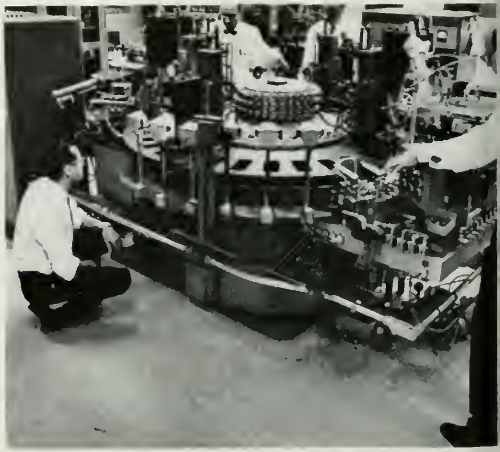
The new process employs temperatures of 5600 degrees (F.) generated by 650-watt quartz iodine lamps inside special gold plated reflectors. The operation points to dramatic gains in quality, along with cuts in cost.

A sealed contact consists of two thin, metal reeds enclosed in a small glass tube, one projecting from each end. The switching action occurs when the reeds inside the tube are made to touch or separate magnetically.

The contacts are assembled on a machine by inserting a reed into each end of a tube and then melting the glass at the ends so that it grips and holds the metal reeds. The glass was formerly melted by electric heating coils, which took almost a minute to soften the glass and seal the tube.

The new process produces a reliable bond

Rotary machine was adapted to infra-red heating process to produce sealed contacts.



between glass and metal with virtually no interruption or variation. It was developed cooperatively by W.E.'s Engineering Research Center and engineers at W. E. plants in Allentown, Pa., and Winston-Salem, N.C. With production schedules calling for 22 million of the contacts this year, and perhaps 180 million a year by 1970, the prospective savings run into millions of dollars.

Epitaxial Transistor Patent

The method of making the epitaxial transistor and other improved semiconductor devices is the subject of a patent awarded recently to J. J. Kleimack, H. C. Theuerer, and Dr. H. H. Loar of Bell Telephone Laboratories. The process, first announced by Bell Labs in 1960, had immediate and widespread impact on the semiconductor industry as it made possible transistors, diodes and integrated circuits of improved electrical performance and low cost. It is considered one of the most important inventions in the field of solid-state electronics since the original transistor was invented at Bell Laboratories.

At first, the process was applied in the fabrication of low-power switching transistors of the type used in computer circuits; this resulted in transistors of faster speeds and lower power consumption. The fabrication technique is now used to make a majority of transistors—low-frequency devices as well as those which operate at microwave frequencies and devices which operate over a broad range of the power spectrum.

Last Undersea Amplifier Tube

With hardly a ripple one of the most amazing and exacting manufacturing jobs ever undertaken for the Bell System has slipped into communications history.

Production of a unique electron amplifier tube, built to operate continuously for 20 years or more at the bottom of the sea, was concluded at Western Electric's Allentown, Pa., plant when tube number 67,201 reached the end of the special assembly line.

Advances in transistor technology have made it unnecessary to continue manufac-

Workers in super-clean shop smile as last of amplifying tubes reaches end of the line.

turing the tube, which was built to serve as the basic voice signal amplifier in rigid undersea repeaters. Spliced into trans-oceanic telephone cables at 20-mile intervals, the repeaters strengthen voice currents.

To insure dependability, W.E. assembled the tubes with painstaking care in specially designed, super-clean facilities at Allentown. The air was carefully filtered; employees wore lint-free uniforms; parts were sheltered under protective hoods during assembly; people and materials entered through air locks to keep out even stray particles of dust.

Each tube required nine months of production time, which included 2,980 inspections and 5,000 hours of simulated operation. Only about one of every ten tubes passed a final, rigorous analysis by a committee of Western Electric and Bell Laboratories engineers.

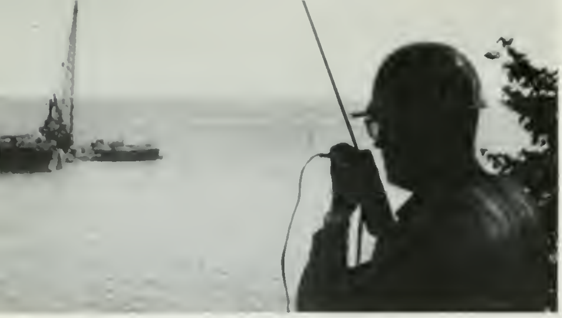
But meticulous selection paid off. When the last tube came off the line, not a single failure had occurred among nearly 6,000 tubes already at work in eight cables crisscrossing the seas.

The tubes have already been delivered for the last three cables to use the electron tube repeater. Two of them will be laid this year.

Armored Cable Under Hudson

Two specially-made telephone cables have been buried in the floor of the Hudson River north of New York City as an addition to the Bell System's underground cross-country cable route, designed to withstand nuclear attack and natural disaster.

The cables cross near the river's broadest point from the Tarrytown, N.Y. area to north of Nyack, N.Y. Placed in the depths by the Long Lines Department of A.T.&T., the



Long Lines man coordinates shore operation as armored cable is laid under Hudson River.

cables will help carry a growing volume of long distance calls to and from Boston.

Long distance calls are usually transmitted across the Hudson via microwave radio systems. The new underwater cables provide more secure communications channels in accordance with the "blast-proof" design of the transcontinental underground system.

Both manufacture and installation of the cables were geared toward maximum security. More than six miles of heavily armored 12-tube coaxial cable were manufactured for the project by Western Electric's Baltimore works. The portions of the cables that cross the river were armored with an added layer of steel, as protection against river currents, heavy tides and passing ships.

Laying of the two cables was accomplished by specially trained crews working from two large barges. After the cables had been placed on the bed of the river in parallel paths 300 feet apart, divers and digging equipment descended to complete the job. For final protection, two four-foot trenches were plowed across the river's floor, the cables were placed in the trenches and the openings were filled with silt.

Central Office Fire

A central office fire in a General Telephone Company exchange in Richmond, Indiana, early on February 4, interrupted service to about 24,000 stations and isolated Richmond from the toll network. Less than eight hours after the fire, essential services were established through two transportable switchboard units which had been developed to serve the President of the U.S. while he is traveling. These units, sent from the Ohio Bell and Indiana Bell Telephone Companies, were later replaced by three larger manual switchboards. General Telephone supplied one and another was a trailer-mounted switchboard sent by Michigan Bell Telephone Company.

The largest unit, from Illinois Bell Telephone Company, was a 28-position switchboard. It was sent to Richmond without being completely dismantled to keep reconnection time to a minimum. Indiana State Police met this shipment at the Illinois-Indiana state line and provided an escort to speed the board across the state to Richmond, which is in eastern Indiana near the Ohio boundary.

An excellently designed and executed plan by General Telephone and Indiana Bell people was used to connect subscribers' lines to these switchboards. Nine large concerns in the area were connected into the DDD network at Indianapolis. WATS lines were re-established by switching them at New Castle and Indianapolis. Circuit reroutings were accomplished by close coordination between Indiana Bell and the Long Lines testboard at Indianapolis.

Top. Hole was cut in wall of Antioch, Ill. central office to remove 28-position board. Below. Huge board on its way with escort; sign reads: "emergency switchboard for fire stricken Richmond, Ind. from Illinois Bell."

Big telephone installer? No, it is actually a pint-sized phone booth, one of several in the new "Telefair" area for children at the Bell System World's Fair exhibit. The normal-sized installer is hooking up a direct line to Goofy, one of the Walt Disney creatures who will talk to small fry. The new area is one of a number of additions and changes being made in the Bell System pavilion for this World's Fair Season.

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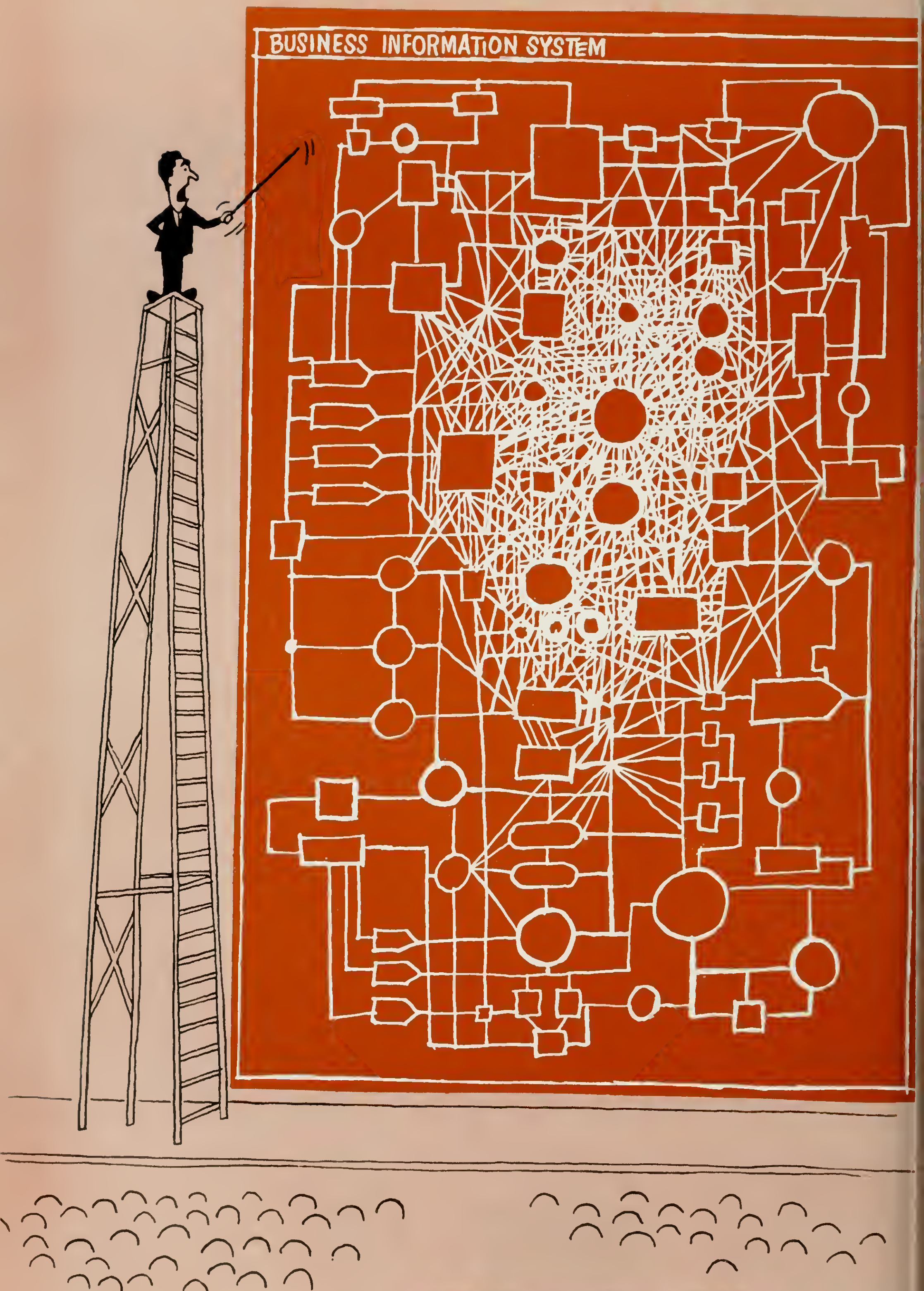


"And now, gentlemen, I'd like to go over
implementation of BIS with you!..."

BIS

Donald R. Woodford, *Managing Editor*

The initials heading this article, through their growing ubiquity, are becoming familiar to the American business community. They stand for Business Information System; they mean a completely new way of managing the flow of information generated and needed by an enterprise of any size. This is an interim report on the introduction of B.I.S. in the Bell System.

■ In all respects, the concept of a business information system is an inevitable product of the age. As total knowledge and record-keeping requirements have increased, the capabilities for processing data electronically have increased apace. Demands for new and better products and services provided by changing technology must be met by improved overall operation of a business—almost any business. This overall improvement can be brought about through development of business information systems: the combining of computers and communications in a new information technology which is very different from anything we have had before.

"Real-Time" and "On-Line"

Telephone employees daily meet demands for service, just as people do in most other enterprises. The customer's request for service is the beginning of the business and its reason for existence. Each demand requires decisions which in turn require action; and action depends on information. Therefore, the rationale of a B.I.S. could be reduced to a brief formula: the right *kind* of information, at the right *time*, in the right *place*, in the right *form*. This condensation implies immediacy—and that is one of the principal keys to a B.I.S. Here the term "real-time" enters the vocabulary of business management. Essentially, it means that each transaction is handled individually *as it occurs*, with inquiries being answered as quickly as the situation demands. Another term inherent in the concept of a B.I.S. is "on-line," which means that all electronic elements in the system are inter-connected with and are under the control of a central processing unit. The Bell System's Direct Distance Dialing network is a working example of an on-line, real-time system.

A few of the obvious factors which have made a real-time information system imperative in the Bell System are the tremendous growth and the growing complexity of the business, new technologies that both meet and create new demands and the consequent multiplicity of management functions. The needs of the future cannot possibly be met without some means of accumulating, processing and transmitting information on a truly current basis.

Leveling Paper Mountains

In the past—and still to a great extent in the present—the means for handling information has been an ancient one: paper. As the business has grown, the

When the Bell System began mechanized data processing a few years ago, the state of the art did not permit fully integrated information systems; operations were divided into parts. But capturing source data for machine handling on a piece-part basis was difficult and costly.

need for information has grown, and concomitantly the amount of paper for recording, analyzing, controlling, decision-making, has grown to mountainous proportions. Throughout the Bell System and in many other businesses there has been duplication of files at many locations, repetition of entries with attendant possibilities for error, differences in forms used (for the same purpose), delays in summarizing from paper records so that much information is old and perhaps not even valid when management sees it.

The tools and techniques to solve the problem are now available to us: the new generation of computers and the communications network. The solution, however, is not so simple as merely hooking computers and communications together.

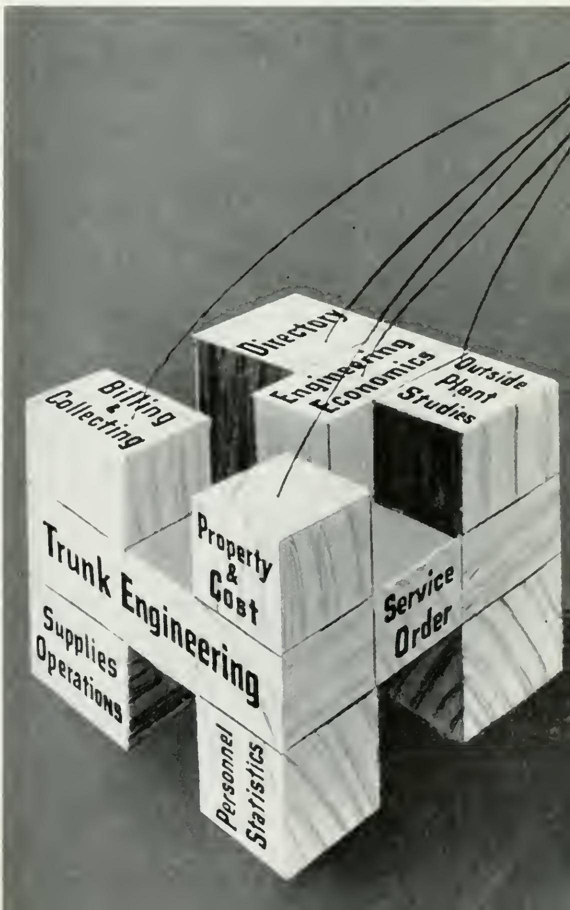
For several years now, the Bell System has been actively engaged in electronic data processing—E.D.P. for short. In the mid-1950's, comptrollers in the System began using computers on such large-volume accounting jobs as sorting toll tickets by the millions, preparing bills and posting payments to accounts receivable. At that time, the comptrollers were given the responsibility for establishing E.D.P. centers on a service bureau basis. But electronic data processing soon began to have an effect on other departments not directly involved in those functions. This result was unforeseen because the operation had been approached on a fragmented basis, piece by piece; the state of the computer art then did not permit standing back to see the whole picture.

It may seem that an easy solution to the problem, then and now, would be simply to mechanize the processing of all data in all departments, all at once. If that were possible, it might help, but it is not the whole answer. A Chinese proverb says that the longest journey begins with but a single step. Mechanizing all data processing might be that step but this is a journey which has to be planned with elaborate care from the start.

Finding a Beginning

The logical beginning of any journey —or of any task—is to define the objective, the reason for making the trip or doing the job. The reasons for developing an integrated, real-time business information system can be broadly summarized this way: to improve service and daily efficiency of operation, and to facilitate better management. Each of these is a large mansion with many rooms. Improved service includes a *personalized* service and responding to special situations more readily than is possible with present methods of gathering, processing and acting upon information. Daily efficiency of operation means easing the mounting burden of paper work and reducing the attendant repetitive clerical

There is an operational fit between broad categories of operations, and an interdependence in providing service to customers.



operations. It also means latitude for innovation both in existing and in new techniques of the communications art—which may be another way of describing responsiveness to special situations.

Better management is a direct product of current, pertinent, up-to-the-minute information—information on the availability of equipment and circuits: the status of the hardware. It is also information on receipts and expenditures, on traffic flow, on scheduling of personnel, on payroll matters, on sales forecasting, on changes in rate structures, on sampling of customer opinion. As the transmission network is activated by electrical impulses, so the network of business management is activated by a parallel flow of information. And this flow of information must reflect, in real-time, the changing conditions in the operating communications system itself.

A concomitant objective is to enhance our community identity which, in turn, is or should be a product of personalized service: service *as* the customer wants it *when* he wants it. Another objective—perhaps it should be termed a result—of a working B.I.S. is the effective, flexible communications system necessary to make it work: a model of the imaginative use of data links between the many decentralized parts of a vast but integrated whole.

All of these specific goals can be comprehended in a general goal: that of improved overall operation and better service for the customer.

Basic Functions

General objectives must be achieved by specific measures. The basic functions of a business information system can be outlined briefly:

- Data (information) is gathered from operating or external sources
- The data is processed by machine at a central location
- Data is integrated; reports are produced
- Output information is distributed for action as needed; it is analyzed and interpreted
- Pertinent information is passed to decision-making levels of management for action where necessary.

The requirements for implementing these broadly outlined functions can be defined in greater detail. First, the source data must be placed on the input document *in machine language*. It must be *captured* in a form which the machine can accept and process. It must also be understandable, in practice, by the people who use the machine. The information is edited by the electronic processor, and if acceptable (in machine terms) is stored in the memory file. If it is unacceptable (in machine terms) it is rejected and returned to the source for correction. Correction accomplished, the machine again edits, then processes and stores the information.

The output of the central electronic file is custom-made to provide pertinent information for the specific needs of the many functions in the business—the essential business of giving communications service from the customer's point of view. "Mission accomplished" information—the completion of an order, for example, with all its details—goes back into the machine, where it is edited, processed and stored for future reference. From this input information the machine also generates reports—*current* reports—tailored to the needs of management at all levels. The latter is one of the most important functions in a B.I.S. from the standpoint of improved operations, for through it management can obtain real-time information on the communications system daily, hourly, if necessary.

A long-range view of B.I.S. showing files in the central data processor, inputs and outputs.

Advantages of a Master File

Fundamental to the concept and operation of a business information system is the central, mechanized master file. Its advantages over the present distributive record-keeping are several and clear. As it is now, records which carry all information on a customer's service—his name, address, telephone number, equipment, assigned pairs of wires in a cable, location of these wires in a central office distributing frame, his credit rating, toll usage, record of service trouble, directory listings and more—are used by many telephone people in several departments and usually in several different locations. Much of the information is necessarily duplicated; the telephone number, for instance, may appear on seven or eight separate records in as many different places. Since clerical forces are human beings, and since no human being is infallible, such repetition of entries obviously multiplies the chance for error and therefore lack of agreement among records.

The problem is further complicated by the fact that the paper records themselves are not uniform among the companies in the Bell System, or even among the areas in a given company. (Some local variations may always exist, but could be reduced.) When changes occur in a customer's service, *all* of these records must be changed accordingly—a process which not only consumes time but also again increases the chance for error. And information retrieval from such records for all the operating people who need it —service representative, installer, central office man, information operator, billing clerk, directory clerk—can rarely be called current. Inevitably, there is a time lag between the customer's request and completion of the order work by all concerned.

One File for Everyone

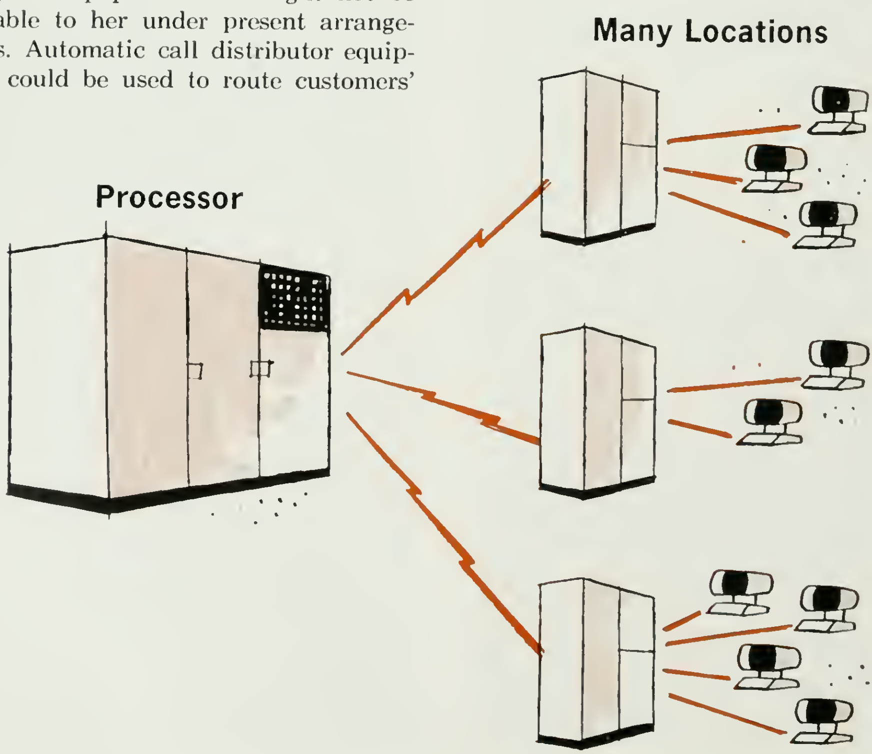
An integrated business information system would be designed to reduce the time lag and improve accuracy. The situation just described would be altered radically. The record of all information pertaining to a customer's service would be stored in one location: in the computer. (A block diagram illustrating this is shown on page 9.) There, it is accessible to as many people as need to work with it. Furthermore, it is always *in file,* and always available on a real-time basis.

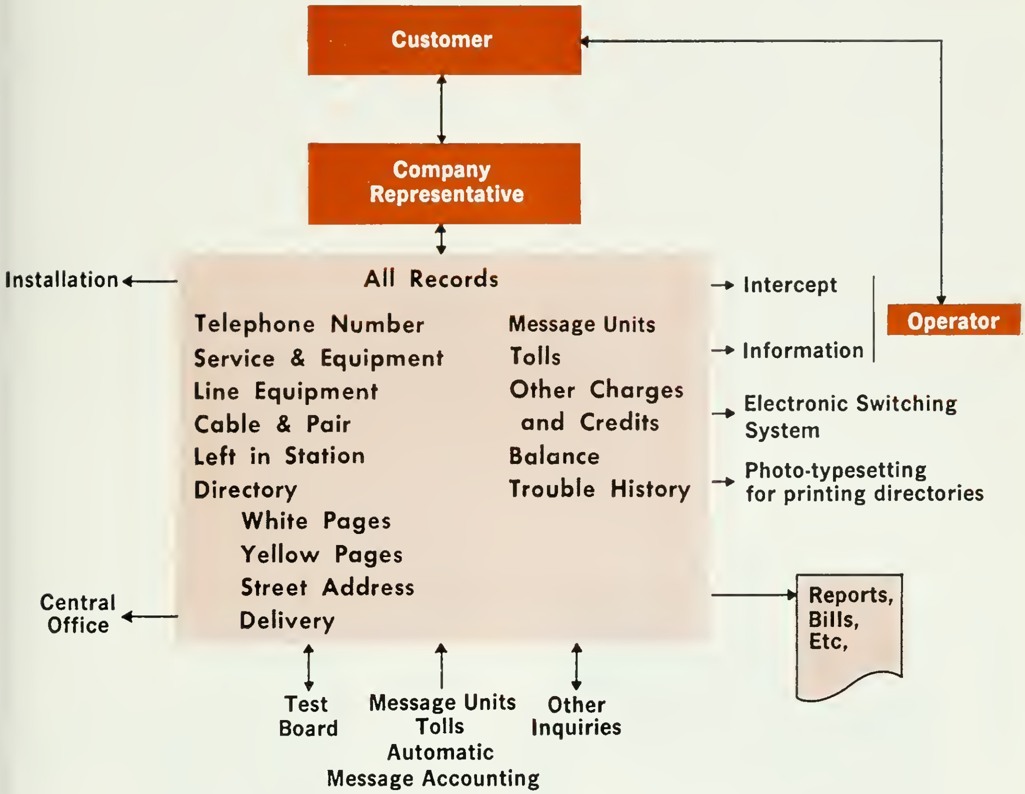
Updating, involving changes in the record, is done at computer speeds—

which today are defined in terms of microseconds. The activity is reflected immediately in the central electronic storage and can be used by people in various operating departments literally seconds after its entry. It is this real-time, on-line characteristic of a B.I.S. in processing the customer's request for service that brings new and exciting service objectives within realistic reach.

For example, ease of access for the service representative to the central electronic file is one of the benefits of a working B.I.S. which would first become obvious to the public. With the new system, any service representative in an operating unit of a telephone company would have access to the central computer serving that unit, and therefore could retrieve information on the customer's service from the central file, even though his paper record might not be available to her under present arrangements. Automatic call distributor equipment could be used to route customers'

One possible arrangement which could tie service representatives in several different locations to the central computer file.





Relationship between customer, service representative, central file and its products.

calls to whichever service representatives are free to answer them. The customer would not have to wait for someone who had access to his record to handle his request. The illustrations on these pages show this principle of ready accessibility in block diagram form. A further benefit, of course, is the fact that she could complete all negotiations with the customer very quickly, while he is on the line. She would have access to the computer through a typewriter-like keyboard; her queries would bring an instant response from the central processor, which could show all the information she needs on a display device similar to a small television set or teletypewriter. This flexibility and capability will enable us to have the efficiency of centralized information while keeping the local representation of telephone company people and offices.

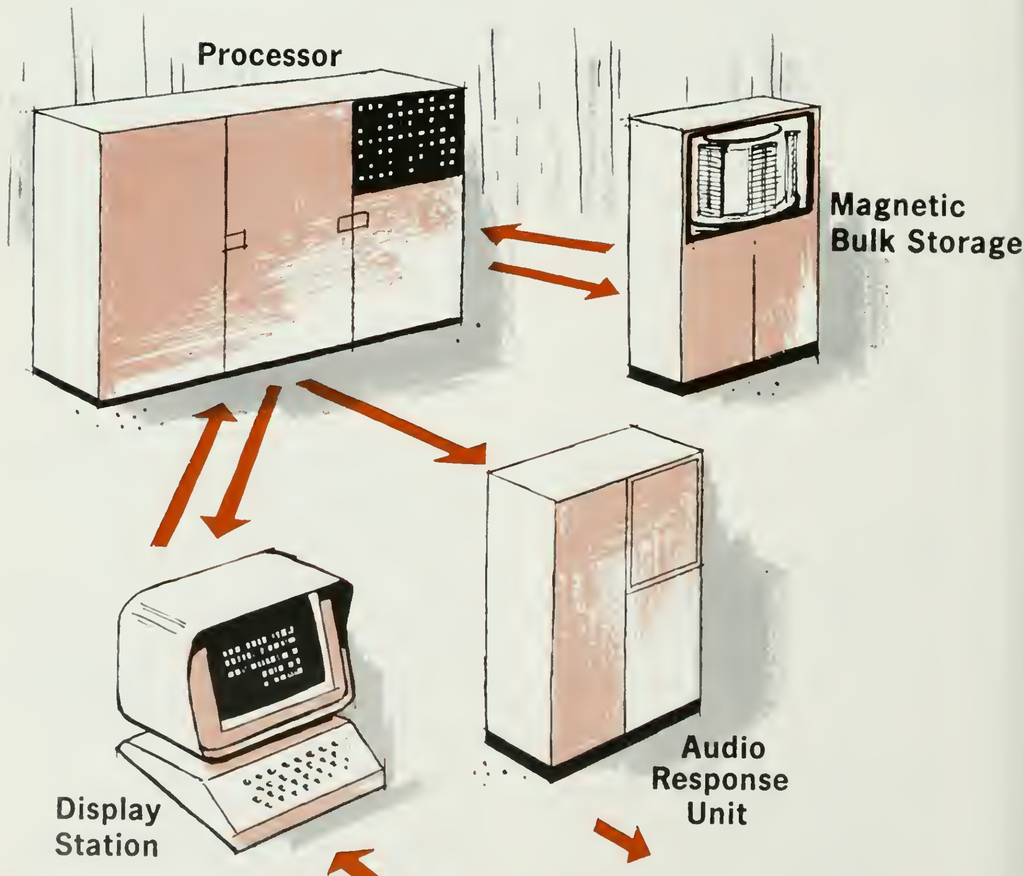
Frederick R. Kappel, chairman of the board of A.T.&T., has pointed out that the service representative "had better be close enough to her customers so that she can really understand local circumstances . . . . As for the computer . . . that might be almost anywhere."

The Matter of Hardware

The foregoing brief description of how one phase of B.I.S. could work must be understood as taking place in future time.

Many questions as to the physical properties that will be needed to make it work must be settled as an integral part of the planning process for any such system. There are certain design requirements, for example, that must be met in a centralized electronic processor. In order that each transaction be handled individually as it occurs (*i.e.,* in real-time), the central storage must be capable of direct access and random retrieval. In everyday English, that means substantially that service representatives and all other personnel in various locations who use the central file information can go directly into the computer through appropriate data links and input/output devices. It also means that any piece of information stored anywhere in the memory file can be located and retrieved at any time, not in any pre-determined sequence but simply as queries come in, on a random basis.

The equipment itself may consist of high-speed memory, magnetic disk, magnetic drum or some other form of bulk storage. The various segments of information pertaining to a customer's service



Two possible types of terminal equipment for an operating B.I.S.: an audio response unit for information operators; a visual display device for service representatives.

may be stored in several different parts of the total file system, designated by different categories such as name, address, telephone number, wire facilities, etc., but these must all be linked so that a single query produces information on all details of the customer's service.

There are many other factors which will have to be considered in selecting the hardware for a B.I.S.—factors such as capacity, speed, compatibility with existing hardware, "software" (packaged computer routines for real-time operation, including control, maintenance and diagnostic functions), reliability and cost. There are also the technical problems of the communications network (or subsystem) which interconnects the specific B.I.S. equipment, data transmitting and receiving equipment and input/output devices—all of which are integral parts of the total system and must be considered in its design from the start. These subsystems must be compatible, for instance, not only with the requirements of the computer program and the format of the records in the central file, but also with the requirements of an efficient system—an optimum marriage of machine potential and human capabilities.

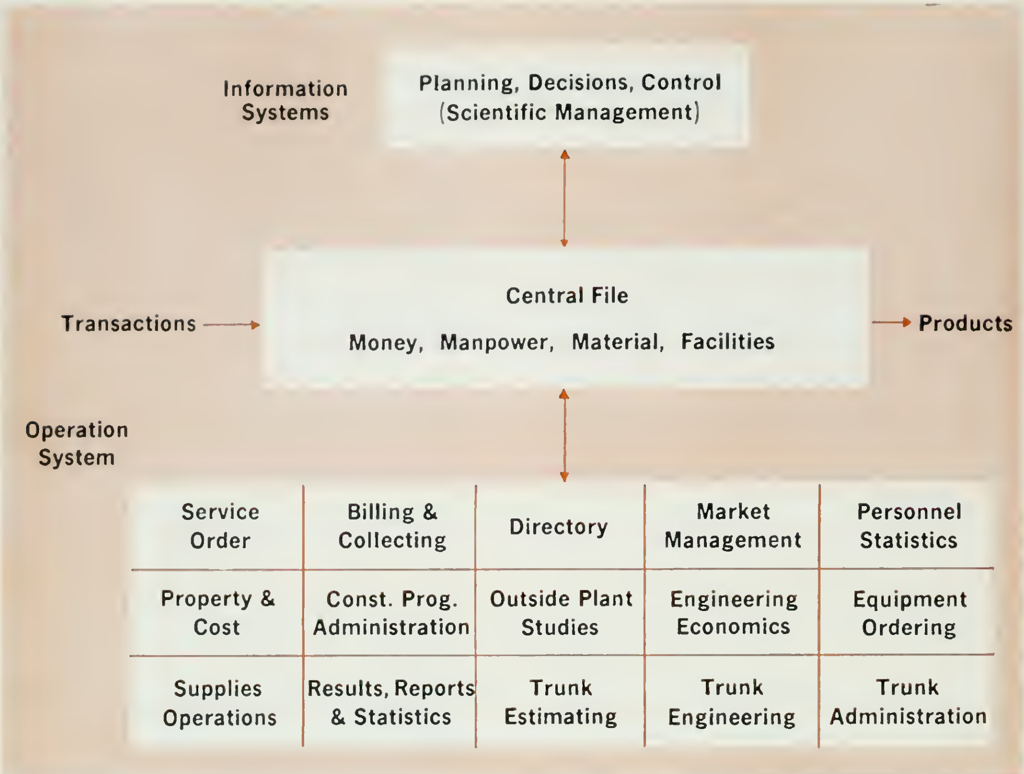
Clearly, such a system for handling information on a real-time basis in an organization the size of the Bell System cannot be put together in a day—or in a year. Planning and preparation are the essence of the task.

Transferability

Preparation has progressed in various degrees among the operating telephone companies—although in some cases it was not originally envisioned as such. Some time ago, when application of electronic data processing to Bell System operations first became feasible, it was instituted on a "trial company" basis. Earliest and now best-known of these trials was that involving customer records and billing, conducted by the Bell Telephone Company of Pennsylvania in Conshohocken. Not only was the trial itself successful, but also it produced a gratifying amount of information and technique which was transferable to similar operations elsewhere in the System. *Transferability,* in fact, is a key principle in preparation for an ultimate B.I.S. Its advantages are obvious. For one thing, it provides the benefit of experience for a company about to launch an E.D.P. project. This experience, transferred from a company which has completed a trial, not only saves time, money and duplication of effort, but also can be adapted to fit local variations in operating practice, availability of personnel, etc. Eliminating duplication of effort is a second important advantage of transferability. If each of the Bell Companies had to start from scratch on its own E.D.P. program, without benefit of experience already gained elsewhere, much time and money would be spent needlessly just to reach what should have been the starting point. This transferring of experiences from one company to another is proceeding; its tempo will undoubtedly quicken as planning for B.I.S. is implemented with concrete preliminary steps.

Customer Service

The first of these steps has been the selection of the customer request for service as a starting point toward the long-range goals of a B.I.S. As was pointed out early in this article, everything in the telephone business really begins with a customer's request for service. Most other functions center around it and flow from it. There are the greatest immediate opportunities to improve service in this area: an immense amount of paper work is handled there with present methods. The benefits of E.D.P. can be realized most quickly there. The beginnings of a customer service and equipment file would have to be established, which could be used for phasing-in the Custo-



A working B.I.S. serves both operational needs at all levels and management needs.

mer Requests for Service function of a B.I.S.

People

The preceding pages have been sprinkled rather thickly with words that are relatively new in the language: real-time, on-line, random access, hardware, software—the specialized vocabulary of the computer age. One word which is not new is *people*. The current spate of jokes about "electronic brains" and "machines that think" to the contrary notwithstanding, the computer still is the servant of the man. It is axiomatic among computer experts that the machine's output is only as good as its input. First and last, people are responsible for that input, whatever form it may take, whatever purpose it may have. People are also responsible for what is done with the output.

This fact has profound implications for people throughout the Bell System. Mr. Kappel, addressing the 1965 Management Conference at the University of Chicago last March, said, "While the magazine writers are worrying about how computers will do our thinking for us, I will take a different view here and say that their greatest impact, at least in the foreseeable future, will be in forcing *us* to think. In fact, my guess is that of all the tools mankind has ever had, this is the one that most peremptorily requires us all to use our heads . . . . In our business we foresee that with new capabilities at hand, we will have to rethink not only procedures but organization and objectives as well."

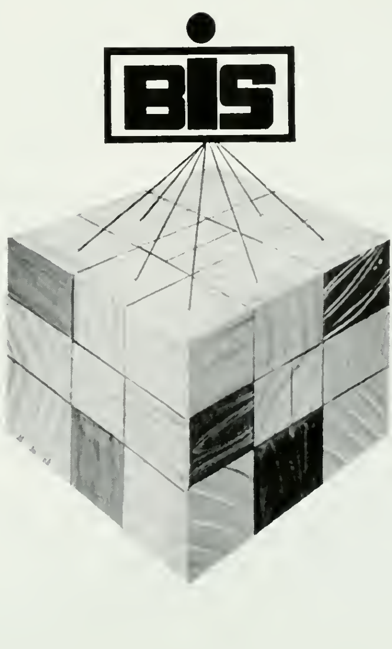
Implicit in the gradual change in the kinds of specific things that many people do in the telephone business are changes in the organizational structures of operating areas and of the companies themselves. Distinctions between parts of the whole which have evolved over the years as a practical means of running the business may no longer be meaningful or necessary. Traditional departmental lines may dissolve and merge into new kinds of integrated operating units with new names and new functions.

H. I. Romnes, president of A.T.&T., addressing the Industrial Communications Association meeting in Pittsburgh recently, pointed out that the introduction of a business information system is "so intimately bound up with a company's operations, its organization structure, the decision-making power of its managers, the job satisfaction of its employees—not to mention its responsiveness to its customers and its profitability—as to require the most comprehensive management consideration."

Dimensions of the Job

No one in the Bell System claims originality for the *concept* of a business information system. Such systems have been planned and implemented to some extent in other industries; books, magazines and the daily press have devoted hundreds of pages and thousands of words to the subject. The design and phasing-in, however, of a B.I.S. in the nation-wide Bell System presents problems unique to the business. It will be a task of staggering size. It will take years of time, millions of dollars and the participation of all management, from the top down. But, for those hundreds of telephone people who have already participated in trials and in delineating the grand design, there is a scent of inevitability in the air. And there is the stimulation and the challenge of perfecting a new and better way of doing things.

Despite an apparent paradox in terms, the establishment of a business information system throughout the Bell System will be a calculated *revolution* that must come through calculated *evolution*. There really is no other choice for an enterprise that proposes to survive and prosper in the competitive, real-time world which is now before us.



Reliability is a key factor in communications for the electric power industry. The telephone industry is demonstrating that it has the skill and experience to meet the power industry's needs

Serving The ELECTRIC POWER INDUSTRY

Robert W. Ehrlich, *Vice President*
Pacific Telephone and Telegraph Company

■ THOUSANDS of employees dedicated to a vital public service . . .

Millions of customers throughout the country . . .

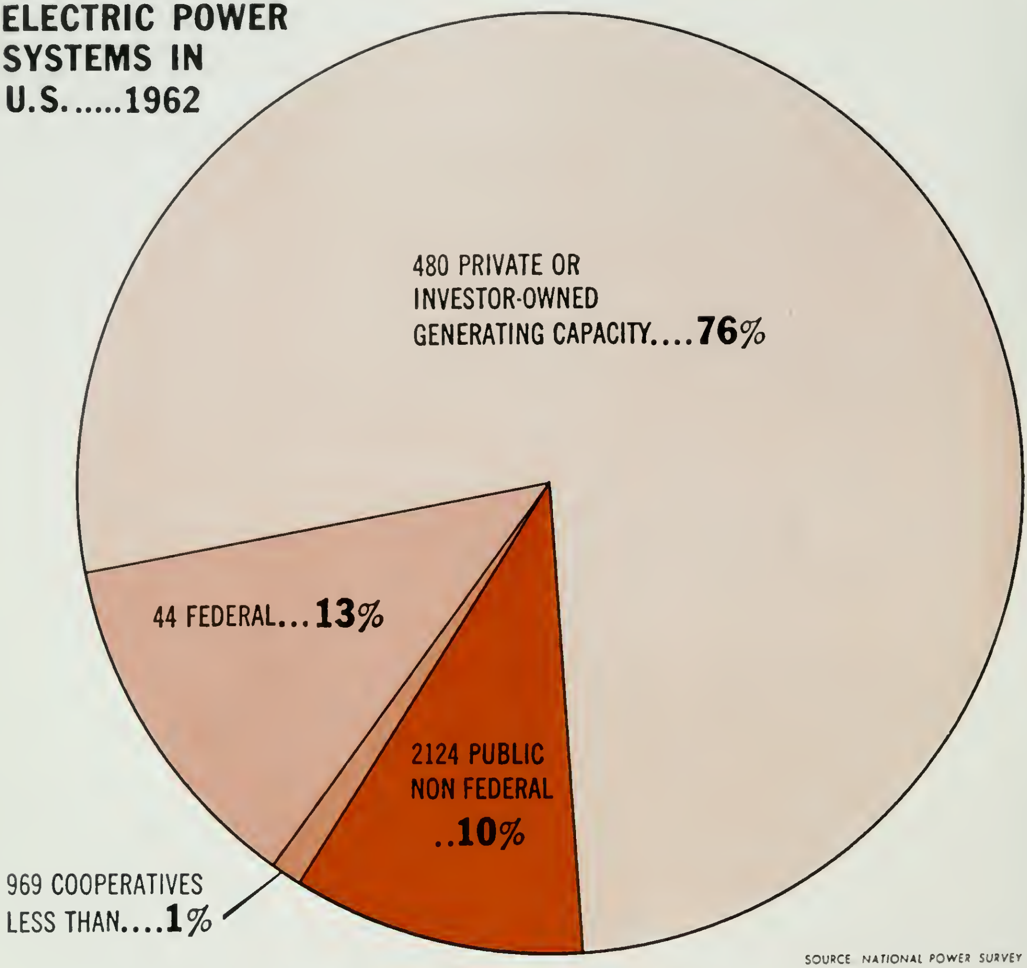
Billions of dollars invested in a highly automated and complex network . . .

Does this sound like a description of the Bell System? It certainly does. But the same phrases also describe another utility industry that is even bigger, just as complex, and just as vital to our way of life—the electric power industry.

During the past few months, it's been my exciting assignment to go out and study our fellow utilities—to learn of their progress, problems, and hopes for the future, and of course, to gain a better understanding on behalf of Bell System people of the communications services the electric utilities require. Talking with leaders in management and engineering in the industry soon brings out how close we are in the basic issues facing us in the future—growth and technological change. And it brings out, too, the magnitude of the challenge to us in the communications business if we are to serve electric power utilities adequately.

■ Let's take a look at the electric power industry. It had its small beginning in 1880, when the Rochester, N.Y. Electric Light Company installed a water driven generator to operate elec-

COMPOSITION OF ELECTRIC POWER SYSTEMS IN U.S.....1962



SOURCE NATIONAL POWER SURVEY

tric arc lights, making a charge of \$.75 per night for each light. The famous Pearl Street station installed by Thomas A. Edison in New York began serving customers in downtown New York in 1882. From these modest beginnings, it has grown to become the largest single U.S. industry today.

Electric power in the United States is furnished by some 3,600 different systems which vary widely in size and organizational makeup. As shown above, the 480 investor-owned systems together furnish the bulk of the service; they own just over three-fourths of the generating capacity. The remaining 24 per cent of capacity is owned by over three thousand public, cooperative and Federal systems.

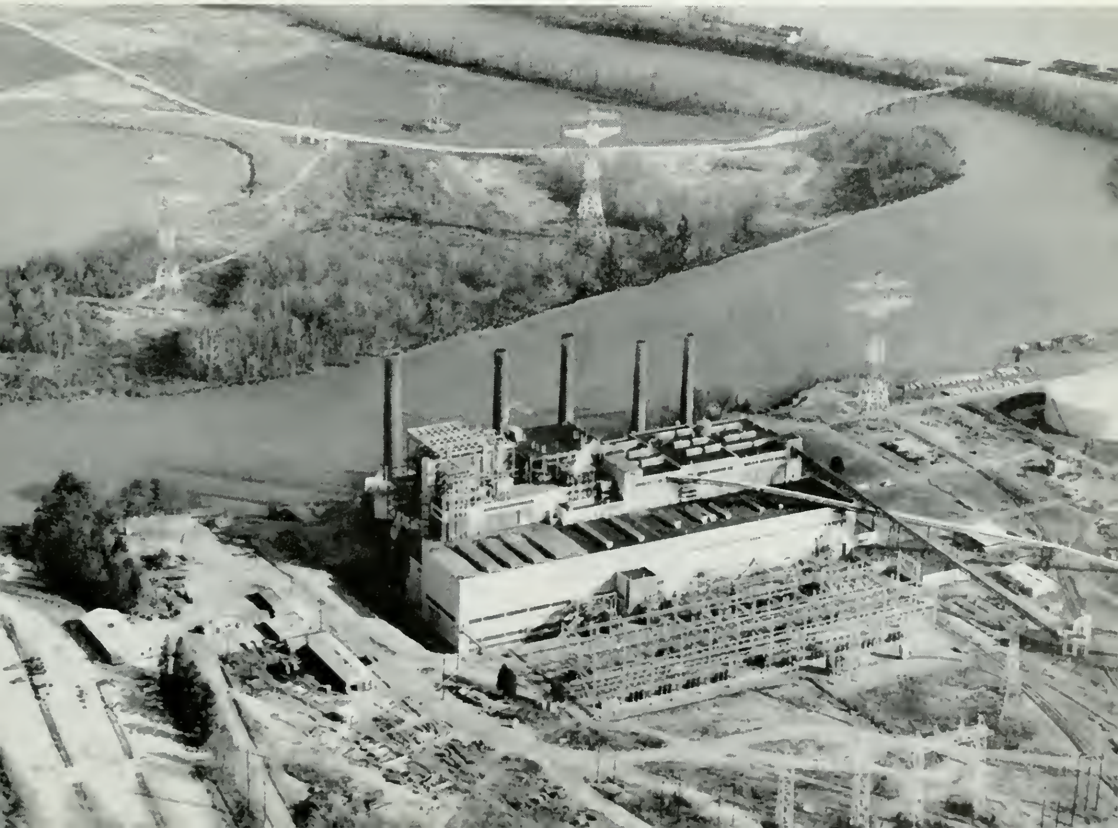
The keynote of the industry's progress has been steady growth due to the constant increase in the use of its products.

Total consumption has just about doubled every ten years, closely matching our experience in the telephone business. An industry that has experienced this much growth has to add as much new capacity each year now as it had in the entire system back in the early Thirties. And if this keeps up, as most forecasters say it will, they can look ahead to the year 2000 and expect to be building as much new generating capacity each year as there is in the whole system today. Here, certainly, is no small challenge for the future.

A continuing program of technical improvements and advances is necessary to meet this steadily increasing consumption of electric power. Scientists and engineers

This Virginia Electric and Power Co. station in Richmond, which was built in 1899, first generated power mainly for streetcars.

Symbolic of growth in the power industry is the new Chesterfield Power Station operated by Virginia Electric and Power Company. Now the company's most powerful generating station, Chesterfield produces over 731,000 kilowatts for the Richmond-Petersburg-Hopewell area.



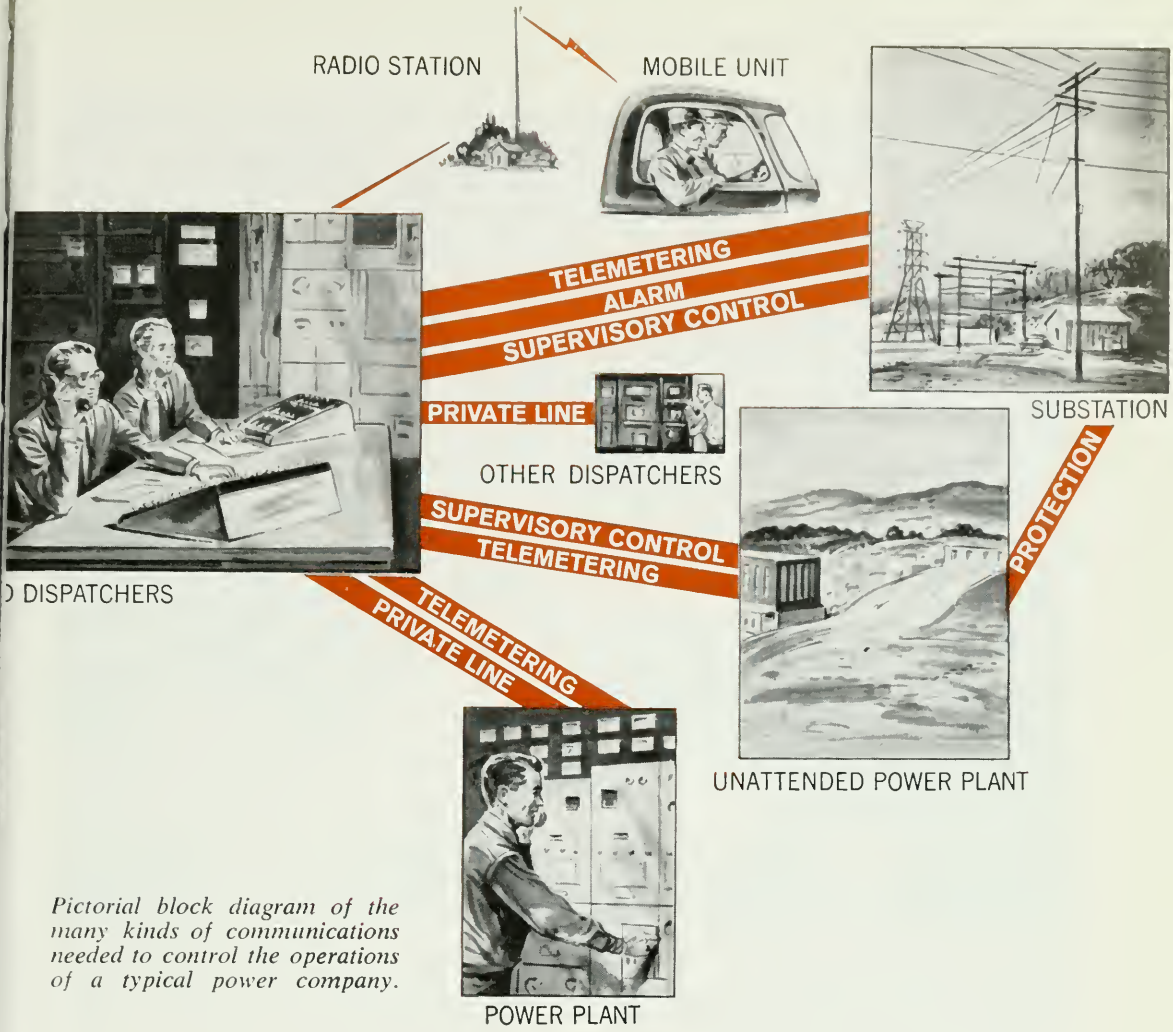
in the electric power industry are continuing to press forward with larger and more efficient generating units and with transmission lines of high voltage and greater efficiency. Compare the 50,000 kilowatt generating plant of the 1930's with a modern 700,000 kilowatt station such as the Chesterfield Station of the Virginia Electric and Power Company. Compare the typical hydroelectric station of the 20's, with the mighty power dams of today. Such great increases in the capacity of individual power plants are accompanied by a steady downward trend in the cost for each kilowatt of capacity installed, helping in turn to make possible lower rates and even more widespread use of electric power. Even larger generating units are projected for the future. And nuclear power plants will take their place in the scheme of things, too; several companies have announced plans for nuclear generating stations that will operate at or even below the cost of conventional plants.

Pacific Northwest-Southwest Intertie: a vast power transmission network, now being built, which will interconnect 11 western states.

New developments are also going on in the field of transmission with the introduction of Extra High Voltage (EHV) systems. The higher the voltage used, the more efficient is the transmission of electric power. Throughout the 30's and until 1954, the highest voltage used was 287,000 volts. Since then the maximum voltage has jumped first to 345,000 and just recently to 500,000 volts, as improvements in equipment and construction methods have made these advances possible.

Still another promising technique is the use of direct current (DC) for long distance power transmission. A DC system offers substantial savings in transmission line cost because smaller conductors and simpler tower structures can be used compared to the conventional alternating current (AC) system. But DC has not been practical up to now because there was no way to obtain the required high voltage. However, recent developments by Swedish engineers now make it possible to construct converter stations which may be used at each end of a line to convert high voltage AC to DC and back to AC again. On systems of several hundred miles or more, the cost of converters will be more than offset by the savings in transmission line cost. A few DC systems are already in operation in foreign countries and several are now planned for the United States.

■ All these technical developments—high capacity generating units and more efficient methods of transmission—point to the need for new methods of organization and operaton in the industry. For example, individual power companies that cannot justify constructing one of the giant new high-efficiency generating units by themselves can often pool their resources to build one. Thus, they can all gain the advantages of lower



Pictorial block diagram of the many kinds of communications needed to control the operations of a typical power company.

first cost and cheaper operation. And with the new EHV transmission lines, companies can interconnect their systems to make use of these large generating units as well as to gain many other benefits in the nature of reduced standby requirements, exchange of power to care for demand peaks, etc.

One tangible and very large project that exemplifies the benefits to be gained through interconnection is the Pacific Northwest-Southwest Intertie. This gigantic transmission system will comprise essentially four large transmission lines (opposite page) connecting the vast hydro-electric generating resources of the Pacific Northwest with the growing power-using centers of the Southwest. Two of these lines will operate at 500,000 volts AC, and two will operate at 750,000 volts, using the new DC technique. Together, the lines will be able to transmit over four million kilowatts of power, over twice the output of Grand Coulee Dam!

The Intertie will make more effective use of all the available power capacity in the Pacific region. In the summertime, for example, power from the great rivers of the Northwest can be sent southward to care for the peak loads due to air conditioning and irrigation pumping. Then in the winter, the steam generating resources of the Southwest can send power back northward to meet the heating loads in the colder climate and to permit conserving the reduced river flows there. Then too, the reserve capacities required in any particular area can be reduced by pooling the reserve requirements of the entire system. In other words, the interconnected system can produce more dependable power, and at less cost, than can the individual systems acting on their own.

It is not surprising, then, that power companies all over the nation are joining together in various associations and pools to take advantage of the lower costs and greater dependability arising from interconnection and joint planning. As these networks merge and grow beyond corporate boundaries, the problems of management and control of the systems will become more complex.

■ The intricate task of supervising and controlling the power networks is going to depend more and more on automatic devices. Skilled dispatchers will continue to make the overall decisions in managing a power system, but computers will handle the routine adjustments of load and frequency. In the future, dispatchers will have to call on more and more complex computer systems. Centrally located for huge regional networks, such computer systems will automatically select the most economical generating source for each increment of load (taking into account the tie line losses), regulate system frequency at close tolerances, regulate the transfer of energy between systems, and see that adequate generators are in reserve for emergencies. What is more, the exacting task of protecting the system against the effects of breakdowns or faults—now handled on a line-by-line basis—may someday also be handled by the fast-acting computers.

■ So, as the electric industry moves to accept the challenge of its growth and adapts to technological change, it has to depend more and more upon communications to link its far flung networks into a tightly controlled system. Here then is the challenge to the communicator and to the communications industry. Can we meet the demand for a diverse network of circuits that will be dependable enough to control the nation's electric power networks?

Not all power companies think we can.

Electric power companies differ widely as to the extent to which they obtain their communications from a common carrier. A few companies own and operate complete telephone systems for their internal use, even including the telephones on their employees' desks. Most companies use their own facilities for only a portion of their needs, usually the more critical operations circuits. But some companies, in increasing numbers, are making the decision to turn to their telephone companies for all their future needs in communications. They make this decision in recognition of the growing complexity of the communications job which will require more technical and managerial resources than they can expect to bring to bear; but they only make this decision in those cases where the local telephone company has proved it can be depended upon to do the job.

In state after state the telephone industry, independent and Bell System, has demonstrated that it can meet the power industry's needs despite many seemingly plausible arguments to the contrary. Can the Telephone Company give adequate attention to services for the electric company when it has so many other customers to take care of, too? Will they always be on the job, day or night? Can they appreciate the techniques and requirements for reliable automatic signaling? In other words, can they be depended upon as "outsiders" to do the same kind of service job that employees

The Georgia Power Company's new customer service information center in Atlanta. Bell System's Model 2A call distributing system enables customer service representatives to handle up to 2,000 calls per day and provides for future expansion to 60 positions, 56 trunk lines.

of the electric power company would do? The answer, not just by conjecture but by performance in many areas, is an unqualified "Yes."

■ Let's examine the way telephone companies care for the service needs of their electric power industry customers and see what the Bell System is doing to prepare for the future.

We'll begin with services for administrative communications—services that are not unlike those of other industrial users. They deserve close attention because in many cases the quality of service we render for use by executives and managers in their day-to-day jobs is the most tangible indicator they have of how dependable we might be for more critical communications.

One field where telephone people have done a great deal to help the electric companies is in connection with their business office operations. Just as we do, the power companies have the problem of giving good service to their customers who call in by telephone to their business offices. Drawing upon the Bell System experience in similar problems, alert account managers have helped electric companies everywhere provide the right communications for this job.

Again like the Bell System, many power companies are experimenting with business information systems oriented to the extensive use of computers. Here too, Bell System know-how in the data communications job associated with such systems can be helpful to these customers.

■ Important as these are, the most exacting demands we must meet are the operational circuits. These are the communications channels through which direct control is exercised over the power generation and transmission network. Several types of circuits are involved.

Probably the most critical of these circuits are those used for *protective relaying*. Protective relays are devices that sense any breakdown or fault in the power system and instantly initiate signals to trip circuit breakers at each end of the affected section of the power line. The action must be taken quickly—in a few thousandths of a second—lest the disturbance spread to other portions of the network and perhaps even cause damage to costly equipment. Communications channels form the vital connecting link over which the operational signals must pass, instantly and without fail. Equally important, the channel must not be the source of false signals that would cut off power unnecessarily.

Another type of operational communications is *telemetry*. Through this means, indications or measurements of a variety of conditions are transferred from a remote location to a central point. Telemetry circuits may be used to monitor the positions of switches, the output of generators, the flow of power on transmission lines, and many other significant conditions in the power network. Here again, dependability is essential to effective supervision of the complex network.

Complementing the telemetry channels are *supervisory control* channels, over which command signals are sent out to remote locations. The output of an entire generating station may be controlled remotely over one of these channels. Needless to add, such channels must also have the utmost in dependability and immunity against false operation.

Finally, overall coordination must be directed by people—by skilled dispatchers who know the intricacies of the networks for which they are responsible. They not only make the routine adjustments required in day-by-day operations, but also must act on a moment's notice to correct for a breakdown anywhere in the system. And in these days of interconnected systems, a number of dispatchers in component units of the system must work together as a team. So a network of voice grade circuits, called *dispatch* circuits, is set up between the control centers. Once more, dependability is essential—more so than ever under emergency conditions.

■ As I said earlier, many telephone companies have demonstrated that they can and do meet these kinds of requirements for reliability. How is this done? Here are some of the steps.

Reliability begins with design for trouble-free operation. Dependable types of facilities are given first preference—microwave or underground cable. Circuits are laid out in such a way as to avoid centers of testing and rearrangement activity. And adequate protective devices are installed to insure against the effects of very high voltage or currents around a power station.

Next, we must take advantage of the extensive multiple restoration capabilities in the telephone network. Dual circuit routings, say with one route on cable and another on radio, can be recommended to the customer at only modest extra cost. Planned reroutes can be set up for individual circuits. And broadband restoration plans, whereby whole microwave channels can be rerouted in minutes, will often be applicable.

Finally, reliability begins and ends with people—telephone men who are assigned with a particular service as their first responsibility, who are trained in,

A dispatcher at the Public Service Company of Colorado uses a new desk-top switchboard, invention of Mountain States Telephone engineers, which replaces the array of complicated equipment behind it. Touch-Tone phone buttons give easy access to any of 100 lines.

and familiar with, their customers' operations, and who have access to the support of the whole telephone organization in caring for their customers' needs promptly and efficiently. This concept is already being implemented in a number of Bell Companies through a special service center—in the West we call it a Special Services Management Bureau (SSMB)—located in each state or major operating area. (page 24).

The SSMB is manned 24 hours a day, receives all trouble reports and service alarms, and coordinates restoration of special services for its customers. More than that, it prevents trouble by overseeing the installation of new services and exercising control over the release of any circuits for maintenance or rearrangement. And the people in the bureau hold periodic meetings with their customers' operating and engineering people to go over restoration plans, circuit details and performance results. So the Telephone man essentially acts like an employee of the customer's organization he serves. In other words, he is an extension of the dispatcher's control over the communications that are so vital to his service job.

■ These are just a few of the things that telephone companies are doing to provide reliable service that meets the needs of the electric power customers. Of course, there are many other ingredients in good communications—such things as overall system design, coordinated installation, and a well-organized system of end-to-end maintenance. It is significant that while high quality equipment, such as we use in the Bell System, is important to reliable service, the ultimate payoff in performance depends on the skill and experience of the organization managing the operation. All these factors will become more and more important to the communications services of the electric power industry as their networks expand to encompass greater numbers of operating agencies and larger territories.

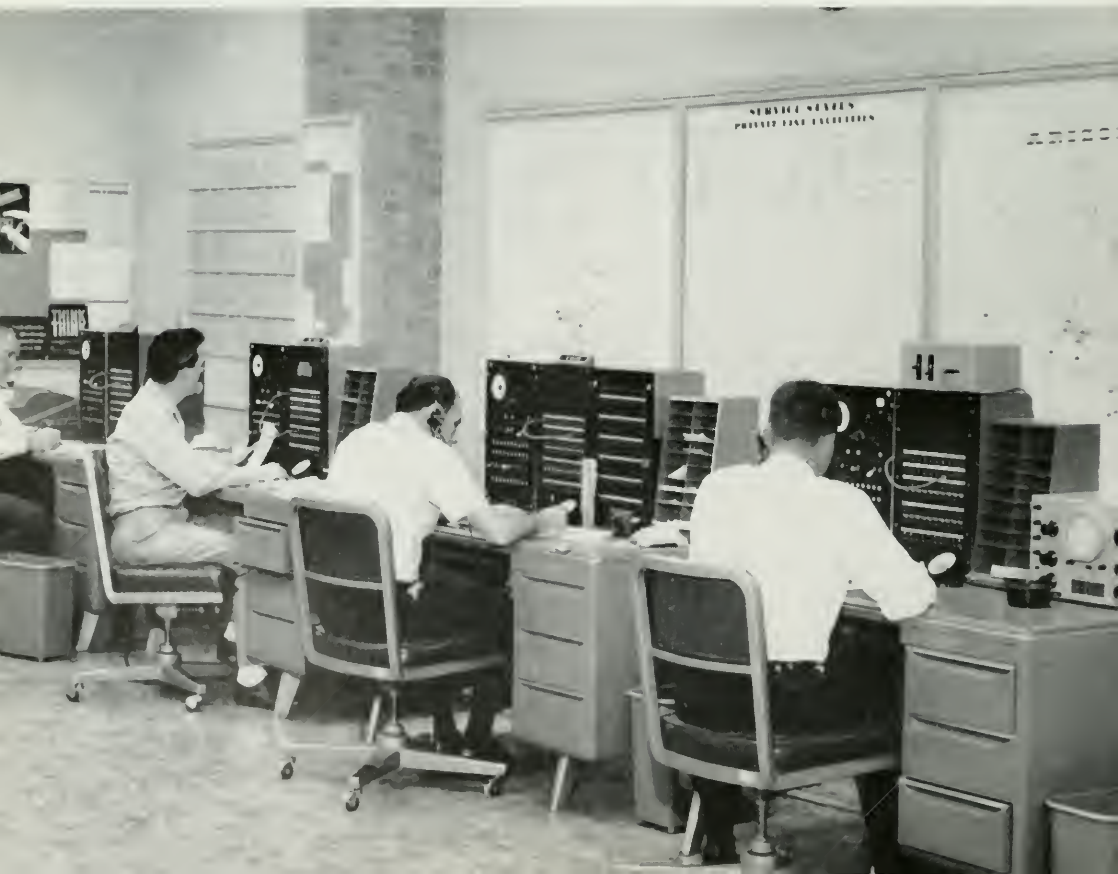
■ The challenge to telephone people was recently stated by Earl Ewald, president of Northern States Power Company, in the following words:

"The communication industry must first of all recognize that electric power is a large potential market. It must intensify its interest in the field and assist with the research and development necessary to perfect the specialized facilities which electric power needs.

"The communication industry, secondly, must gain an appreciation for the severe demands in terms of reliability that the power industry requires. Electronic and communications engineers have gained much experience in meeting rigorous requirements for dependability in their work with military and space applications. This is fortunate."

Bell System and indepedent telephone companies together are accepting this challenge, bringing together the management and technical skills to do a dependable communications job that will meet the critical needs of the electric power industry.

Special Service Management Bureau at Phoenix, Arizona. Specially trained customer contact men at these test board positions, manned around the clock, coordinate trouble clearing for critical services throughout the state. Customer calls one number to report trouble.



The Bell System has a traditional sense of responsibility toward communications for the handicapped. A recently developed three-phase program is part of this continuing effort

Services for SPECIAL NEEDS

Dr. L. Holland Whitney, *Medical Director*
Personnel Relations Department, A.T.&T. Co.

■ Pick up a telephone; dial a number; hear an answer at the other end of the line, and order a loaf of bread—an action as automatic and familiar to most of us as putting one foot ahead of the other to walk down the street. But to many—those for whom talking or hearing (or seeing) is difficult or impossible—this simple and familiar use of the telephone is a challenge, one that often requires very special help.

Accustomed as most of us are to communicating with other people at the drop of an idea, we take the gifts of speech and hearing pretty much for granted. Unfortunately, to many, many people around us, life is not that generous.

Let us take as an example a fictitious but typical man in, say, Ohio. We'll call him Harry Adams. Harry has a wife, two children and an interest in selling. And, up to a date he'll never forget, a pleasant, resonant voice has helped him become a successful salesman in one of Ohio's major cities. Then it happens—cancer of the throat, an operation to remove his larynx and what would seem to be an inevitable voiceless future. What does he do now? Take this turn of events lying down—or try to take advantage of the corrective measures available to him? If it is the latter, the Bell System can offer some of the corrective measures which can help him.

Harry's case is far from isolated. And, instead of having speech problems, he could be hard of hearing or totally deaf. In this country, it is estimated that there are 750,000 people with speech problems, 300,000 who are totally deaf and 5,000,000 who are partially deaf. Obviously, communication with the world around them can present difficulties for these people. They need help.

A Legacy of Responsibility

The Bell System has felt a traditional sense of responsibility toward the handicapped, in terms of communication. An obvious reason, of course, is the fact that we're in the communications business. But it goes back further than that—as a matter of fact, to before the time the telephone was invented. Indeed, it goes back to the early life of Alexander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Graham Bell and to the family influences which helped mold the direction his later efforts would take.

Bell's father was well known as a teacher of speech. He invented what he called "Visible Speech," a code of symbols which indicated the position and action of the throat, tongue and lips when various sounds were uttered. Although originally planned for more general purposes, "Visible Speech" turned out to be a helpful guide for the deaf in learning to speak. Undoubtedly influenced by his mother's loss of hearing—which started when he was twelve—Bell took a keen interest in his father's theories and became expert in their use as he grew up.

He undertook a certain amount of speech research on his own, too. The story goes that Bell and his brothers made a model skull and fitted it with a reproduction of human vocal apparatus, operated with a bellows. They managed to produce such a lifelike "mama" wail from their skull one night that the neighbors turned out in alarm, sure that a baby was lost in the vicinity. About the same time, Bell trained his Skye terrier to growl steadily while he manipulated the dog's mouth and vocal cords, trying to shape the growls into words. At the peak of the terrier's career, according to ear witnesses, it was able to give out a reasonable facsimile of "How are you, grandmother?"

Later on, in Boston, Bell took up teaching "Visible Speech" in earnest. And he met with great success at schools for deaf children in the New England area. President of the Clarke School for the Deaf in Massachusetts, one of the schools at which Bell taught, was Gardiner Greene Hubbard, a Boston attorney. His daughter, Mabel, was one of Bell's early pupils—and later was to become his wife. Another of his pupils, about that time, was the five-year-old son of a successful leather merchant named Thomas Sanders. So grateful were Hubbard and Sanders for Bell's success in teaching their children that they financially backed the electrical experiments Bell was conducting at night. That backing was a long step toward the eventual birth of the telephone.

The Bell System's sense of responsibility toward handicapped persons is evident in a number of ways. And perhaps one of the most striking of these is the spirit of public service and productive ingenuity of thousands of Bell System people that, over and over again, have combined to furnish equipment and service for these special needs. But our accomplishments in this direction are not as extensive as we would like them to be. We have made certain strides in developing equipment and services for special needs which are currently available to these people. Practically all of the equipment is standard and it can be used for many diversified purposes. There are also a number of items that are still experimental. Still, we don't know yet enough of the answers to solve all the problems that must be faced. We are trying, however, all the time. And we like to think we are on the threshold of bigger and better horizons in this enormously important endeavor.

Some of the Bell System equipment which serves the special needs of people with speech or hearing handicaps: (1) hard-of-hearing handset with volume control knob; (2) noisy locations handset with push to listen button; (3) bone conduction receiver; (4) electronic larynx; (5) auxiliary signal control device to activate lamp or other appliance when telephone rings; (6) extra-strength signals such as horns or gongs to indicate ringing telephone.

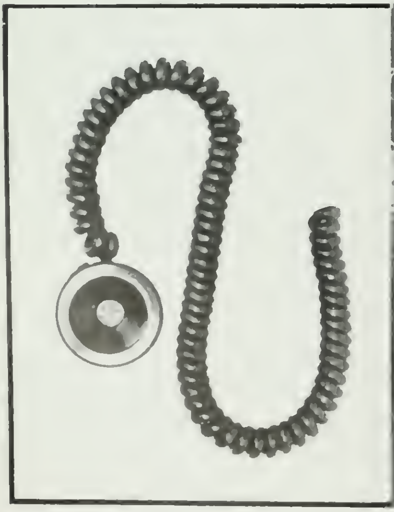
SPECIAL NEEDS

Three-Phase Program

The Bell System, in this continuing effort, has instituted a three-phase program to discover these horizons. The first phase, described here, is to make Bell System people, the medical profession and the public aware of the *standard equipment* already available which can be easily and readily adapted to serving a particular need. In large part this involves making very sure that our own people, particularly the service representatives and installers, are informed about what can be done to serve these special needs. This includes the designation of one person in both the Marketing and Engineering Departments in each of the Operating Companies to now be responsible for coordinating all such efforts. In addition, this phase includes the expansion of informative advertising on this subject appearing in general audience publications and the preparation and distribution of a slide talk about this equipment to the Bell System Companies.

The second phase of this program will be to inform the Operating Companies of existing items of equipment to serve those with motion handicaps. Indeed, at this time A.T.&T. has already established a centralized pool of knowledge about what has been done locally in the Operating Companies to assist such people.

Phase Three is to assess the conclusions of present and future studies and research on what equipment is now available and what is needed—and then develop additional equipment where the need is indicated. The results of this phase of the program are probably several years away from being concrete in terms of equipment. But the research has already been initiated; for example, a Bell System grant is currently enabling Dr. Howard Rusk of the Institute of Physical Medicine and Rehabilitation of New York University Bellevue Medical Center in studies of how Bell System equipment can be adapted to aid those with motion handicaps and how we can best design more such equipment. This project, in which Bell System people will be collaborating will allow patients themselves to test the equipment. We are also initiating studies which attempt to



Watch case receiver enables third person to monitor telephone call and repeat incoming message so that a deaf person can lip read and still participate in the conversation.

find out what kinds of equipment are most effective for different types of speech and hearing handicaps as well as what is additionally needed.

Speaking and Hearing

Developing the right kind of tools to help compensate for speaking and hearing deficiencies requires detailed knowledge of the physical speaking and hearing processes, of course. Each process is remarkable.

For instance, talking, with all its importance, is a secondary skill: all of the organs involved in speech have other primary functions. The organs in the mouth and throat, first of all, are involved in breathing, chewing, swallowing and keeping things out of our lungs that don't belong there. And yet they work together as a team to carry out the secondary function of speaking.

The sound of speech is caused by a series of organic functions, starting in the lungs and proceeding upward into the head. As air comes up from the lungs and passes through the opening in the larynx, it vibrates the vocal cords and produces an audible buzz. This buzz is amplified by the acoustic properties of our resonance chambers—the cavities we have in our mouth, nose and throat. At the same time, it is articulated, or shaped into words, a job that is done for us by movements of the mouth, by muscles of the throat, and by the lips, teeth, cheeks, tongue and palate.

The loudness of our speech depends on how much air is forced out of our lungs. The pitch is the result of the tightness of our vocal cords. The quality of speech depends on the shape and size of our resonance cavities. And the clarity and accent depend on habit and how skillful we are at articulating.

Unlike the speech organs, our hearing organs are designed primarily for one function, hearing. The ear is what scientists call a "transducer." It converts vibrations of the air molecules into nerve impulses which the brain can interpret. A healthy ear is an incredibly sensitive device and covers an enormous range of sound level. The human voice, like a symphony orchestra or the siren of a fire engine, is a parade of vibrations that first reach the outer ear, then travel to the eardrum, on through the middle ear to the inner ear, where tiny nerves are stimulated to carry impulses to the brain. Here, of course, the impulses are recognized as the sound they represent. Incidentally, deterioration of these tiny nerves from noise abuse—overexposure to horns, whistles, the high noise levels of cities and the like—often lessens the ability of older people to respond to and recognize high-pitched sounds.

When others speak, we use our ears to hear what they say. We also use our ears to hear ourselves. As we speak, our own ears tell us if we are saying what we intended to say—and saying it intelligibly. If it doesn't come out the way we intended it to, we back up and try again.

"Bee hive" lamps in place of or in addition to bell signals indicate ringing telephone.

SPECIAL NEEDS

This is why people who are totally deaf find it so difficult to speak well. Indeed, when you are talking on the telephone, your voice is carried not only to the ear of the person you're talking to, but also up through the receiver to your own ear. Undoubtedly you would find a phone conversation a pretty strange experience if you were unable to hear your own voice through the receiver.

Bell System Aids

To return to what the Bell System has done for people who have suffered impairment of either of these remarkable processes of speech and hearing, there are a number of ways the handicapped can be helped to gainful employment, as well as relaxed social adjustment to daily living, by communications equipment already in existence. The electronic larynx, for example, has solved a lot of problems for those who have lost the use of their larynx as a result of surgery or paralysis of both vocal cords and are unable to master the technique of esophageal speech—and could easily be one of the solutions for Harry Adams, our typical but fictitious man in Ohio.

In simple language, the electronic larynx is a device that substitutes electronic vibrations for the natural vibrations of vocal cords. If a vocally handicapped person holds it in the proper position against his neck the sound comes out of his mouth. Using his tongue, lips and teeth in the same manner as the normal talker reproducing speech sounds, he can learn to speak conversationally—even with inflections. As somebody has aptly said, "It might not sound like the best voice in the world, but it sounds pretty wonderful to somebody who can't talk at all without one." The device was developed by the Bell System and is sold at cost by local telephone companies to anybody in need of that kind of service. It is also distributed to other countries through the World Health Organization.

Bell System electronic seeing aid enables blind to work as switchboard operators.

Equipment for the Deaf

Because partially deaf people vary in their hearing needs almost as widely as people who need prescriptions for eyeglasses, there has to be a good deal of flexibility in the telephone equipment designed to aid them. And so there is. One relatively familiar item of telephone equipment is the special hard-of-hearing telephone set with a small volume control knob in the receiver which amplifies the sound reception comfortably to the proper level within hearing range. There is a similar telephone that amplifies the voice of a person with weak speech who is talking on it. Another telephone, which looks like the other two, has a "push to listen" button beside the volume control knob and works effectively in noisy locations for both hard-of-hearing and normal hearing persons. The "push to listen" button amplifies the voice at the other end of the line and cuts out most of the noise from the background.

For certain types of serious ear damage, such as the loss of capacity to hear by air conduction, we also offer a "bone conduction" receiver, from which sound vibrations are conducted through the skull, then analyzed by the inner ear and heard in the brain as in normal hearing. Another solution for those with serious hearing problems is the "watch case receiver" which enables a third person to "plug in" on a conversation and repeat what is being said on the other end of the line to a deaf person so that he can lip read what is being said and yet carry on his side of the conversation on his own. It might be additionally noted here that the Teletrainer—a device originally designed for teaching telephone usage—is being used experimentally to enable deaf children to learn to make brief but necessary calls.

By the way, you might think that, of all people, switchboard operators would be expected to have adequate, if not better than average, hearing capabilities. The truth is we've supplied thousands, in all kinds of businesses, with small transistorized amplifier devices that plug into their switchboards. When an operator plug her headset into one of these amplifiers, she can adjust the volume to her most comfortable level by turning a volume control knob.

When The Telephone Rings

Of course, conversing on the telephone is just one of the communications problems faced by the person with impaired hearing. First, he has to be made aware of the fact that somebody is trying to reach him—in other words, that the phone is ringing. There are various methods of tackling this, depending upon the degree of his deafness. We can, for example, provide a louder signal. We can also provide a signal in a different frequency range, where his hearing might be less impaired. Indeed, the standard telephone can be equipped with bells with any one of six different frequency ranges at no extra cost. In the area of sound, we offer such extra-strength signals as horns and large gongs (recommended only if you have distant or very understanding neighbors). We can also provide buzzers, which are particularly good when attached to some kind of sounding board, and the Bell Chime* signaling device, which usually is adequate for those with only moderate hearing impairment.

If the hearing problem is particularly acute, we can supply what we call an "Auxiliary Signal Control" device. This is an electrically-controlled switch that causes an appliance to go on when the telephone rings and off when the phone stops ringing. It will control any appliance the user wants to connect with it, such as a lamp to catch his eye or an electric fan to feel on the back of his neck. We have also provided, in some cases, "bee hive" lamps (called that because of their shape) that can be used in place of, or in addition to, bell signals. They light when the telephone rings and, naturally, can be seen to best advantage in subdued illumination.

Small transistorized amplifier with volume control aids operator with hearing problem.

*Trademark of the Bell System.

SPECIAL NEEDS

At the present time, there is no standard Bell System equipment for use by the totally deaf although special systems have been developed that have been successful in a number of instances. However, the people at Bell Telephone Laboratories are presently working on a standardized sight and touch set as well as other devices to ease these special communications problems in a variety of ways. One experimental set will include a small light the totally deaf person will watch when he wishes to make a call. A steady light will indicate a dial tone. A busy signal will be represented by a light flashing on and off at a rate of one cycle per second. And a ringing signal will show up in the same two-seconds-on, four-seconds-off rhythm that we hear on a regular receiver. When the light flashes irregularly, he'll know the telephone has been answered. Another experimental set will substitute a little vibrating button, on which the deaf person can place his fingertip, for the light. The message he receives from the person he's calling can be in the dots and dashes of the Morse code or in some other pre-arranged system. This type of solution is also possible with the visual light system.

So there is indeed help, and hope, for Harry Adams and the millions of other handicapped men, women and children around the country. And we are proud that we're able to contribute to that help. In the not-too-distant future we hope to be able to offer standard aids to the motion-handicapped and more aids for the blind as well. (Present aids for the blind include a special device for blind switchboard operators.) We are experimenting with this kind of equipment at the present time.

The Bell System claims to have no panacea now—nor does it ever expect to have one—to end all the hardships these people are suffering. But we do have useful equipment and services to offer—and we have them today. Many of them undoubtedly can do jobs they've never been assigned to do before.

We are only beginning to cope with speech, hearing, sight and other problems of the handicapped. With continued research and study at Bell Laboratories and on-the-job trial and error experimenting by the local telephone companies, we hope to be able to bring these people better solutions and better communications tomorrow. Meanwhile, we are exerting every effort to make Bell System people and the public aware of the hope made possible by the capabilities of the equipment available today.

Jack-equipped telephone set with optional handset-headset operation is one of the aids of use to the motion handicapped that will be the focus of Phase Two of the current program.

Mutual understanding of problems and objectives is essential to the successful conduct of any business. To achieve such understanding we must listen as well as talk

To Understand And Be Understood

C. Earl Schooley
Director of Operations
Long Lines Department
A.T.&T. Co.

"As MANAGERS, communication is the most important tool we have to get things done. It is the only means by which we can get action; it is the only means by which we can obtain cooperation; it is the only means by which we can get understanding."

A young manager was talking during a Long Lines Department conference. He was concerned, as are many of us, about the need for better communication, and through it, greater understanding, among the people in our business.

"To run any business successfully," he was saying, "the practice of striving to understand and be understood is necessary and it must go up, down and across the lines of organization."

As I listened to him and others talk about the problem, I was struck by the paradox of the situation. These men work with some of the communications marvels of all time, from communications satellites to television to complex networks vital to our nation's defense.

Yet they were worried about the many gaps in our *personal* communications, and concerned that these gaps are multiplying as our business, and our society, become more complicated. They were worried that these gaps might become gulfs.

The five men who were talking have helped provide and maintain facilities which have given this country the best communications system in the world. But when it comes to communication among the people who make up our business, they seemed to be saying, the message very often is poor, the transmission slow and garbled, and the reception awful. And too often, they felt, our personal communications—like water following the line of least resistance—flowed downhill.

One of the men at the discussion told about his efforts to get some of our communications flowing uphill. He had recently moved into a new job, a tough, demanding

". . . if you sit and listen long enough you start getting answers."

job involving the supervision of over 3,000 people. He found evidence of apparent low morale and "apparent mutual distrust between supervision and craftsmen." He went out to talk to the people.

"But, after awhile, we changed from talkers to listeners," he told the others. "The introduction took maybe ten to 15 minutes, and then we listened. Sometimes for eight hours we listened. And I found that if you sit and listen long enough, you start getting answers. And you hear what others think the problems are, and what they think the answers are, instead of what you think the answers are. It's quite an experience."

It *is* quite an experience—sometimes a deflating one. It's often a temptation not to ask for ideas or answers from other people, particularly those working for us because their ideas and opinions may well tear down our own carefully thought-out answers.

Listening can also be disturbing because it sometimes uncovers problems we didn't realize existed. It's sometimes more comfortable not to listen, not to pay attention to the warning signals, than to have to face new problems.

One of the men at the discussion told how listening to some of the people in his area uncovered a problem he hadn't known existed.

"We knew that understanding our goals and policies by all management and non-management people was necessary to attain our objectives," he said. "So we talked in depth with a lot of first and second level supervisors, particularly those first level supervisors who had been appointed during the past two years. We also talked with—and listened to—a large cross-section of non-management people. We found our people didn't know nearly as much about our goals and policies as we had assumed they did."

What did they do? The first step toward correcting the situation was more talking and listening. Every supervisor in the area was invited to a meeting and urged to bring any and all questions about the business. They were promised that all of these questions would be answered frankly and fully.

"The questions were stimulating," the manager told the group, "and we felt we were able to clear up a lot of misunderstandings. Above all, we convinced the supervisors that our policies and practices are not secret, and that all of us should be ready, willing and able to discuss them fully. We think those give-and-take discussions broke down a lot of barriers."

Another man in the discussion told of some of his attempts to create an atmosphere of real two-way communication in his group.

"We haven't attempted to tell people that we are going to make them happy. We don't know what happiness is; we can't always achieve it in our own homes," he said. "But we have tried to say we are going to set up an atmosphere where understanding, being understood, might have a better chance to take place."

One of the managers said it a different way:

"Perhaps this is our greatest weakness in communication—our lack of ability to listen and listen with sensitivity. To do this, we have to create a climate where people feel free to express their views, have their opinions considered and their suggestions and ideas recognized. Any manager who doesn't do this is losing."

". . . those give-and-take discussions broke down a lot of barriers."

That statement made me wonder just how much we do lose—in our business and in our whole society—through faulty communication and the inability to listen.

I know of no real way to measure it. We can assign dollar figures to some of the problems that beset us and to the projects in which we are involved. In our own business, we spend a great deal of money each year to make our facilities more reliable and secure, and to protect them during maintenance operations and for use in case of possible disaster. We know that if we did not do this, the cost of an outage might be many dollars more than the cost of protection. We spend a great deal of money to make this a safe place to work. If we did not spend this, we know the ultimate cost would be higher, and the human suffering greater.

I have no idea how much our communications failures cost us. A person has to feel he's a part of the organization in order to put forth his best efforts. A person must understand our goals to do things the right way. A person who feels his boss will listen to him may make suggestions that could improve the way we do things, saving us time and money.

Not long ago, a Long Lines construction supervisor had an idea for a better method of making splice closures on coaxial cables, developed the idea, talked to his boss about it and it was sent up the line and eventually to Bell Laboratories. The final result was a new and better work method, which we estimate will save us some $2 million between now and 1970.

I'm convinced that good communication definitely played a part in this savings. If this man had not worked in the right atmosphere, he probably wouldn't have bothered looking for new ways of doing things. If his boss had not encouraged new ideas, and listened to them and acted on them, the $2 million savings would have been lost.

There are, of course, many instances in the Bell System like this: the team working together for a common purpose—to furnish a communications service by electrical means and doing it with an honest effort to make this a good house to live in and to make it a fine place to work.

"Too many of us give only lip service to the importance of communication . . ."

Perhaps it's wrong to talk about personal communication in terms of dollars lost or dollars saved, because I'm not sure there is a way to plot a graph or make an index showing the value of talking and listening to people. Nor should we try. But I mention dollars simply because we so often use dollar figures when discussing our other business problems.

Too many of us give only lip service to the importance of communication because communication—talking and listening—takes time. And time means money and time is an important ingredient of service.

My point is that the lack of good communication *costs* time and money and service, too.

"I want to tell you about a group in my area involved in furnishing private line service," one of the managers

". . . morale is higher and productivity has improved

in the discussion broke in. "They had about 1,700 services furnished to over 500 customers. Obviously, when you are dealing with these kinds of things, the reputation of the Bell System is going to be affected one way or another by the job that these people do.

"The boss of this group," the man said, "was concerned about attitude and apparent low morale. The fellows seemed to have chips on their shoulders. The quality of service was certainly nothing like it should have been."

In an attempt to find out what was wrong, the supervisor decided to meet with some of the craftsmen and see if they could tell him what they thought was wrong and how things could be improved. The first meeting was so encouraging he arranged to have meetings set up on a continuing basis "to talk about the job, what was going on in the office, and any other things the fellows wanted to talk about."

What has happened since? Here's what that manager had to say:

"You go in there today and you can tell the morale of this group is high. You can see they know and are interested in their jobs and the results they are getting. I think it is interesting to note that the supervisors in the office will tell you their jobs are a lot easier today than some months back. And you can see that the service results and the productivity in this group have gone from a point that was really poor to the point that it is good and improving."

To me, this is evidence of the value of good communication within a work group. Holding these meetings took valuable time. Yet morale is higher and productivity has improved. This was time and money well spent and the teamwork has improved "the house we live in."

In the Long Lines Department, we are helping supervisors by providing them with a number of discussion guides, covering such subjects as employee benefits, public affairs, seeing ourselves from the customer's viewpoint, and personal advancement. They have been well used in helping supervisors conduct discussion meetings. The reaction has been good.

"We don't improve communication by a 'cover all your people by tomorrow' approach."

But one of the sad things is that, on occasion, even our communication *about* the discussion guides has been garbled in transmission. Some supervisors have felt that using a discussion guide was all they needed to do to fix up their communication problems. Others got the idea the object was to cover as many people as possible as quickly as possible with a discussion guide. Some have felt employee discussions are a passing fad.

Of course, not one of these things is true.

The use of any one discussion guide, mailed to a supervisor from headquarters, is not going to make a work group's morale zoom overnight. Informal meetings on local subjects and problems are needed. And group meetings themselves aren't the whole answer by any means. An honest *individual* exchange of ideas, between an employee and his boss, on a day-to-day basis is often the best kind of communications. This can usually do more to improve morale and give recognition than any series of meetings.

The idea of competing to see who can hold the most discussion meetings, or who can cover the most people with a given subject in a given time, is one of the big stumbling blocks in communication. We don't improve communication with a "cover all your people by tomorrow" approach. Discussions should be held frequently, but the need and subject matter and approach will vary with each group of people.

To consider the need to improve communication as a fad that will soon pass in favor of another fad is a sad mistake. Good communication must be *continuous*. It must be practiced *every day*, as a regular and continuing part of the job. It can't ever be divorced from the regular day-to-day job.

We communicate with people personally in three main ways: by our actions, by listening and by talking. I've listed them in the order of their importance.

People form an opinion of us based largely on what we do, how we act. If we don't show a willingness to listen and talk to people, if we fail to welcome ideas and suggestions, then all the speeches in the world won't

". . . listen to and act on the communication that comes out."

help. Our actions will have spoken much louder.

Listening is, of course, a key to good communication. But even listening by itself isn't enough. We have to act on what we hear. If an employee asks a question, we have to do more than listen; we have to get the answer for him. If we don't know the answer we must *find* it for him. In doing so we become better off as supervisors by learning something new ourselves. If we listen to an idea or suggestion, we have to follow through on it, and let the person know the outcome.

I hesitate to say much about the third method of communicating, talking, because all of us do so much of it. I'm convinced we do too much talking and not enough listening. Wherever possible, we need to put the emphasis on *discussing with,* rather than *talking to.*

In one of our areas recently, Plant errors were a problem. Instead of talking to the men about the need to improve, the manager discussed the problem with the craftsmen and asked them to come up with their ideas.

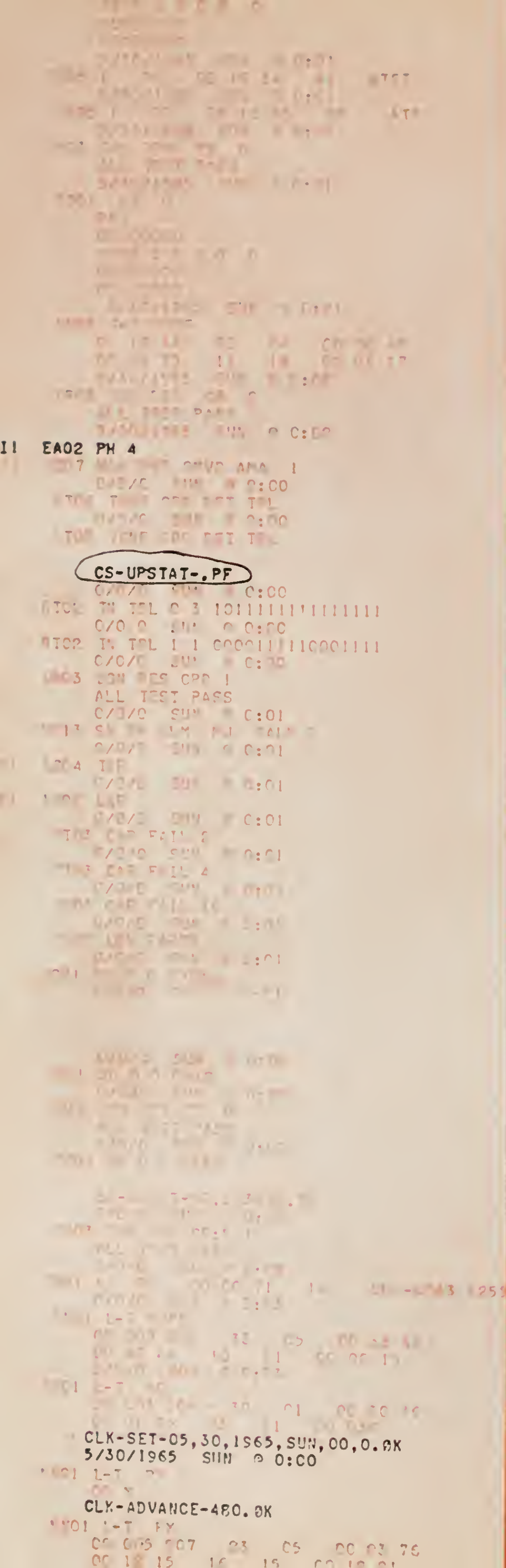
"The craftsmen came down and put on a show for the whole group and did an outstanding job," the manager said. "We had craftsmen standing up and telling top management what was wrong and what should be done about it. And, of course, they are the guys who are actually going to do the job."

I'm sure the results here are going to be much better than if we had lectured to the group about the need to eliminate errors.

"People do want to have a part in solving the problems of our business," added another of the managers. "They produce better, and feel more a part of things, when given a chance to participate."

That's what we all want; to feel more a part of things and to be given the chance to participate.

We have a lot of personal communication channels available to help everyone in our business have that sense of participation if we use the channels properly. I think the five young managers with whom I talked have the right ideas: open those channels wide, make sure they run up the line as well as down, and listen to and act on the communication which comes out.

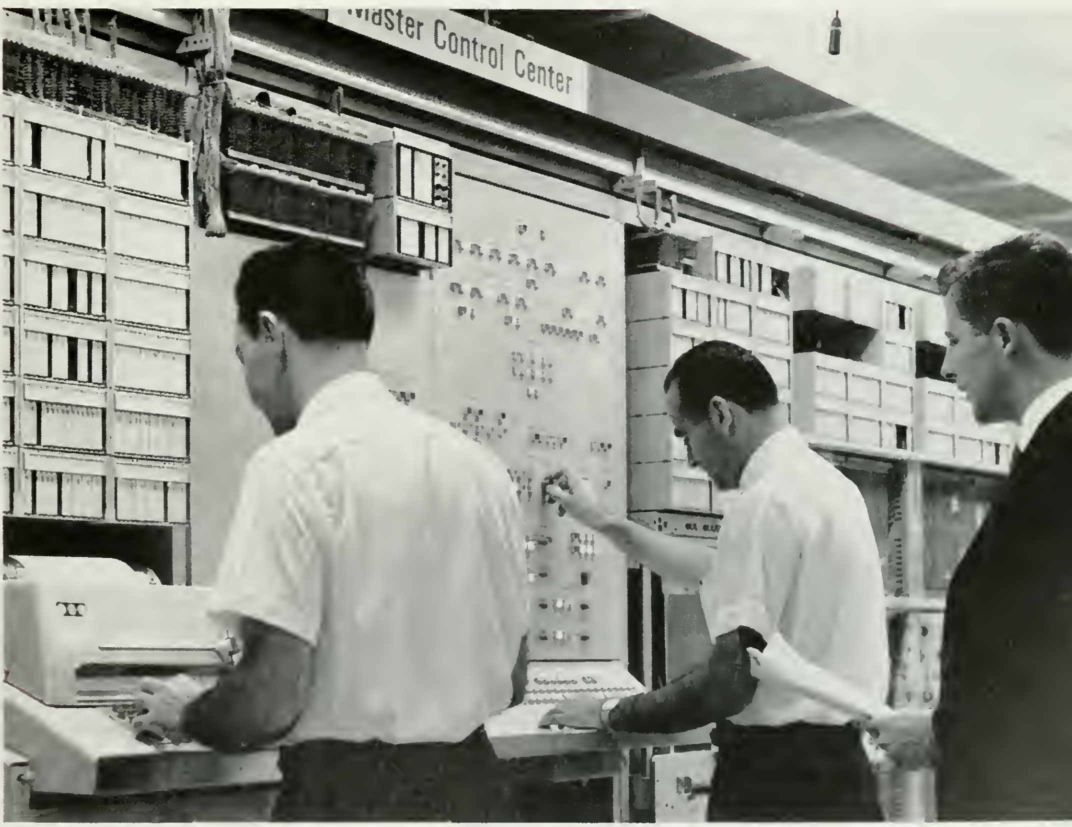

EA02 PH 4
CS-UPSTAT-.PF
ALL TEST PASS
CLK-SET-05,30,1965,SUN,00,0.OK
5/30/1965 SUN @ 0:00
CLK-ADVANCE-480.OK

ESS
'U E

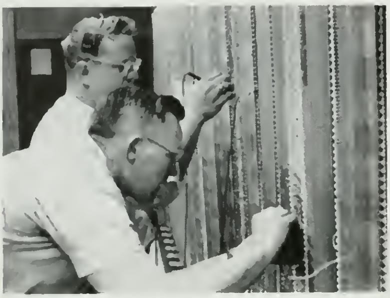
Left: ESS talk. Instructions to, and reports from, the ESS are sent and received on a teletypewriter. This is what was printed out at the time of the cutover. EAO indicated that the heat coils had been pulled in the old central office, putting it out of service. Picture at top right shows framemen and switchmen at the ready, waiting to pull the heat coils and initiate the cutover. CS-UPSTAT was the command given, in conjunction with commands given by pushbutton, to close the ferreed switches so that the ESS could start processing calls. At right, switchmen are seen at the master control, receiving their instructions from the chief switchman, as they give the commands for the cutover to the ESS system. PF was the machine's instantaneous response indicating that it was in the process of complying with the command. And, a few seconds later, as the machine's clock was started and corrected to correspond with local time, the ESS was ready for the first call.

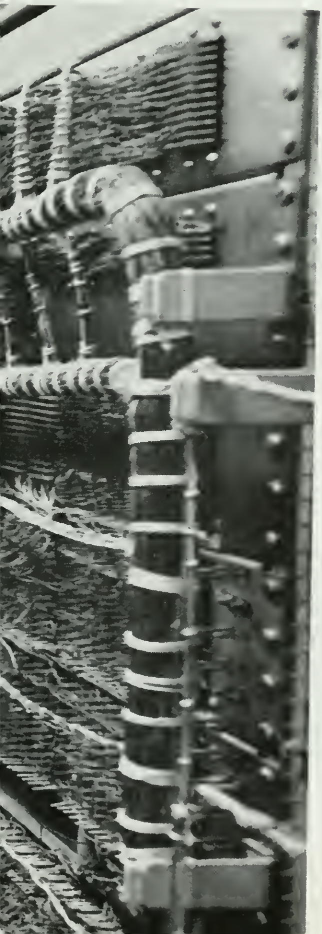
S T A T'

The strange word above is electronic switching language. It was the command given to the Electronic Switching System in Succasunna, New Jersey to get ready to handle its first call. This dramatic culmination of years of work and planning occurred at 12:01 a.m., May 30, as the first No. 1 ESS was successfully cut into service. At this time, some 4,300 New Jersey Bell Telephone Company customers—including the 200 customers who will take part in a trial of special "memory services"—began to be served by what has been designed to be the most modern telephone service ever, an achievement that was the result of closely coordinated teamwork between Bell Telephone Laboratories, the Western Electric Company and the Bell Operating Companies.



In the weeks leading up to the cutover and inauguration of service to this small northern New Jersey town, the electronic central office was the scene of busy and varied activity by New Jersey Bell, Bell Labs and W.E. people as they made the final preparations, top left and below. Constantly checking — as, at left, New Jersey Bell switchmen check circuits—they performed exhaustive tests every step of the way. At last, while two intent Bell Labs men looked on, the central test unit, far right, completed the final check-out of the system.





Communications history was made in this modest-sized building in Succasunna, N. J., when Bell System's first central office offering ESS on a commercial basis was put into operation.

Attending ESS dedication ceremonies were left to right: E. Hornsby Wasson, then president of New Jersey Bell; Frederick R. Kappel, A.T.&T. board chairman; Paul A. Gorman, president of Western Electric Co., Dr. James B. Fisk, president of Bell Telephone Laboratories and Richard J. Hughes, Governor of New Jersey.

The first official call through the electronic central office was made when Governor Hughes, left, tested the telephone service of the future by adding on John T. Connor, U.S. Secretary of Commerce, who was in New York City, to an existing conversation between himself and Mayor Louis Nero, second from left, of Roxbury Township.

Being a practical thoug
lighthearted manual of arms for thos
who must write business letter
memoranda, etc. and also for thos
who must finally approve such document

Whatever Happened To The Subjunctive?

Kermit Rolland

My friend was in a reflective, Friday afternoon mood. He said, "We can invent the telephone—we can lay cables beneath the seas—we can transmit data across the boundaries of space. In short, we are capable of creating the most sophisticated tools to aid people in extending the range of their voices beyond their immediate environment. In addition, we have learned how to manage these tools and the people who operate them so that the communications services we supply are remarkably trouble-free. And yet . . ."

My friend smiled ruefully. ". . . and yet so many of us still lack the knowledge—skill—ability—whatever it is, to manage the most familiar communications tool of all: the simple English sentence. All too often when we try to communicate in writing our good intentions are not matched by results.

"In particular, I am thinking of the relationships between the people who write letters, memos, and the like and the other people who have the responsibility for approving (or not approving) their efforts. We do know that some—call them writer-manager-relationships—are very successful. On the other hand we know of some that lead to mutual frustration. When this relationship fails, the communication can fail."

Far below us a blue and white ship hooted its departure from its Hudson River berth.

"That's quite a speech," I said. "What makes you think a writer and his manager will ever see eye-to-eye on what constitutes a successful English sentence?"

"I think we could find a basis for agreement if we knew what causes disagreement in the first place. What's needed is some fact finding."

"How do you propose to do that?"

"That's why I asked you to drop in. You're a writer. You work with writers.

And you're an outsider, so you should be able to bring some objectivity to the assignment. Like to try it?"

"Free rein?"

"Absolutely."

■ This article, then, is the result of an informal fact-finding prowl through the Bell System, specifically in A.T.&T., Bell Laboratories, Western Electric, and one Operating Company. It consists of personal observations, comments from many individuals, and it concludes with a kind of check list directed to each of the parties in the communication process: the writer, who seeks approval, and the manager who must, eventually, approve.

The first actual evidence that there might be muskets concealed in the hay rick came to light in the form of various signs, or mottos, to be found taped above the desks of writers of various kinds and in various locations. I quote from them.

Ours not to reason why, ours but to do it over.

My Mother told me not to give up my piano lessons.

The most poignant of these was one that simply asked:

Why?

And there was this ominous quotation from Richelieu:

"Give me ten lines written by the most honorable of men and I will find in them something to hang him."

■ Following this initial appraisal of the site, I continued my fact-finding by interviewing some representative writers and managers. To each, I addressed myself as follows:

"I am here in the interest of better

Sometimes there is mutual frustration.

letters, reports, and memoranda. I appreciate that you, personally, don't have any problems. However, we would like to help others less gifted than you. What suggestions can you offer that will improve the quality of business writing?"

The reaction to my question was universally heartwarming. Rarely have I experienced such a generous out-pouring of friendly advice and good natured criticism. What follows is a sampling of their responses.

First, the managers:

As it happened my first respondent was busy on the speakerphone. I caught a few words of his conversation.

"I just sent you a letter," he was saying, "and I wanted to explain it to you . . . ."

When he had finished, I asked him my standard question about how to improve company writing. He arose and softly closed the door.

"I think you're looking for solutions at the wrong level," he said.

"My boys and I don't have any problems—it's a happy collaboration: Give a little take a little. But upstairs . . ." (he rolled his eyes heavenward).

"The other day we were asked to comment on a letter that had been prepared upstairs. The gist of my comment was that I didn't think anyone would understand it. You know what answer I got? 'They'll understand it all right. Why shouldn't they? After all, they get letters like this all the time.' "

I registered appropriate dismay.

My informant summed up: "I *still* maintain that it is not the reader's responsibility to understand, but the writer's to be understood."

This seemed to be very much in line with the comment I had overheard while he was telephoning.

■ To keep my perspective, I decided to interview a writer next. I found him to be a sturdy, likeable and articulate chap.

He rose to my standard question like a bobolink to a ray of sunlight.

"The problem," he opined earnestly, "starts when you first come on the job."

"Some helpful soul comes in and deposits a heap of files in front of you and says, 'You're going to be doing some writing on your new job. Why don't you look through this so you'll get an idea how we do things here?' Now, understand, you come to the job as a trained man — engineer, accountant, whatever. But when you start reading those files you feel you'll never be able to handle your new job because you just can't understand most of what you are reading.

"Inevitably the day comes when you're asked to write something for the boss's approval. You know your subject. You could easily explain it over the telephone. But you soon find out that writing about it is something else again.

"You start by re-reading the files. But, if you are honest with yourself, you soon admit that you *can't* write in that important-sounding way. All you can do is write the way you've always written—the way Miss Green tried to teach you in school. It's not a question of choosing to write one way or the other—you only *can* write your own way. So you start out.

"When you've finished, you read it over. It doesn't seem too bad. And you send it off.

"With something approximating the speed of light, it comes back to you with a little note in the boss's handwriting. The note reads: *Have you had a chance to study the file?* So there you are: right back where you began.

"If you're lucky, someone with a little more experience will help you out at this point—at least this is what happened to me. I was told, 'You've trapped yourself by your own misconception of your role here. In this game your primary purpose must be *to get your writing approved.* Therefore, you write it the way it's written in the approved file. Remember: the operative word is *approved.*'

I took my leave and my informant returned to his task of adapting a 1947 letter to fit a new situation.

■ The next writer I interviewed showed me a comment written in the margin of a memorandum that had just been returned to him for rewriting. I quote the comment in full:

You have used the same word twice in this sentence.

The writer looked at me with a puzzled expression.

"Tell me," he said, "what's a synonym for *is*?"

I deftly side-stepped his question.

He continued. "Last week it was a split infinitive. The week before, I ended a sentence with a preposition. My boss is a nut on split infinitives. Personally, he doesn't care one way or the other about prepositions at the end of sentences—it's *his* boss who's the preposition nut.

"Have you studied the file?"

"My job is like being at the small end of a funnel: all the accumulated grammatical rules, notions and superstitions from all levels above me pour down on me. I've discovered that none of these things have very much to do with the clear communication of an idea.

"It's a game of one-upmanship. The easiest way in the world to prove your superiority is to point out someone else's error in the traditional Latin-English grammar that no progressive school has tried to teach in this country for over a quarter of a century. Most people don't realize this: they just feel insecure, and even guilty, about their own language.

"The guy who knows one more rule of Latin-English grammar than anyone else is the ultimate one-upper and is destined for fame and glory."

■ My next writer greeted my standard question with an initial stunned silence. Then he said, "Surely you can't be serious."

"Never more so."

Not completely convinced, he nevertheless continued.

"Last week I finished a company course in better writing," he said. "This week I wrote my first piece following the principles laid down in the course. One of the principles was that, when you write to a non-technical audience, you should try to relate your ideas to something that will be familiar to them. Would you agree with that?"

"Agreed," I agreed.

"My assignment was to describe a new amplifier to a commercial audience. First, I stated the purpose of the amplifier. Then, I tried to think how I could describe its general physical appearance in terms that would be most economical and meaningful to the people who would be reading about it."

"And?"

"So I wrote, '*This amplifier is about the size and shape of a package of king-size cigarettes*'."

"Don't try to read the boss's mind."

"Bravo!"

"Bravo, your uncle. My piece just came back with the suggestion that I rewrite the description. This I can live with; it's the *reason* that drives me out of my skull."

"And that is?"

"Read it for yourself." He slid a paper across the desk to me. Opposite the offending statement I read the following:

Rewrite. King-size cigarettes may not be around forever.

"This," said the writer, "is what I call our 'time capsule complex': that everything we write is enduring. I wonder if the people of ancient Crete thought that way, too. We've found a lot of their writing—on vases and tablets. There's only one problem: we can't read any of it because we can't understand their language. We don't know what they're talking about.

"Maybe it'll be different when archeologists unearth our approved practice on the amplifier."

■ My final interview took place at a Bell Laboratories' location in a spacious, sunlit lobby during a lunch hour. I had decided to round out my inquiries with one more interview with a manager. I found him seated before a Japanese *Go* game (something like chess) with a bearded opponent opposite him. Goodnaturedly he interrupted his game and gave me his attention.

"I feel like a character in a Kafka novel," he declared. "You know, questioning of personal identity, uncertain as to sense of place."

The beard nodded in sad agreement.

"Pourquoi?" I asked in my best high school French, sensing that this was a highly intellectual situation.

He produced a folded paper from the pocket of his white shirt. "My company has just released this document which purports to explain my status as a resident of this state. If this sets the standard for our writing, we are all lost."

He unfolded the document and read aloud in what my untutored ear took to be iambic pentameter.

A resident includes any person domiciled in the State except a person who, though domiciled in the State, maintains no permanent place of abode within the State, but does maintain a permanent place of abode outside of the State, and who spends in the aggregate not to exceed 30 days of the taxable year within the State.

"Sheer poetry," murmured the beard.

"Any further questions?" the manager asked me.

"None," I whispered, taking my leave.

* * *

After mulling over the interviews for several days, I produced the following rules of the road for writers and for managers in an effort to smooth the journey of an idea from the creator to his audience. The lists are by no means comprehensive. However, they do cover what I gather are the main points of difference between many writers and managers.

Whatever Happened...

For Writers	For Managers
• Don't try to read your boss's mind on questions of policy, procedure or the objective of the piece you are writing. If you aren't sure, ask.	• Don't expect your people to read your mind. After all, it is *your* responsibility to make policies, procedures and objectives clear and *known*.
• Your boss probably isn't as well-informed on current, accepted usage as you are. So be a little conservative in your choice of words.	• Your writers probably aren't as well-informed on current, accepted usage as you are. So be a little liberal toward their choice of words.
• Don't use your writing assignment as a chance to show off how much you know about a subject. You'll exhaust your reader long before you exhaust your subject.	• Don't make changes in a piece of writing as a way of proving to your people that you outrank them. Remember the management principle of "good enough." It applies to writing as well as to any other phase of the business.
• Stick to the point. Ask, "How much do my readers *need* to know in order to be adequately informed." Limit yourself to this amount.	• Encourage your writers to stick to the point. Brevity isn't necessarily a virtue. But conciseness *is*.
• Be yourself. Any effort to sound like an engineer, a comptroller, or a telephone company is fore-doomed to failure. You'll just end up sounding pretentious, pompous or confusing.	• Don't expect your writers to imitate the way you write. Even the President of the United States doesn't expect this.
• Write simply. Prefer one idea per sentence—never use more than two in a technical paper.	• Encourage simplicity. Prefer one idea per sentence—discourage more than two.
• Be willing to accept criticism. "Pride of authorship" is the prerogative of amateurs. Remember, you are a professional.	• People are sensitive to criticism, even though they may not show it. If you change someone else's writing, do so on the basis of known and accepted policy and procedure—and be sure to explain *why* you made the change.
• Your boss probably has certain fixed ideas about the "right way" to say things. Be patient with him.	• Your writers have certain fixed ideas about the "right way" to say things. Be patient with them.

"Be patient with him."

After completing the lists, I concluded my assignment with another visit to my friend at his office high above the Hudson River.

"Interesting experience for you?" he asked.

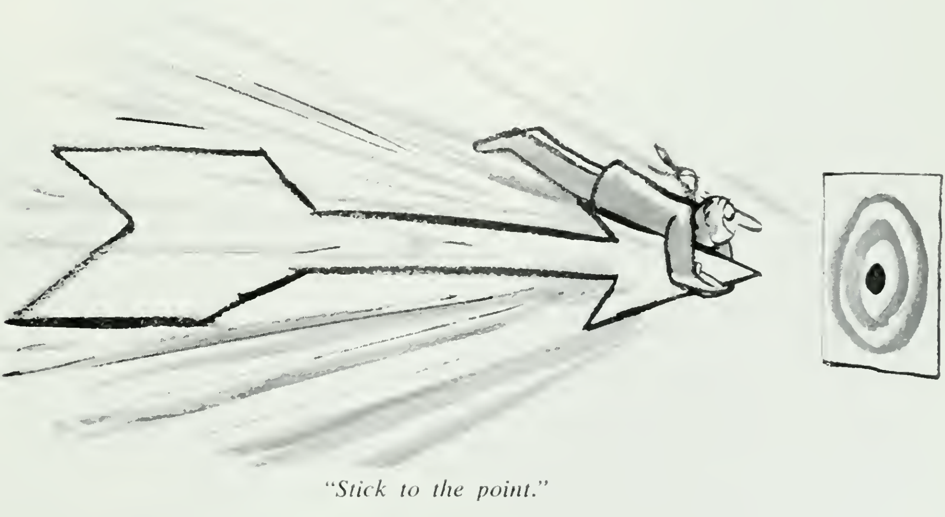
"Very," I said. "Problems of goals, standards, procedures — nothing that can't be worked out. And, yes, problems of what constitutes our proper language."

"Speaking of proper language," said my friend slyly, "isn't it awful what's happened to the *subjunctive*?"

"Awful!" I blurted.

As soon as I got back to my office I looked it up.

You know, he's right. It's awful what's happened to the subjunctive.



"Stick to the point."

It will be many years before its use on a large scale is practical. Nevertheless Picturephone service is already showing a potential as a business aid.

Business Experiments with PICTUREPHONE* Service

Eugene Lapé, *Assistant Advertising Manager-Sales Promotion*
Public Relations Department, A.T.&T. Co.

In Picturephone service experiment, representatives of drug firm demonstrate preparation of antibiotic for intervenous injection. The view as seen on the remote Picturephone screen is reproduced above.

*Service mark of the Bell System.

■ JUNE 24 of this year marked the first anniversary of the date on which Picturephone see-while-you-talk service was initially offered commercially between New York, Chicago and Washington, D. C. During this first year this new service was used experimentally for the most part and there has not been time to explore many of its potentials. Nevertheless, it is already showing that it has possibilities as an important new business tool.

During the year some imaginative businessmen in varied fields explored the possibilities of this new service by using Picturephone calls in place of traditional methods of merchandising, for interviewing personnel, initiating product promotions, holding sales conferences and staff meetings, and other company funtions. The consensus among these early users is that the effective use of this personal communications service can mean time and money saved.

One of the earliest users of Picturephone service, and the first to benefit from its potential as a sales tool, was Tom Slater, sales manager for the Benay-Albee Novelty Company, New York. He initially thought that the see-while-you-talk phone service might aid his novelty hat business as a promotional asset to keep his company's name prominent in the mind of a buyer. Having seen Picturephone service in operation at the World's Fair, Slater decided to unveil his new line of children's play hats in a call from New York's Picturephone calling center to Henry Mertins, executive toy buyer for S. S. Kresge Company, at the Picturephone calling center in Chicago. As the call progressed, Slater launched a serious presentation and received an $18,000 order for two lines of novelty hats. "The hook-up was as effective as if I had made the presentation in person," says Slater.

Benay-Albee trade advertising has invited other buyers to contact Slater for similar calls to review merchandise. Explaining the purpose behind the program, Slater says that calls to the Chicago and Washington Picturephone calling centers should enable him to increase his coverage by up to 25 per cent and make more effective use of his time. For example, he was able to make a tour of purchasing agents that he says would not have been possible if he had spent two-and-a-half days in Chicago instead of making the Picturephone call.

■ As part of this trend, several other firms have developed effective business applications for Picturephone service since Slater's original sales call. Companies such as Transogram, Henry Pollak, Inc., and Hat Corporation of America have tested Picturephone service as a selling tool within their respective fields.

Transogram Company, Inc., one of the nation's leading toy manufacturers, added a new dimension to toy merchandising by using the two-way visual telephone service to review part of its product line with a major buyer, Montgomery Ward, in Chicago.

Explaining the purpose for the call, Charles S. Raizen Sr., chairman of the board, says that they decided to use Picturephone service because it afforded an opportunity to show and demonstrate certain leading items, providing a valuable visual reference for their conversation. Transogram's call via Picturephone facilities produced a 400 per cent increase in the order of one item and a 300 per cent increase in another.

■ A series of Picturephone sales calls were initiated by Henry Pollak, Inc., New York importer and supply firm, and Olympic Accessories Corporation, a Pollak subsidiary.

Marking the first call of its kind in the ready-to-wear women's fashion industry, Henry Pollak, president, used the Bell System's Picturephone service in a pioneering technique to merchandise a new line of women's sweaters. "We needed a fast way to show our newly imported line of sweaters," comments Pollak, "and decided to experiment with a sales conference via Picturephone transmission. It enabled us to show the sweaters with the aid of a model, make the sale, and immediately air-ship the goods," adds Pollak, "so that (the store) could begin selling the following day. This ability to visually show new merchandise by phone, saving the usual time and cost involved,

Toy manufacturer used Picturephone service to demonstrate line of toys to a buyer. The result: 400 per cent increase in order of one item; 300 per cent increase in another. Top, the demonstration under way. Above, toy as it appeared on Picturephone screen.

PICTUREPHONE Service

Ad agency team demonstrates handling of TV commercial for TV station executives.

Artist in New York shows painting to representatives of National Geographic Society at the Washington D.C. Picturephone Center.

appears to offer many benefits in accelerated merchandising."

Olympic Accessories Corporation capitalized on the experience gained by Pollak and expanded the firm's "Picturephone Sales Conference Technique" method of merchandising through a

Above, a new hair styling service was inaugurated between New York and Washington.

planned series of calls to promote its line of ladies' handbags to buyers. "By using the visual telephone, we were able to show our product line from the New York Picturephone center, discuss the handbag features and create the same buying interest as in a personal sales visit," says Sam Schiff, the Olympic corporation's sales manager.

"Our first series of three Picturephone calls were to buyers in the Washington area," he reports. "Although the primary purpose of this particular campaign was just to offer buyers a sneak preview of our line before the industry's market show in New York, we received immediate advance orders." Olympic Accessories Corporation's program marks the first planned program of Picturephone calls by a single firm.

■ The possible uses for Picturephone service seem to be almost unlimited and the list of applications is lengthening through the influence of creative thinking. Creativity immediately pinpoints the advertising and graphics industry, a business where the visual telephone's benefits are compounded.

N. W. Ayer & Son, Inc., first in the advertising agency field to experiment with Picturephone service, sees "many potential applications in the agency business—to say nothing of other service businesses," according to Jerry N. Jordan, vice president and assistant to the president. Ayer conducted a series of test transmissions via Picturephone facilities including projection of both the live demonstration and film portion of a combination commercial to executives of WTTG-TV in Washington, D. C.

From the Picturephone calling center in New York, Ayer people demonstrated the desired manner in which the commercial should be handled, explained the assembly of a display, action of a puppet, and the switch to an accompanying 60-second spot film. Since a performer generally has contact with the agency and client through correspondence or actual commercial copy only, Picturephone service opens the door of an entire new means of communications. It makes it possible for the performer to be in direct contact with the people who conceived the spot and be shown exactly how they want it done, assuring proper presentation of the product.

WTTG's general manager and vice president, Lawrence Fraiberg, sees a number of uses for Picturephone service. "I envision the time when a program presentation to an agency can be made by Picturephone service, when a commercial idea can be transmitted to a client or agency, and when TV stations also can communicate with each other through this service."

From the agency standpoint, Jordan terms Picturephone service "a dramatic advance in communications for which we, at Ayer, see many potential applications. While there is no substitute for direct personal contact in our business," Jordan says, "Picturephone calls are the closest thing to it that has been developed and as demonstrated in our experiments, a truly superior means of communications."

Other recent tests by Ayer show potential usefulness for the new communications medium in transmitting art layouts, graphic material, packaging designs, sales presentations and new product introductions.

■ Picturephone service was used in another recent graphics transmission when a painting was unveiled in New York to an audience in Washington, D. C. The event marked a first for artists, as representatives of the National Geographic Society at the Picturephone center in Washington were able to view a painting of General Lee's surrender to General Grant transmitted from the center in New York. On hand in Washington to view the painting was Major General U. S. Grant 3rd, Retired, grandson of the famous Civil War general, who supplied much of the information for the painting's detail and accuracy.

Two views on the Picturephone screen. Hair stylist at work . . .

. . . view of puppet for TV commercial displayed for TV station by ad agency.

Picturephone service being used to merchandise a new line of women's sweaters. Importer was able to show sweaters being modeled, make sale, immediately air ship the merchandise.

Commenting on the call, Andrew Poggenpohl, art editor for the Society, says that seeing the painting via Picturephone service "enabled us to get an overall impression while discussing detail in a face-to-face conversation with the artist, Tom Lovell." After the unveiling, the painting was forwarded to the National Geographic Society for closer inspection and evaluation.

■ Another valuable business application for Picturephone service has been its use for interviewing prospective employees. Milton R. Stohl, marketing vice president of Mystik Tape, Inc., Chicago, hired a New York job applicant as district manager for the Boston area after a 20-minute interview via Picturephone service, terming the call "more than worth it, because of time and money saved." Picturephone service is credited with doing the job for one-third the cost while saving valuable executive time.

Personnel Laboratory, Inc., also used Picturephone service as a means of interviewing job applicants. The firm made a call from New York to Washington, D. C. "For preliminary screening, Picturephone service is a new tool that forward-looking personnel people will welcome," says James H. Pierson, consultant. He feels that companies will be hiring better people with the use of Picturephone calling, since they can canvass the field more thoroughly than is usually feasible.

■ Perhaps the most unusual business for Picturephone service that has yet been developed is the new "Hair Styling Consultant Service" being offered by John Fonda, nationally known New York hair stylist. His service was inaugurated to enable women in Washington and Chicago to call him via Picturephone service for consultation on their hair problems. As part of the consultation service, Mr. Fonda designs an individualistic hair style for them and sends a geometric diagram which enables a local beauty salon to re-create the coiffure.

The potential of Picturephone service seems to be stimulating considerable interest among nearly every phase of business operations. In another recent Picturephone call, the president of a large Chicago bank called a bank official in New York to discuss security transactions and new building construction. In this instance, the desire for a face-to-face conference prompted the call.

Several other business calls placed over the tri-city network include a conference by two airline executives to discuss developments in the fields of communications, bookings and transportation; a person-to-person taped interview of Broadway producer-director Herman Shumlin by Chicago TV-radio personality Sig Sackowicz; a New York builder to show three model homes to an official of the American Association of Home Builders in Washington, D. C.; a staff sales conference by Chicago and New York executives of the Stanley Home Products Corporation.

And, perhaps as a sign of the future, a product trial of Picturephone service began July 7 in the Chicago and New York headquarters buildings of the Union Carbide Corporation. About 35 Union Carbide employees are participating in the trial and have Picturephone sets installed on their desks. They can communicate with other Picturephone set users in their own organization; between the Union Carbide offices in New York and Chicago; and with the Picturephone calling centers in New York, Chicago and Washington.

The trial, which will extend over several months, gives Union Carbide employees the use of this new telephone service under nearly normal office conditions and enables them to determine its value to them in their daily activities. At the same time, Bell Laboratories and the New York and Illinois Bell Telephone Companies which are conducting the trial will be able to analyze Picturephone hardware and the ways in which customers use the service to get some reactions to its utility, application and design.

J. E. Currens, president of Union Carbide's Realty Division, said the company was participating in the Picturephone service trial "as part of its continuing effort to speed and improve communications for the purpose of increasing operational efficiency. Also, as a research-oriented company, we are pleased to test new products and advances in technology."

in this issue...

Donald R. Woodford

Robert W. Ehrlich

■ An assignment to write an article on business information systems—or an article on No. 5 Crossbar, or on the cities of New Jersey—is another assignment in a professional lifetime of writing assignments for Donald R. Woodford, whose "B.I.S." starts this issue on page 2. The challenge of the present assignment, he says, was to compress a large and complicated subject into an article of manageable length—and in a stipulated period of time, magazine deadlines being what they are.

Mr. Woodford began his writing and editorial career in the press department of the National Broadcasting Company in 1941, after receiving the A.B. in English Literature from Princeton University. Four years in the Signal Corps culminated in Honolulu, where he was news chief of the Middle Pacific Area. He joined the New Jersey Bell Telephone Company in 1946, and became assistant editor of the New Jersey Bell magazine in 1949. Three years later he joined A.T.&T. as editor of the *195 Magazine,* then served as information supervisor in charge of booklets before moving to his present post as managing editor of the *Bell Telephone Magazine.*

■ As vice president of the Pacific Telephone and Telegraph Company, Robert W. Ehrlich heads a special group he has organized to study communications requirements for the electric power industry in the West. Interconnection and pooling of power facilities have brought with them the need for more extensive and completely up-to-date communications for the electric power networks. It is Mr. Ehrlich's job to set out both broad guide-lines and specific measures for meeting these needs with Bell System services, which he tells about in the article starting on page 14.

Mr. Ehrlich brings to his task an extensive background in communications engineering, which includes many positions in Plant, Engineering and Traffic in A.T.&T.'s Long Lines Department, the Defense Projects Division of Western Electric and the Engineering Department of A.T.&T. where he was assistant chief engineer before assuming his new duties for Pacific Telephone.

In his article "Services for Special Needs" (page 25), Dr. L. Holland Whitney points out that "the Bell System has felt a traditional sense of responsibility toward the handicapped, in terms of communication." Dr. Whitney himself has been actively committed to implementing that traditional sense; in his capacity as medical director of A.T.&T. he has worked on the Committee on Communication for the Handicapped, which both serves as a clearing house for, and guides the progress of, Bell System effort in this field.

"Communication can mean many things to the handicapped person," says Dr. Whitney. "It may mean an opportunity for a job in the outside world. It may mean the ability to work in a Sheltered Workshop. It may mean the opportunity to live and work in dignity at home.

"Adequate communication doesn't just *happen*. It requires research, knowledge and know-how of a team—physicians, therapists, engineers, nurses, teachers .... Their combined efforts can help not only the disabled, but often also the members of their families, to sign their own 'Declaration of Independence.' "

Dr. Whitney took his M.D. at the College of Medicine of Syracuse University in 1928. He engaged in the private practice of medicine in Brooklyn, N.Y., for about a decade, and later held various positions in industrial medicine. In 1948 he joined the Bell System as medical director of the New Jersey Bell Telephone Company, and on August 1, 1955, assumed the same post at A.T.&T.

Among his professional affiliations, he is vice president of the American Academy of Occupational Medicine and a member of its board of directors; a Fellow of the American College of Physicians, the American College of Preventive Medicine and of the Industrial Medical Association, the American Public Health Association and the New York State and New York County Medical Societies.

Although C. Earl Schooley's Bell System career has been devoted to engineering the physical facilities for telephone communication, his years of experience at managerial and executive levels have made him keenly aware of the need for understanding between people through oral communication. His article starting on page 33 underlines the importance of a candid interplay of ideas and opinions, both up and down the line, in maintaining the vitality of any organization.

Beginning as a student engineer in 1927 with A.T.&T. in St. Louis, Mr. Schooley progressed through a number of Engineering and Plant assignments there and in Kansas City, Washington and New York. During the past nine years he has served in a variety of executive posts, including those as chief engineer of the Southern Bell Telephone and Telegraph Company and vice president and general manager of the Indiana Bell Telephone Company. Since December, 1959 Mr. Schooley has been director of operations of A.T.&T.'s Long Lines Department.

L. Holland Whitney, M.D.

C. Earl Schooley

Kermit Rolland

Eugene Lapé

■ Kermit Rolland, author of "Whatever Happened to the Subjunctive?" beginning on page 46, is a professional writer and trainer of writers for both industry and government. He has written a number of articles, booklets and programs for the Bell System, including the booklet *Writing to Say What You Mean,* which had a circulation of a half-million copies a few years ago. He has also designed and conducted writing improvement programs for A.T.&T., the Bell Telephone Laboratories and Western Electric. The idea for his current article was suggested by years of experience in conducting business writing seminars.

After attending the University of Illinois, Mr. Rolland worked as a newspaper man in the Midwest and in New England. He served with the Signal Corps in New Guinea and the Philippines during World War II, then returned to writing, contributing articles and fiction to magazines in this country and in Europe. He is represented in a "best stories" collection; one was purchased for a motion picture in England.

Mr. Rolland's base of operations is in Princeton, N.J., where he is president of Scribe International, a company of professional writers serving clients both here and abroad.

■ In writing "Business Experiments with PICTUREPHONE Service," beginning on page 54, Eugene Lapé is on familiar ground. As assistant advertising manager—sales promotion, he is intimately involved in informing the business community of the potential of the new service through publicity media. Mr. Lapé points out that the sales promotion function grew with the Bell System's shift in emphasis from meeting postwar demand for basic telephone service to discovering and stimulating demand for new and additional services. The role of sales promotion and the author's part in it has grown with the development of new products and services, the necessity for isolating markets and the training and motivation of sales personnel in the Bell System.

Mr. Lapé completed his B.S. in Marketing at the School of Commerce of New York University in 1946, after four years as a naval aviator, when he saw action as a carrier pilot in the Pacific Theater. He did advertising and publicity copywriting for the Union Carbide and Carbon Corporation from 1946 to 1950, then worked in public relations, industrial advertising and publicity for the American Locomotive Company. He joined the New York Telephone Company in June, 1951 as a copywriter, and, after a recall to active Navy duty, returned to that company in 1954. He came to A.T.&T. in 1958, when the sales promotion group was formed.

in the news...

Excise Tax Repeal

Cable to Europe

Miami-Boston Cable

NORAD Communications

TELSTAR Beacon Turned Off

Telephone Quotation Service

Excise Tax Repeal

An historic moment for millions of telephone customers took place when President Lyndon B. Johnson signed a bill repealing many Federal excise taxes. Under the bill, the ten per cent tax on local and long distance telephone service will be reduced to three per cent next January 1, and shaved by one percentage point each January 1 until completely removed by 1969. Similarly affected is the ten per cent levy on teletypewriter exchange service.

In addition, the ten per cent tax on private communications services will be dropped next January 1. This includes PBX switching and stations and virtually all private line services.

The new law repeals a telephone tax that has been on the books in some form since 1932 when long distance service was taxed to help support government programs during the Depression. In 1941 the tax on local service was enacted for the purpose of wartime preparedness. Both taxes have been at the ten per cent level since 1954. Last year, communications customers paid almost $1 billion in Federal excise taxes.

For telephone customers, the benefits of the repeal will be automatic since excise tax charges have never been included in telephone rates. When the reduction takes effect, it will be reflected immediately in lower telephone bills.

Fourth Transatlantic Cable

The C. S. Long Lines, Bell System cable ship, began laying the fourth transatlantic telephone cable to Europe on June 18. First to link the United States with continental Europe, the $50 million cable system will stretch 3,575 nautical miles from Tuckerton, N.J., to St. Hilaire-de-Riez, France.

Scheduled for service next fall, the cable will have a capacity of 128 voice-grade circuits. More than half of these will be used for telephone message traffic with France, West Germany and other countries in continental Europe. The rest will carry data, tele-

Shore end of transatlantic cable streams off distinctive bow of C. S. Long Lines.

graph and other non-voice communications.

The C. S. **Long Lines** went into service in the summer of 1963. Last year, she payed out 10,360 nautical miles of deep-sea cable—more than any cable ship ever placed in a single year.

The cable will be jointly owned by the Long Lines Department of A.T.&T.; the French and German Ministries of Posts and Telecommunications; Western Union International, Inc.; ITT World Communications, Inc.; RCA Communications, Inc.; and Press Wireless.

Miami-Boston Cable

Plans for a super-capacity cable between Miami and Boston have been announced by the Long Lines Department of A.T.&T. When fully operational, the cable will add 32,400 circuits — funneled through 20 coaxial tubes—to the network serving the eastern seaboard. It will be the first major cable capable of handling so many circuits.

The blast-resistant route, including several branch cables, will represent a Bell System investment of $182,000,000. All cable, communications centers and amplifier stations will be underground and engineered to withstand natural disasters — floods, hurricanes and cyclones—and nuclear blasts short of a direct hit.

The route, which will avoid large cities and major target areas, will be built in two sections. The Miami-Washington, D.C., section is scheduled for service in 1967; the Washington-Boston section in 1968.

Long distance traffic out of Florida has been growing between 10-15 per cent annually and is expected to continue to rise well above the nationwide average of nine per cent. Existing microwave and cable routes along the East Coast will be operating at maximum capacity within the next three years. The new route will provide urgently needed circuits and will help insure the survivability of communications in this highly industrialized section of the country.

The system will include nearly 1,800 miles of coaxial cable; 900 auxiliary amplifier stations strung along the route in pre-cast manholes; and 16 communications centers to link the cable to the nationwide network. It will pass through 12 states: Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, New Jersey, New York, Connecticut, Rhode Island and Massachusetts.

Communications Stronghold

Deep within the granite tooth of Cheyenne Mountain, in the Colorado Rockies, men are hewing the nerve center for one of the largest communications complexes undertaken for national defense: the bombproof Combat Operations Center of the North American Air Defense Command. When the installation is completed next year, Bell System electronic switching systems will make the Operation Center the hub of a vast web of aircraft and missile detection networks.

Information received at the Center from these networks would signal any attack on the continent. From the Center, NORAD would alert retaliatory forces and civil defense agencies; it would direct the battle, deploy defensive weapons and maintain communications with Washington and other key points.

Built within the mountain, in a maze of chambers and tunnels will be eleven steel buildings mounted on huge steel springs to dissipate the shock of a nuclear hit, along with 1,300 feet of protective granite overhead. The entire complex is connected to the outside by two access tunnels which can be sealed off by blast-proof doors weighing 30,000 pounds each. If an attack came, separate water, food and power supplies would allow the Center to operate for many weeks.

The heart of the Center's communications will be the electronic telephone switching system. Specially trained teams of Western Electric and Bell Operating Company engineers and installers are creating a system that would insure communications for NORAD in the event of disaster. Unlike other private line Bell System networks, which transmit information over specific point-to-point routes, two-way communication from switching centers in NORAD's eight regions would continue to funnel into the Center over a variety of alternate routes, should one or more routes be destroyed. Electronic memory banks would automatically scan the network and select open paths.

W. E. installers inside granite tunnels of NORAD center in Cheyenne Mountain.

The Center's electronic switching system will be connected, through associated toll equipment, by multiple cable and microwave routes. For further diversity, these will be able to enter the mountain via several entrance points.

Transmission flexibility is only one feature built into the Cheyenne Mountain complex. Besides providing voice, data and Teletype® transmission, electronic switching equipment will permit unique features useful to the military. In emergency conditions, priority calls will be able to take over busy lines. Conferencing, another feature, will allow a number of parties to connect into the same conversation by selecting one of many pre-set conference arrangements. Other services to aid NORAD will include direct long distance dialing and telpak—large capacity channels for voice, teletypewriter, telephoto and other kinds of information.

TELSTAR Beacon Turned Off

On May 16, engineers at the Andover ground station announced that the Telstar® communications satellite had successfully turned off its VHF beacon and telemetry transmitter as scheduled. A pre-set two-year clock in the satellite turned off the beacon on the 4,736th orbit around the earth during a time when the Andover station was tracking the VHF beacon. Final confirmation that the beacon turned off occurred the following evening.

The timing mechanism was built into the satellite to turn off the VHF beacon transmitter so the 136-megacycle radio frequency could be used for other satellites. VHF signals are used by many satellites to transmit tracking and telemetry information to a world-wide network of tracking stations.

The experimental communications satellite's microwave transmitter, which is still in excellent condition, continues to be capable of transmitting telephone, television, data, and facsimile signals on command from the Andover ground station. Data on the condition of the satellite and its space environment, which the VHF tracking beacon has been sending to ground stations, will now be sent over the microwave transmitter.

Telephone Quotation Service

"Bid sixty-seven and one-eighth. Ask sixty-seven and a half." This is the language of men, money and markets—the Wall Street broker getting information for a customer on the "Big Board," the New York Stock Exchange.

By dialing four digits on his telephone, a broker can now get this information via "computer voice" in less than a second, directly from the trading floor. It's provided by a new service, based on the electronic marriage of telephone and computer.

The broker using the Exchange's Telephone Quotation Service gets information from a computer that will also feed the Exchange's ticker system. Data is available for any of the 1,600 stocks listed on the Exchange. The service is geared to handle as many as 300 calls at once from member subscribers, with no delays.

To obtain an immediate quotation on any stock, a broker simply dials the number assigned to the particular stock. Within a fraction of a second, the computer identifies the stock, locates the latest trading data, assembles the response from a recording drum vocabulary of 126 words (the computer voice) and sends it back to the inquirer.

Depending on message length, the Telephone Quotation Service is capable of handling up to 400,000 calls daily, providing bid-ask and last sale information. The average announcement time is six seconds.

Broker gets latest "Big Board" stock quotation with Telephone Quotation Service.

Special high-speed access telephone switching equipment, manufactured by Western Electric for the New York Telephone Company, links the Exchange's computing center with up to 1,000 direct private wire telephone lines. The crossbar-type switching equipment was specially tailored to meet the needs of the Exchange by telephone company engineers.

The Quotation Service uses Bell System Data-phone data communications equipment to convert phone dial impulses into code language the computer can accept. A computer then translates the language, through a Voice Assembler unit, into an audible message, which is spoken a split-second later.

The system is virtually errorless, in that the computer automatically checks all information processed. It is programed to question any item which is inconsistent with previous data, or which is otherwise unusual.

Fold Two-Mile Laser Beam

Bell Telephone Laboratories scientists have succeeded in folding a two-mile long laser beam into a ten-foot space.

The laser beam was reflected over a thousand times between two mirrors. Because the points of reflection on the mirrors do not overlap, information can be modulated into the light beam, stored, and retrieved 10 microseconds later.

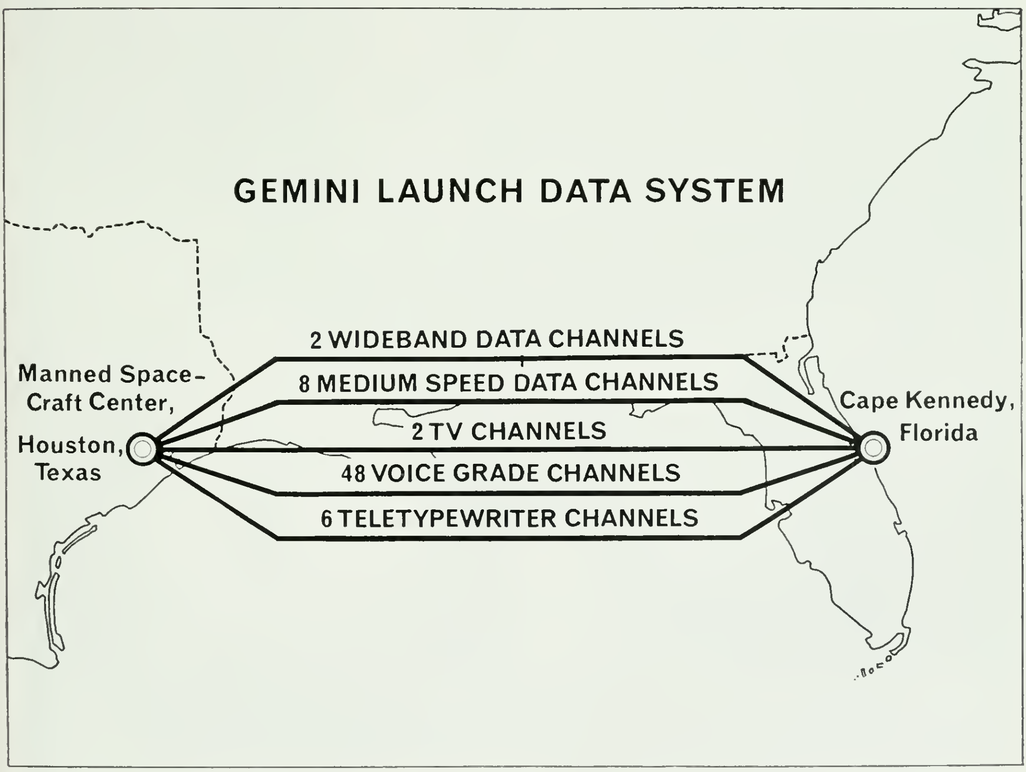
This experiment opens the way for optical delay lines used as high-speed, sequential, computer memories. An optical delay line of this nature could store 10,000 bits of information which could be read out serially, one bit every nanosecond (one-billionth-second).

Gemini Launch Data System

For the highly successful Gemini-4 flight by astronauts James A. McDivitt and Edward H. White, Cape Kennedy mission control was "shuttled" 900 miles to Houston over a broad communications expressway designed and engineered for NASA by the Bell System. Called the Gemini Launch Data System (GLDS), the expressway is a radio and cable complex of data, television, telephone and teletypewriter circuits that extends the mission control capabilities of Cape Kennedy to the Manned Spacecraft Center in Houston.

Gemini-4 flight functions handled over GLDS included checking out the spacecraft; controlling the launching; directing the booster engine as it lifted the astronauts into orbit; and maintaining command and control of the entire mission, from lift-off to touchdown.

Critical information needed for Gemini mission control—exercised for the first time by Houston—was funneled from the Cape into seven Houston computers over data channels that can handle more than 97,000 bits of information a second. Computers at Houston use the data to make constant flight contingency recommendations, predict



Gemini Launch Data System, designed and engineered for NASA by the Bell System, extends mission control capabilities of Cape Kennedy to the Manned Spacecraft Center in Houston.

flight paths, determine time to start re-entry and forecast the capsule's impact point.

Mission data is converted into visual presentations by Houston's Display Control System. NASA's flight directors see the information on large screens within half-a-second after it is received. The Gemini Launch Data System also provides closed-circuit television channels for face-to-face contact between flight controllers at Houston and back-up teams at Cape Kennedy. In addition, the system includes 48 voice circuits and six 100-words-per-minute teletypewriter channels.

The Gemini Launch Data System is part of a 225,000-mile global tracking and communications network, for which the Bell System is the major supplier and assists in the overall coordination, used by NASA to control manned and unmanned space missions (see **BTM**, Spring '65, p. 64).

Telephone with Headset

Busy people who must handle paperwork and phone calls at the same time will get help with a new telephone now being made by Western Electric. The instrument looks like a standard Bell System desk set, with one important difference: it has a jack into which an operator's headset can be plugged. Use of the headset frees both hands for typing, searching for papers or any other business that might be conducted while on the phone.

The new phone is expected to be a help to thousands of heavy telephone users. It will be especially useful to secretaries, order clerks, newspaper reporters and others who need both hands free while phoning. It will also be useful for those with motion handicaps (see p. 32).

New telephone with plug-in headset makes it easier for people who must handle paperwork and phone calls at the same time. Button switches phone from handset to headset operation.

When the headset is not in use, the phone operates like any other. Turning a button above the dial switches the phone from handset to headset operation. A push of the button signals the operator or regains the dial tone.

Lower PICTUREPHONE Service Rates

■ Lower rates for the Bell System's Picturephone see-while-you-talk service went into effect June 10 on calls from Picturephone calling centers in New York, Chicago and Washington, D.C. The new rates are $8 for the initial three-minute period between New York and Washington, $10.50 for the same period between Chicago and Washington, and $13.50 between Chicago and New York.

The revised rates are one-half the original charges. They will make it possible to explore the market potential and to determine customer reaction to the service at the reduced rate level.

Picturephone centers are located at Grand Central Terminal in New York, the National Geographic Society Building in Washington and the Prudential Insurance Company of America Building in Chicago.

"Memory Services"

■ Plans have been announced for an interdepartmental evaluation of the marketability of "Memory Services" for the residence and non-PBX business markets.

The tremendous potential of electronic switching has stimulated parallel development work in electro-mechanical offices. This development has progressed to a point where technical feasibility is assured; what remains to be determined is marketability.

The objective of the plans is to determine the feasibility of eventually offering Memory Services in all types of central offices. The six services under consideration are: Call Waiting, Abbreviated Dialing, Add-On Conference, Dial Conference, Automatic Transfer, and Pre-Set Automatic Transfer.

A market trial of the six Memory Services will be conducted in Sioux City, Iowa, and Wellesley, Massachusetts, both of which have Touch-Tone® calling. The service starting date is planned for the first quarter of 1966.

Broadly, the market trial will determine: saleability of the service at rate levels necessary to support an across the board offering; market potential for two package offerings—one for business and one for residence customers; future central office capacity requirements for Memory Services; how Touch-Tone telephone users will react to the services; the validity of product trial conclusions, and guide lines for central office forecasting.

Service to Liberia

■ The opening of radiotelephone service with Liberia has been announced by the Long Lines Department of A.T.&T. The new service, bringing the west African republic in telephone contact with the United States for the first time, will be routed between New York City and Monrovia, capital of Liberia.

With the addition of Liberia, any of the 90,000,000 telephones in the U.S. are within reach of 186 countries and territories throughout the world—or over 97 per cent of the world's telephones.

The rate, exclusive of tax, for a three-minute call to Liberia from any point in the United States is $12 on week days and $9 on Sunday.

Electronic PBX

■ An 800A Electronic PBX has been cut into service for a department store in Philadelphia in a Bell Laboratories technical trial. The 800A PBX is designed on a modular basis for economical growth up to 80 lines, light to heavy traffic, and is capable of supplying a wide range of service features. The unit placed in service in Philadelphia is a 60 line, heavy traffic system.

Western Electric is expected to have the 800A PBX in standard production in 1966. This is the second electronic PBX switching system, the other being the 101 ESS which is used for larger installations.

Type 5 DATASPEED Service

Type 5 Dataspeed tape-to-tape transmission service is now available, the newest addition to the Bell System Dataspeed service offerings. In 1961 the Bell System introduced Dataspeed service, Type 1, which enabled business customers to transmit data recorded in punched paper tape at 1,050 words-per-minute, more than ten times faster than regular teletypewriters. Type 2, an updated version of Type 1, came along early in 1963.

Type 5 Dataspeed service differs from Types 1 and 2 in that transmission is at 750 wpm and in a simpler fashion. This makes Type 5 senders less expensive to build and, therefore, permits a more economical service for the customer. This new service will be particularly attractive in systems requiring many sending locations, but few receiving locations.

W. E.'s Newest Plant

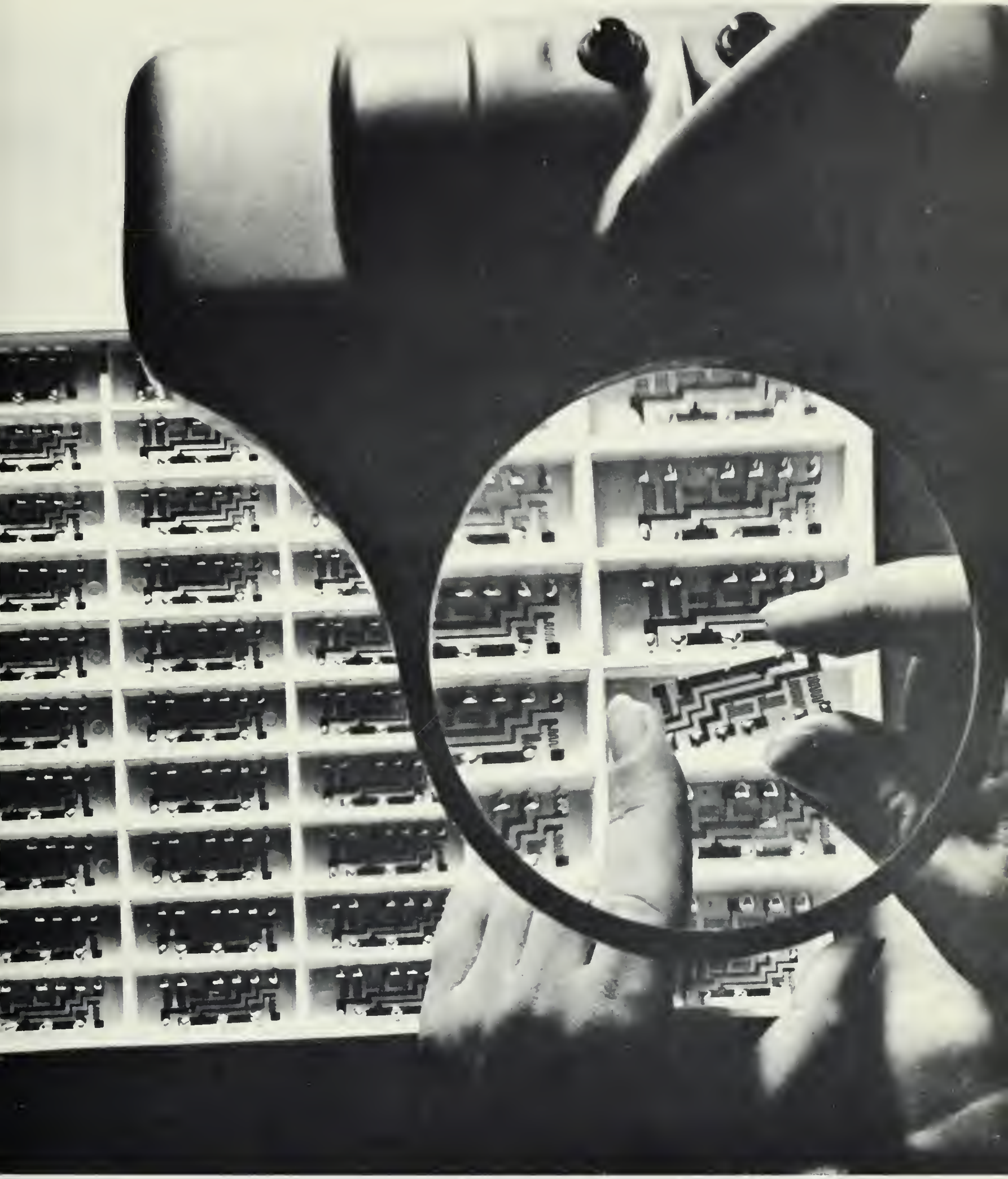
Four days after hiring the first production employee, Western Electric's newest plant was turning out its first telephones.

The sets were only slightly newer than the plant's fixtures. Workmen were still completing the transition from warehouse to manufacturing facility when the first 17 women started their initial day of work at the new pilot plant in Shreveport, La.

Engineers had estimated that they would produce about 100 key-type telephone sets during their first week at the unfamiliar work. At week's end the assembly line, set up and supervised by six men and women on loan from Western's Indianapolis Works, had turned out 1,494 sets.

Plans to locate a plant in Shreveport were announced January 25. Leasing of the plant space was announced March 2. The first telephone was assembled on May 3.

Many kinds of work started right away at Western Electric's newest plant in Shreveport, La., including instruction for these trainees, already at work on a tool-making course.



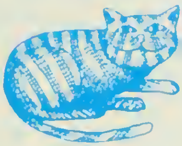
Present and future needs of the Bell System require the precision manufacture of smaller and smaller components by Western Electric, the Bell System's manufacturing and distributing arm. Here, thin film circuits, which offer great advantages in miniaturization, are thoroughly inspected under high intensity light and magnification at Western Electric's Allentown, Pennsylvania plant.

OUR CURIOUS WARS WITH THE ANIMAL WORLD

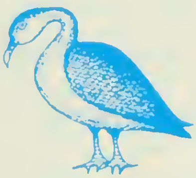
(In defense of your telephone service)

Ever since the telephone business began, birds, beasts and insects have been doing their best to disrupt it. The struggle never ends. Here are a few of the many amusing skirmishes.

A belligerent Minnesota moose butted down a telephone pole. Another tore out a mile and a half of line serving a forest fire station. We put in tougher and taller replacements!



An Illinois cat kept chewing the spring cord on her owner's phone. We pleased everybody by providing a piece of *old* spring cord the cat could safely chew on.



A hungry goose in North Dakota pecked the long worm that ran up the side of the house until he cut it through. We just hope he doesn't bust his beak on the *new* telephone wire!

Prairie gophers have tough teeth and an insatiable appetite for the lead sheathing on buried cable. We *think* our new steel-jacketed cable is gopher-proof.

We try hard to win each little war. In these and many more important ways, we do our human best to bring you good service—service so free from trouble that most people take it for granted and can't remember the last time they had to have a phone fixed!

Bell System
American Telephone & Telegraph
and Associated Companies

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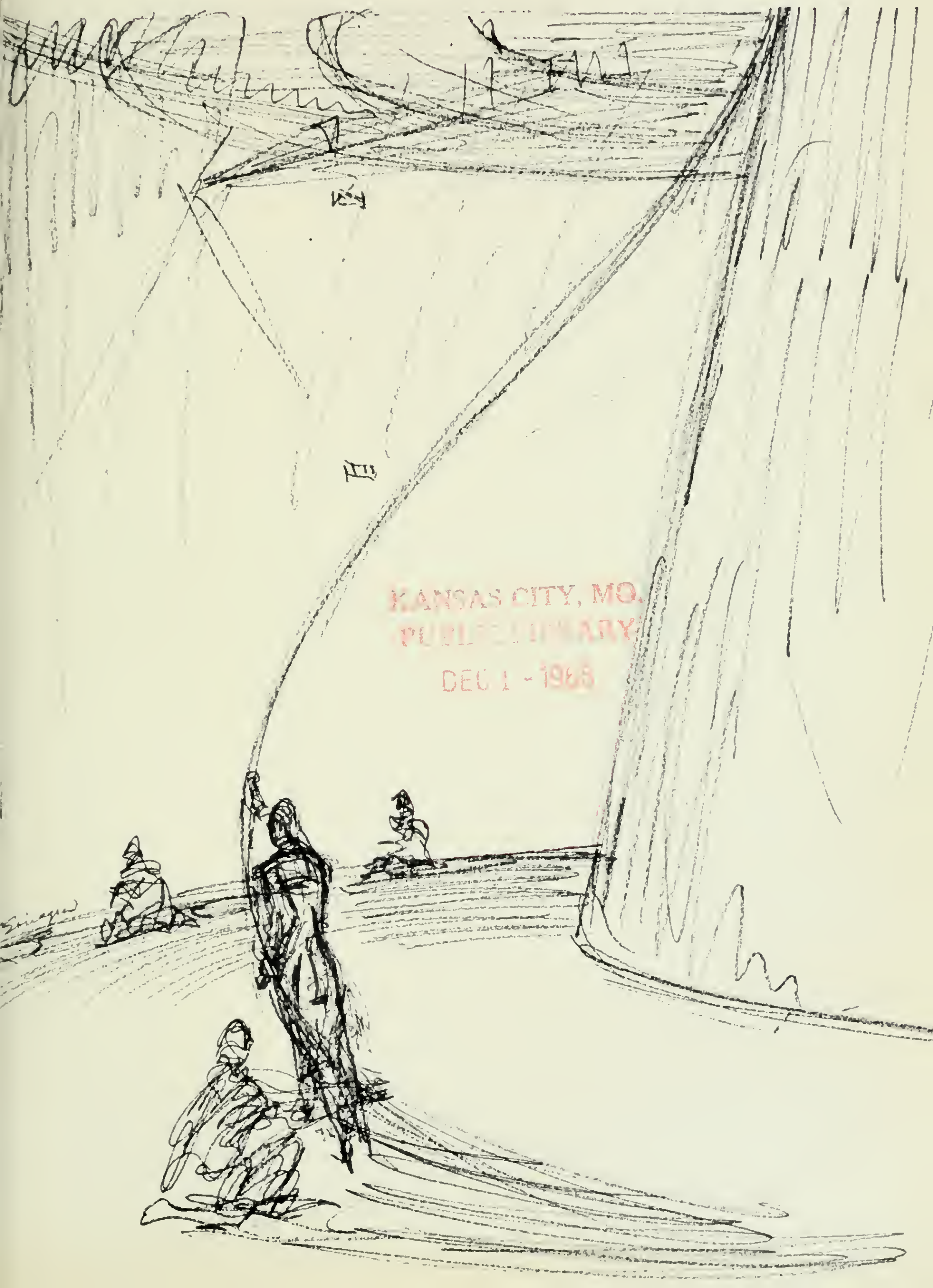
BELL TELEPHONE MAGAZINE

AUTUMN 1965



BELL TELEPHONE MAGAZINE

Published for the Bell System by the Public Relations Department, American Telephone and Telegraph Company, 195 Broadway, New York, N. Y. 10007 Area Code 212 393-2410

VOLUME XLIV ▪ NUMBER THREE ▪ AUTUMN 1965

This magazine is published to present significant developments in communications and to interpret Bell System objectives, policies and programs for the management of the Bell System and for leaders of business, education and government.

Cover:

This striking sketch by Attilio Sinagra, the artist whose work appears in the portfolio "Long Lines in Action" on page 25 of this issue, dramatically catches the action of the men who coil undersea cable as it is fed into cable tanks on the Bell System's cable ship, C.S. Long Lines.

In this day
of automation,
concentration,
the spreading
megalopolis,
it is more important
than ever
to keep alive
the human touch
between the
telephone company
and the
public it serves

New Dimensions In Customer Service

Lee C. Tait, *Assistant Vice President*
Operations Department, A.T.&T. Co.

■ THROUGHOUT the nation today we're sensing changes in the attitudes, the standards of the people we serve. Our customers are becoming more sophisticated, better educated, with wider interests, broader horizons. They're more critical and articulate; their standards are higher. They take good telephone service for granted. They *expect* to be able to dial a call spanning 3,000 miles, to reach one—and only one—of over 84 million telephones in about half a minute, to be able to hear as well as they do on local calls, and finally, they expect to be billed accurately and promptly with a legible, easily-understood—yet detailed—bill. *All* of our customers seem to want to talk to more and more people longer, farther away, more often. The increasing convenience, speed, reliability and lower cost of our services today are making it easier for them to do just that.

Inevitably—with growing use of telephone service and the introduction of new products, new services and wider calling areas—go bigger problems. Our negotiations with customers are becoming longer, involving a wider range of subjects. The installation and engineering problems, too, are becoming more complex. All of this means that we need more and more capable people with a higher state of training, better supervision, better, more efficient methods. Just keeping pace with expanding needs alone is a big job, and our "standing still" costs are going up every year.

But we are not satisfied with standing still. What, then, are some of the things we are doing to solve our service problems? What are we doing to meet these new challenges that appear, like the rising sun, with each new day? Let us look at some of the things we're putting into effect now to answer those questions.

The logical place to begin is with the first point of contact: with the customer's call to the business office. We serve a highly mobile population—people moving to new cities, new jobs; calling us to

"We must make it easy for customers to reach us, to do business with us."

change, connect, disconnect their service. All together, they make more than 122 million calls a year to our business offices. We *must* make it easy for customers to reach us, to do business with us. And we can be certain that they will not be satisfied with a lower grade of service at their new location than they had at the one they left. Our service must be consistently and uniformly high, *wherever* they may move.

When they arrive at their new home, telephone service is probably one of the most important things to have working immediately. By way of making it easy for the customer to have his new telephone service as soon as he wants it, we are working on a plan which is somewhat like the "Call Ahead" service offered by many hotels and motels. Having the telephone business office in the area he's leaving contact the office in the area to which he's moving saves the customer the trouble of hunting us up and starting from scratch on arranging for service in his new home. He's *expected* when he arrives, even though he may not yet have a definite address. He doesn't have to worry about going to the new business office to make a deposit or advance payment at a time when he has a hundred other things on his mind; all details of his service, including his credit standing, have been relayed from the telephone office where he formerly lived.

Business customers are just as important to us and they must be able to reach us easily, too. There are now over 25 million contacts a year with owners of businesses; their communications needs are expanding. What is the Bell System doing to improve service to these customers? We have some 6,500 communications consultants knocking on customers' doors to offer technical help in solving their business problems through efficient, adequate communications service. These consultants make a complete analysis of each customer's business operations—purchasing, administration, production and distribution—and tailor their recommendations to fit the customer's specific problems and needs. They *seek out* the customer; the business offices, on the other hand, are responsible for handling the "demand" contacts which are best done by telephone.

The Business Office Concept

In the early 1930's, Bell System management recognized the need for a place where customers could easily reach a fully-trained representative of management who was capable of handling a wide range of company matters without having to pass the customer from employee to employee or from department to department. The resulting organization worked well and offered great flexibility.

In 1960, some departures were made from the original concept in an attempt to find an effective way of handling growing business order demand and high force turnover. This Business Office Organization Plan, as it was known, had the effect of fragmenting the service representative's job and centralizing certain functions. The Plan, however, proved to be unwieldy in many locations and clashed with the fundamental objective of satisfying the customer's request in one place and with one contact. As a result, some of the Bell Operating Companies began to experiment with other organizational arrangements.

In 1964, a System-wide task force was formed to study busines office organization. The findings of the study have essentially reaffirmed the soundness of the business office organization as it was originally conceived. It calls for re-establishment of the service representative's responsibility and authority to speak for all departments; it also recommends restatement of business office objectives and standards of performance. The business office is the connecting link between the customer and the company. What service representatives say, how they say it and what they do have a major influence on the customer's confidence in the company. A service representative must accept complete responsibility for actions—even failures—of other departments, and take action on her own to insure customer satisfaction. And other departments must recognize her authority to speak for them and to make decisions in the customer's behalf.

A touchstone of business office organization is the principle that it must be responsive to local community considerations—a principle which can best be achieved by locating offices in or near the communities they serve. If a customer wants to talk with us face-to-face, we should be conveniently available so he can do just that.

Customer Contacts

Each contact with a customer—residence or business—should be regarded as an opportunity to demonstrate the company's genuine interest, helpfulness and competence—an opportunity to make a positively pleasing impression. The contact should be handled so that the customer will recognize that his request is clearly understood, his viewpoint appreciated, and that a sincere effort will be made to be truly helpful. The service given by the business office must be accurate, complete, prompt and dependable. This means that:

- The customer should reach promptly a responsible person who can help him with a minimum of delay.
  Customers should be able to complete their transactions *on the initial call* to the business office. They should not have to call several times or to several places for answers to their questions or solutions to their problems.

- Information given customers should be correct and complete; they should always be given a clear understanding of what can be done for them and when it will be done. Explanations therefore should be easily understood, and be given courteously, reasonably and fairly. Promises made to customers must always be kept. Service orders, adjustment vouchers, notifications to other departments and all other work required to carry out arrangements made with customers must be accurately and promptly completed.

- When service representatives have to hold the customer on the line to consult records, other departments, etc., the time he is required to wait should be kept to a minimum. Although sales effort should be an extension of the service job, it must be made with

"We must provide the tools and environment so that our service representatives can concentrate on . . . this important job."

intelligence and tact to avoid leaving the false impression that we are merely interested in sales; *service* still is the business office's reason for being.

- When it is necessary to take action to obtain payment of money due the company, collection effort must be made with the least possible irritation to the customer. We must exercise extreme caution to avoid taking action when special arrangements have been agreed upon with the customer or when payments have already been received.

Obviously, our service representatives are providing a most important customer service function. They regularly are negotiating telephone business with our customers. Clearly, this takes competent, well-trained people. We must do all we can to provide the tools and environment so that our service representatives can concentrate on the essentials of this important job.

Behind the Scenes

Once our customers—business or residence—have reached us and have transacted their business, our work is just beginning. We have to issue orders and arrange for work to be done on time, up-date our records and finally see that the customer is accurately billed for the service or equipment he has ordered. In this day when change is accepted as a way of life, we are developing new techniques to handle this mounting burden of essential work behind the scenes.

Fundamental in these new techniques is the Business Information System (BIS). A number of the Bell System Companies now are using computers for such things as rating long distance calls, preparing customer bills and treating customer accounts. The Customer Records and Billing phase of BIS was first introduced on a trial basis at Conshohocken, Pennsylvania in December, 1960. Today over 11 per cent of our customers have the benefits of mechanized billing and collecting, with 43 per cent scheduled for conversion to this new system in the next three years. It might be helpful here to summarize some of the features of computerized Customer Records and Billing (CRB):

- CRB treatment procedures—transfer of many clerical and minor decision-making operations to the computer.
- Daily computer updating of all billing media—payments, adjustments, toll charges, service orders.
- Direct service order input to the computer.
- Computer rating of service and equipment.
- Computer billing of all accounts, including semipublic telephones, government services and private branch exchange.
- Combined bill and statement of toll charges.
- Computer computation and preparation of "other charges and credits" statements.
- Prompt issuance of final bills.
- Possible continuous billing when customer moves.

- Single record of the customer's service and equipment, prepared and maintained by the computer.
- Management data, such as reports, summaries, etc.

In those companies where the billing and collecting job *is* being done by machine, it is a "batch" type of operation. That means that the machine is started on its way to perform certain functions in sequence until the job is completed or until the machine is stopped. This works very well for billing and collecting, but there are other things a machine could do for us if we could feed into it diverse information, have it acted upon, and were able to interrogate the machine. This is known as a random-access or real-time computer—which will enable us to think in terms of a Business Information System (See *BTM,* Summer '65, p. 2).

Essentially, this is a method of storing in computer memory all information about a customer's account: name, address, service and equipment, treatment data, billing history, toll calls, etc. When any employee with appropriate access equipment in any department wants to interrogate the machine, the needed information will be immediately available.

When computers were first used in business, people had to read source documents and the information to be stored or processed was punched into cards. For efficient direct input, we recognized that we needed a service order document which could be prepared and fed into a computer without having to prepare punched cards—which is a slow, laborious and costly process.

The first such order we developed and used gave the machine instructions by very exact positioning of information (called "formatting") on the order; this is known as a "fielded" order. It served its purpose, but the order is difficult for people to read and process. We have now evolved a simple service order form which is easy to type, can be read by people *and* by machines, and can be used for direct input to the computer. The Bell System Companies are beginning to adopt this form, known as the Universal Service Order.

Next year, the Ohio Bell Telephone Company will start using a real-time, on-line, random-access computer to receive service order information directly from the business office, reach into the master file for related information and re-format each order so that each department will receive only that information it requires to do its job. The advantages of such a system are obvious: to the customer in speed, convenience and accuracy; to the companies in efficiency and operating economies.

With such new developments and techniques advancing rapidly toward us over the horizon, these are indeed exciting times to be in the communications business. And these shapes of new things to come are a mixture of the exotic and what has been affectionately called Plain Old Telephone Service. It seems that we need quite a bit of both to meet these changing times. As human activities constantly become more diverse and at the same time more specialized, it is clear that communications must follow in kind—indeed, must lead in increasing speed, scope and imagination.


New shape, new size, new convenienc
another step in the continuous evoluti
of the telephone produces "the phone
the future in the palm of your hanc

INTRODUCING:

The *Trimline®* Telephone

Charles J. Sentenne, *Staff Representative,*
Marketing Department, A.T.&T. Co.

■ SINCE THAT March day in 1876 when Alexander Graham Bell's original transmitter first carried a spoken sentence, the history of the telephone has been a story of recurrent change and improvement. With technical improvements—audible but usually not visible—have come changes in the shape and size of the phone itself: changes that have made it more attractive, more convenient to use.

The latest of these to reach the customer is the Trimline* dial-in-handset phone, so-called because the dial, receiver and transmitter are all built into one small, graceful unit which is easily held in the hand. Created by Bell Laboratories with the collaboration of the famous industrial designer Henry Dreyfuss, the new phone has a lighted dial which "comes to you" making for easy calling, especially from bed or an easy chair. It also has a "recall" button in the handset; this breaks the connection and enables the customer to make a series of calls without having to replace the phone on its base. Since the dial is in the handset, wall or desk models can be put in unusual but convenient places—beneath a cabinet or counter for example.

People in several areas of the Bell System are now enjoying the convenience of the Trimline phone, and in the next 18 months those throughout the rest of the System will have a chance to use it.

■ Actually, the idea of a dial-in-handset telephone has been evolving for some time. The basic principle has existed for many years in the test set used by Plant Department men. The road from the prototype to a compact set commercially feasible for general use has been long, however, and not always smooth. As far back as 1948 Bell Laboratories built a model—which remained only a model, because at that time simply meeting the demand for basic telephone service was the primary mission of the Bell System. About ten years later, engineers were asked to come up with a

Sculptured elegance of Trimline phone makes it appropriate for use anywhere.

* Trademark of the Bell System

Light-weight Trimline phone has dial in handset, making dialing easier, more convenient.

Trimline® Telephone

compact, dial-in-handset phone which would be technically practical and would have enough "style" to be field-tested. Nicknamed the "Demitasse" by its designers, this set was tested on a limited basis in Brooklyn, New York, San Leandro, California and Columbus, Ohio. Verdict: the public liked the concept but not the style.

A year later, in 1959, a redesigned model with a light in the dial, a new shape and a new nickname, the "Schmoo," was tested in New Brunswick, New Jersey. Once again, there was an enthusiastic reception for the idea, but anyone who remembers the comic strip namesake will understand why trial customers in New Brunswick said the set was too bulky to be practical.

A variety of shapes and designs then came from the drawing boards. Engineers tried to shrink the dial by making the holes smaller, but the size of the average human finger put a practical limit to that effort. Dials having spokes rather than holes were tried, but tests showed that people tend to dial elliptically, and so fingers slipped too easily out of spokes.

■ The solution finally was to reduce the diameter of the dial by eliminating the space between 1 and 0, which was accomplished by designing a movable finger stop. This at first was greeted with some skepticism by people at Bell Laboratories, who feared that the telephone user might have a sense of uncertainty and insecurity with a finger stop which moved with the dial. However, repeated tests with the new dial showed that people were not even aware that the stop was moving.

■ In 1961, two new, narrower, streamlined models were tried, this time in Richmond, Virginia. One of these with rounded, curving lines was called the "Contour;" the other, having spare, straighter lines, was offered as the "Trimline." Customers liked both, but favored the latter insofar as appearance and handling were concerned. Bell Laboratories went to work to perfect the new set internally: both transmitter and receiver were redesigned to reduce their size and printed circuitry was used for the first time in a telephone. The ringer was miniaturized to fit into the base which held the phone when it was not in use.

By 1963, customers in Royal Oak, Michigan had a chance to try the latest Trimline phone, now a completely self-contained dial-in-handset instrument. Public approval was enthusiastic from the beginning; people particularly appreciated the new phone's "recall" button, mentioned earlier. Later on in 1963 the Trimline phone was tested again, with a

Near dial is a recall button which allows you to make call after call without hanging up.

five-month sales campaign, in Jackson, Michigan and Janesville, Wisconsin. Results were very heartening for designers of the compact telephone. During those five months Trimline phones achieved a development of 3.1 per cent of the entire residence market in the two cities; sales of residence extension phones increased by 18 per cent in the same period.

■ The Trimline compact telephone, as is the case with many other successful new products, has traveled a long road of design, trial, re-design, more trial—and the end is not yet. Last July, a product trial was completed in Chicago, this time incorporating the convenience of Touch-Tone® calling in the Trimline phone, with small push-buttons in place of the dial. Manufacture of this newest version of the Trimline phone should be under way by mid-1966.

And so the evolution of the telephone continues. The direction of this evolution will be determined, as it has been in the past, by the customers themselves: by their needs and desires for new convenience, new designs, new services.

Three stages of the new phone's development show the telephone installer's test handset, the early "Schmoo" version with standard-size dial and the present-day Trimline handset.

Time and the Triangle

Clifton W. Phalen, *Chairman of the Board,*
New York Telephone Company

Goals set this year by the Telephone Pioneers of America promise broader opportunities for individual satisfaction and meaningful service to the communities in which Pioneers live and work

■ "TIME," said the wise man, "waits for no man."

If this were meant as a caution, it is little heeded in normal living, since many people squander time recklessly. But circumstances sometimes impose the need to count the value of minutes and the means to use them. This year, faced with the responsibility of generating ways and means for its members to best utilize precious time, the Telephone Pioneers of America is taking an objective look at time itself, and measuring its worth in human value.

Time and the Triangle

In September, the Telephone Pioneers met in Atlantic City for their 40th Annual Assembly. Delegates from the 71 Chapters conferred for three days, exploring the convention theme "Goals for Growth." Recognizing that the setting of goals is essential to achievement, the conferees dealt with the problem with enthusiasm and wisdom. They developed objectives and programs designed to enable all members to participate in educational opportunities and community service activities. These programs are sure to produce important results in the years ahead.

Attending this Assembly, to assist and support the conferees, were Frederick R. Kappel, chairman of the A.T.&T. board of directors, H. I. Romnes, president of A.T.&T., and many other Bell System officers. Also attending was George S. Beinetti, president of the Rochester Telephone Corporation.

■ Back in 1911, when Pioneering began, telephone industry veterans wanted to spend more time together, reminisce about the business, and have fun. But, as the years passed, the Pioneers extended their scope. Instead of just spending time together, they decided to invest some of it in their own betterment. And eventually, seeking greater fulfillment, they set about sharing their spare time with others in community service activities.

When Telephone Pioneers do anything with time, the results are likely to be impressive, since there are nearly 243,000 members. Separated into 12 geographic divisions, with more than 1,000 units, reaching from the Gulf of Mexico to Hudson Bay and from coast to coast, Telephone Pioneers draw their membership principally from the Bell System. Only those employees who have attained 21 years of service are eligible to join. Nearly 95 per cent of those eligible have joined. At present, 60 per cent of the members are active employees, 40 per cent are retirees.

The Spirit of Fellowship of the founding Pioneers has never waned. The warm personal feeling that brought the Telephone Pioneers of America into being has, through the years, sparked the development of a well-rounded Fellowship program. Present-day Pioneers organize bowling leagues, arrange theatre parties, cruises and flying trips abroad. They run dinner-dances, have clambakes, and get together for nights-at-the-ballgame. The countless activities indicate the continuing desire of Pioneers today to spend time with each other.

But, while Fellowship thrives, and is important, it is by no means the sole purpose of Pioneering. The use of time has been planned in many other ways.

Pioneers invest their extra hours in personal development through an expanding educational program that offers courses in Public Affairs, Pre-Retirement Planning, Effective Speaking, and a variety of other subjects. Pioneers also invest their extra hours in each other—by visiting sick members, keeping in touch with the bereaved, maintaining contact with retirees. And, in addition, a growing army of Pioneers dedicate themselves to their fellow man by giving their spare time to an imposing range of community service activities in hundreds of localities across the United States and Canada.

■ Pioneering has always enjoyed the enthusiastic endorsement of telephone industry top management. Such support is not surprising, in view of Pioneering's broad values.

When co-workers and their families spend week-ends and vacations on trips and tours, spend evenings together studying rapid reading, or discussing art and music, it is because they find personal satisfaction and pleasure in each other's company. Such satisfaction and pleasure overlap onto the job. This, I am con-

Pioneers discussing a display of their present community service activities at this year's General Assembly. The future promises broader opportunities for these and similar services.

vinced, is good for individuals, for society, and for the business.

When Telephone Pioneers send cards to sick members, visit homes, make telephone calls, and comfort the grieving, they reveal themselves as humane people. Such inbuilt solicitude for members generates solicitude among other coworkers. This, too, is of value to all.

When Telephone Pioneers go out into communities and share their sight with the blind, when they share their hands with the physically handicapped, when they share their minds with the mentally retarded, they not only help those in need, but they build a warm image of the telephone man and woman in the community. This, too, is good for the individual, for society, and for the business as well.

But the most important measure of Pioneering is its value to the Pioneer himself. The symbol of the Pioneers—a Triangle—pledges the organization to Fellowship, Loyalty, and Service. These Purposes are the cornerstone on which all activities rest. To the Pioneer who is still an active employee, the Triangle promises valuable associations and activities. And it promises continuing, and even more valuable help to him when he reaches the sometimes difficult period of the later years when he must adjust to a life of retirement.

During pre-retirement years, Pioneers offer classes to members and spouses on subjects especially important at that period: money management, insurance and investments, the handling of personal affairs. Hobbies are always encouraged, and are of special interest to those facing increased leisure time. Pioneers approaching retirement know that in addition to Fellowship programs, there are art instruction classes, ham radio groups, and other activities to share. In addition, local Pioneer units are located all over the United States and Canada, so the retiring Pioneer who decides to relocate, can be confident of finding other Pioneers wherever he goes.

At a time when business in general searches for ways to help mature employees adjust to non-working years, the

Time and the Triangle

Telephone Pioneers of America is unobstrusively finding the way to do it.

■ Until recently, we were fortunate to share time in history with that grand old doctor, Albert Schweitzer. During his ninety years, he left a valuable legacy of good deeds, as he worked with the sick, the unwanted, the neglected. Human problems were never remote to him. He once said: "That everyone shall exert himself in that state of life in which he is placed, to practice true humanity towards his fellowmen, on that depends the future of mankind. Enormous values come to nothing every moment through the missing of opportunities, but the values which do get turned into will and deed mean wealth which must not be undervalued."

The society of the world today depends upon service organizations like the Telephone Pioneers to take opportunities, turn them into will and deed, and create a wealth of humane endeavors and accomplishments. We would be sore-pressed today if it were not for these organizations that ease the burdens of the underprivileged, and perform the humanitarian deeds that are needed but neglected. Pioneers themselves have a proud record of repairing talking book machines, promoting the use of seat belts, rolling bandages, getting-out-the-vote, and taking an interest in communities.

But their achievements have been less than their capabilities, because their goals have not always been specific. This has been a handicap to the full realization of the Association's potential. But now, convinced of the interest of all the membership in community activities, convinced of the need and the desire of all communities for their services, the Pioneers have set goals for themselves and pledged themselves wholeheartedly to community service work.

Brailling text books for children is an important Pioneer community service activity. Here, Pioneer ladies learn about the possibilities of a new kind of Braille duplicating machine.

Goals for the years ahead, in terms of new educational programs and new opportunities for community service, were explored in meetings such as this at the recent General Assembly.

■ Within the next ten years, over 200,000 additional people will attain 21 years of service, and will become eligible to join the Pioneers.

These young employees are part of a generation that is currently struggling to evolve a new system of values, which attaches less importance to outward symbols of success, and more importance to inner satisfaction. Instead of indulging in the conventional pastime of "Keeping up with the Joneses," more and more people are seeking to satisfy what one sociologist has labeled "the Inner Jones."

"Inner Jones" is interested in self-development, in being better today than yesterday, in helping others and thereby enriching his own spirit. Pioneers with an "Inner Jones" urge are very much aware of the needs of society, and capable of responsible action. They need only the opportunity to turn the will into deeds of valuable service. We feel the Telephone Pioneers of America can help provide them with that opportunity.

The years ahead are important. By 1975, the Telephone Pioneers could number 405,000 members. The immediate aim is to take vigorous steps to set specific objectives, to organize to meet these goals by specific dates, and thus give assurance to present and new potential members that Pioneering will guide them into worthy and rewarding efforts.

The possibility of an organization of 405,000 community-conscious Pioneers by 1975 is exciting. With the establishment of long-range plans, and the permanent adoption of goal-setting as part of Pioneer administration, this vast family of Telephone people can be of unlimited community benefit. For example, if these hundreds of thousands of Pioneers got behind a nationwide program to teach and preach traffic safety, imagine what good that could do.

Telephone Pioneers know that time, indeed, "waits for no man." And so Pioneers utilize time in the best tradition of their Triangle—for Fellowship, for Loyalty, for Service. That will never change. And we are confident, that as they organize to achieve their goals, they will find more and more opportunities to turn will and deeds into a wealth of community services that will produce value not only for today, but for the future.

How can we best evaluate an individual's strengths and weaknesses relative to management skills? Techniques used in the Bell System assessment program are helping to answer this basic question

Assessment Centers Help Find Management Potential

Cabot L. Jaffee, *Personnel Research Analyst*
Personnel Relations Department, A.T.&T. Co.

■ IT ALL STARTED back in 1956 when Douglas W. Bray, now Director of Personnel Research at A.T.&T., began a long-range "Management Progress Study" designed to investigate the factors which determine the progress of young men in management.

Candidate pores over individual exercise.

A major aspect of this study involved the use of a number of techniques designed to assess the individual's skills on a number of tasks. These included interviews, paper-and-pencil tests of abilities, observations of behavior in groups under stress, an individual work project, and specially constructed tests of personality.

The first assessment center of the Management Progress Study involved college graduates recently hired by the Michigan Bell Telephone Company and was held in that state during the Summer of 1956. After witnessing the assessment center in operation, management people in the Michigan Company questioned whether a program of this type might assist in the selection of Plant Department first line foremen from the ranks of their non-management employees.

In September of 1958, W. G. Garrison, general Plant personnel supervisor, working with the help of Mr. Bray, set up an assessment center in Detroit. This assessment center was modeled after the Management Progress Study Center but did not employ techniques which required professional staff members.

Lest we credit ourselves with the first use of situational techniques to assess people, let me quote from Judges, Chapter 7, which may be the first written report of an "assessment center," when the Lord provided Gideon with a means of choosing the best among his men. "Bring them down unto the water, and I will try them for thee there. . . . Separate every one that lappeth of the water with his tongue, as a dog lappeth, him shalt thou set by himself; likewise every one that boweth down upon his knees to drink. . . ." By choosing the 300 men that bowed down upon their knees to drink rather than those that drank like a dog, Gideon was able to select a superior force by use of a situational technique. Granted the techniques have been refined somewhat since then but the basic thought remains: accurately choose men who have the needed skills, and so may do the required jobs. Sometime after "Gideon's center," the O.S.S. used a number of situational tests to select personnel during World War II, and it appears that the term *assessment center* became a part of the language of psychology during this period.

The use of personnel assessment has grown in the Bell System since 1958 and presently 14 companies are running some 50 centers, for both men and women, and assessing 6,000 candidates yearly for a total to date of 16,000 non-management people assessed for promotion to management. As a correlative of these figures almost 3,000 management people have served on the staffs of these centers and have received valuable training which they might also apply when they are rotated back to their regular positions.

The Assessment Center

The schedule at an assessment center calls for three days during which tests and other techniques are used to give the staff members a view of the candidates' abilities and shortcomings under standardized conditions. The techniques by which measures of the various management skills are obtained may be grouped into four general types: 1) paper-and-pencil tests like the School and College

Depth interview of prospective candidate runs two hours, affords chance to meet staff.

Ability Test (SCAT) which measures the capacity of a person to undertake academic work and ability in both the verbal and quantitative areas; 2) Group Performance tests which create situations where an individual is called upon to interact with a group, participating in whatever fashion he may think is useful. An example would be when the individual becomes a part of a simulated manufacturing organization and concerns himself with matters such as production, inventory, and supply; 3) work situation tests: a selection of letters, reports, papers for signature, etc., which are appropriate for a specific management job are presented to the candidate in the form of an "in-basket;" the material is to be handled as it would be under job conditions; 4) an interview by a staff member which provides background on each of the candidates and explores subjects such as career goals as well as clarifying any confusions the candidate might have regarding the assessment program. These techniques have been designed by professionals with an eye toward their use by management people.

What Qualities Are Assessed?

In this program the major aim is to evaluate the candidate on variables which are considered to be relevant to success in management. The emphasis is on those management variables which are not readily observable when the man is working in a craft assignment. Since these qualities are those about which a line supervisor would have the least information, the Personnel Assessment Program is viewed as being supplementary to line organization and as being one more tool available in considering the promotion of men to management positions. A survey of line supervisors yielded a list of management variables best suited to evaluation at an assessment center. This list included such qualities as scholastic aptitude, oral communication skills, leadership skills, etc. There are 20 such qualities generally measured and each has four characteristics: 1) it should be an important management attribute; 2) it should be simple enough to be defined in behavioral terms; 3) it should be observable enough at a center to make reasonably accurate predictions about the candidates' future behavior; and 4) the characteristic should be relatively stable so that future predictions are worthwhile and valid.

Who Does The Assessing?

The quality of evaluations cannot be expected to exceed the quality of the staff members assigned to the job. This point cannot be overemphasized. The assessment staff must be of the highest possible caliber.

A typical assessment center staff is composed of eight people: a district level director, six second level assessors and a first or second level coordinator. It should be clearly agreed that members assigned to this job will not be transferred or promoted for the duration of their assignment, or approximately 15 weeks. It is not likely that a replacement on the assessment team will reach an adequate level of proficiency if he or she has not participated in the initial training. This

Detailed record of candidate's performance is essential to assessment process. Here, staff men record notes during group exercise.

Paper-and-pencil tests measure candidates' scholastic aptitude in back-to-school atmosphere.

assignment is a full-time job and staff members are not expected to handle the assessment work and their regularly assigned jobs together.

The director of a new center is usually assigned two months before the actual assessment starting date. This will allow him to be adequately trained by either the Personnel Research Staff at A.T.&T. in New York or by any other experienced trainer locally. He should participate in the selection of his staff and in their training. He can help select the working space, order furniture and supplies, and see to the reproduction of the necessary forms. The director should participate in the introduction of the program to the line organization by presentations in group meetings.

The six second-level assessors report about three weeks prior to the beginning of assessment. This period is necessary for their training and the initial assessment of the training group. As mentioned before, they should be the best people available and they should realize that a great deal of personal involvement will be required on their part, in terms of both time and energy. No person is required to work on an assessment center staff against his or her wishes. These six people conduct the assessment program for three days each week and complete the week in an evaluation session where each assessee's performance is thoroughly discussed.

The coordinator, either a second or first-level supervisor, administers and scores paper-and-pencil tests and handles the many administrative details involved in the operation of an assessment center.

The level requirements of the staff just described are dictated by the assessment situation. The assessors should be two levels above the candidates being assessed. This means assessors will be looking for people to meet requirements on a job they themselves have both performed and supervised.

The training that a staff receives during the course of a personnel assessment program is of primary importance. Thus, a new staff is usually trained for each series of assessments. The director of the center usually remains for two series in order to lend continuity.

Two directors and two coordinators of the Personnel Assessment Program at the New Jersey Bell Telephone Company discuss problems of scheduling the program and reporting results.

Who Is Assessed?

The Personnel Assessment Program only aids the field organization in the identification of people who are potentially promotable. As such, it should be used to provide information on those who have already been designated as acceptable by traditional standards used in line organizations. These standards might be technical proficiency, past performance on the job and in training courses, attendance, health records, job attitude, motivation and personal integrity. Information obtained through the program can be aimed at the initiation of training programs, or special assignments, for the development of people with potential or as an inventory of future management people.

It is desirable that candidates know why they are going to the center, and it is important that they be given an opportunity to decline attendance if they wish.

Analyzing Results

Following the three-day session of tests, group situations, etc., the candidates return to their regular assignments. The next phase of the Personnel Assessment Program consists of an evaluation by the staff members of each of the candidates. This evaluation takes place when the staff meets as a group, reviews the performance of each candidate on all of the above mentioned tests and techniques, gives any other pertinent information available, and decides the rating on each of the management variables for each candidate. This decision is made individually by each of the second-level staff members and announced to the group. If there are divergent opinions within a staff as to the merit of a candidate on a given management variable, each of the differing staff members must present to the group the facts which led to his opinion. After a given candidate has been rated on each of the variables in this manner, the staff members individually decide on the candidate's overall potential for management. It should be emphasized that this is not a mechanical summing up of the ratings on the individual management variables, but is a decision based on the relative importance of the strengths and weaknesses as seen by the particular staff member.

The staff members, as experienced line managers, are familiar with the foreman's job. Presumably they have the ability to recognize management potential and within the program, they have the opportunity to exercise this ability under standardized conditions. These people make this evaluation, and in addition write an explanation for their evaluation, citing the strengths and weaknesses of the candidate.

How Are Results Used?

To any company engaged in personnel assessment work, the most important aspect of the program is the use made of the results produced at the center. The assessment of an individual candidate typically has two parts: a report to the line organization about the man's performance and potential, and a report to the man himself. These reports analyze the man's performance during his time at the center and attempt to evaluate his strengths and weaknesses in terms of management skills.

Do Assessment Centers Work?

With an eye toward further examination of the assessment program, a study is currently under way involving over 500 men in five Operating Companies. Bell of Canada, Illinois Bell Telephone Company, Mountain States Telephone Company, Pacific Telephone and Telegraph Company, and Indiana Bell Telephone Company have furnished information on groups of men who have attended assessment centers and been given various ratings and also on men who have not attended centers. The results of this study will supplement the results of two previous studies designed to evaluate assessment centers.

The first of these was done by the Michigan Company; they compared a group of men promoted to management after attending the Personnel Assessment Center and a group of men promoted prior to the introduction of the assessment program. A comparison of overall job performance ratings of the two groups showed considerable differences. Approximately two-thirds of the Assessment Center group is rated better than satisfactory whereas approximately two-thirds of the men promoted prior to the assessment program were rated satisfactory or below. This is strong evidence that the Personnel Assessment Program is an aid in determining management skills.

A vast difference exists between the two groups in their potential for advancement. Only 35 per cent of the non-assessed group appear to have the abilities required to move further in the business while 67 per cent of the assessed group have demonstrated such abilities. Apparently the Assessment Center not only assists in identifying skills in first level management personnel, but also in pointing out those men with potential for a higher-than-first level assignment.

The second study was done in the New England Company where a sample of individuals either accepted or rejected by assessment centers and subsequently promoted and working on the jobs for which they were assessed, were rated by their supervisors. The sample consisted of both first and second level management people and clearly indicated that candidates accepted by the assessment center constitute a higher quality management group than the rejected candidates and that predictions based on assessment techniques are an improvement over those based on appraisals.

The information gathered produces some definite conclusions regarding the assessment center program. First, men given a high rating at the assessment center perform better at their first level supervisory positions than their peers (those given lower ratings and those who are not assessed); and second, men who are given high ratings at the assessment center are seen as having more potential for advancement to higher management levels than their peers.

Assessment Centers

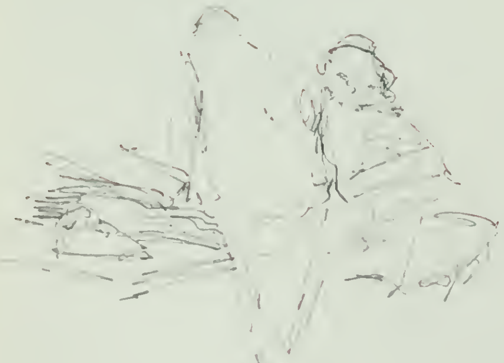
In capsule form, that's the assessment center program. In many ways it may look as though we are "swimming against the tide." Why, in this age of high speed data processing, which we use so well in other areas of the Bell System, have we decided to use an approach that utilizes so many management people in such a time-consuming process? Or to put the question another way, "Why not simply feed a person's characteristics into a computer and get an answer relative to his or her chances of success as a management person?" The answer is the obvious one. We don't feel that an approach that minimizes the human element is the appropriate one. There are still things that are best done by competent people making judgments, and the selecting of good management candidates, in all fairness to the System and the individual, remains one of those areas which will successfully withstand the push of mechanization. Costly and time-consuming as it may be, the selection of good management people justifies the price many times over.

Payoff of the program comes during the approximately two-hour session in which the candidate's performance over the two-and-a-half days is reported on (here by tape playback) and evaluated by the staff. The candidate's supervisor is often present. A record of the session is kept on tape and is available for reference if any questions should arise later.

Long Lines In Action

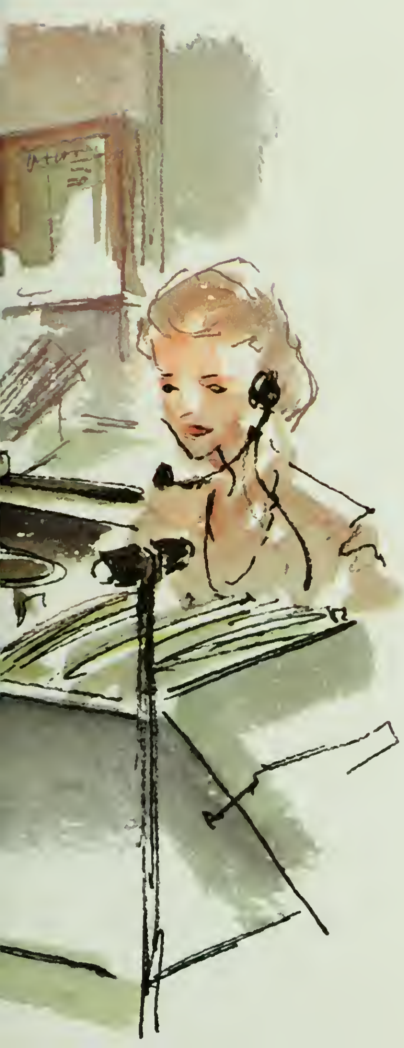
Paintings and Sketches by Attilio Sinagra

As part 2 of this magazine's series of paintings and drawings on the Bell System, famed illustrator and painter Attilio Sinagra was asked to try to capture the essence of the broad and complex service function that is the Long Lines Department of A. T. & T. Specifically, he was asked to give his impressions of the drama inherent in the jobs of the 30,000 people who provide, operate and maintain the equipment and the vast communications networks which bind together the 22 Bell System Operating Companies and some 2,700 independent telephone companies, linking them with telephones in 186 countries and territories beyond our borders and beyond the seas. In terms of scope and sheer variety of subject matter, it was, the artist says, the most challenging assignment of his career. However, his initial trepidation was soon replaced by boundless enthusiasm for what he saw and experienced. The fact that his work, reproduced on this and the following pages, so graphically conveys the spirit of Long Lines is a measure of this enthusiasm. It is a measure, too, of his perceptive eye and abundant talent.



Long Lines is the microwave tower rising above the desert landscape, the Overseas operators calling cities halfway around the world. It is a nationwide network carrying voice messages and data, facsimile, teletypewriter telephotography, radio, TV. It is people with many skills, working at many different jobs in many different places — all helping to keep the switching equipment, wire and cable and microwave equipment operating smoothly so that over five million interstate calls can go through swifty and accurately on an average business day.

Operators in Long Lines handle calls that may span the nation — or the world, such as those handled by the Overseas operators at right. Rate and Route operators below give information on how much calls cost and how they should be routed to the operators handling calls.



Watchful eyes, alert minds, keep the networks functioning efficiently today, look ahead to the growing needs of the future. At left are sketches made in the headquarters Status Center in New York where Plant supervisors keep track of the service condition of the Long Distance network around the clock. Below, in this Network Management Center other experts help eliminate or avoid communications "traffic jams," keep traffic on the network flowing. At right, communications specialists work on Plant Department practices to improve service today and tomorrow.

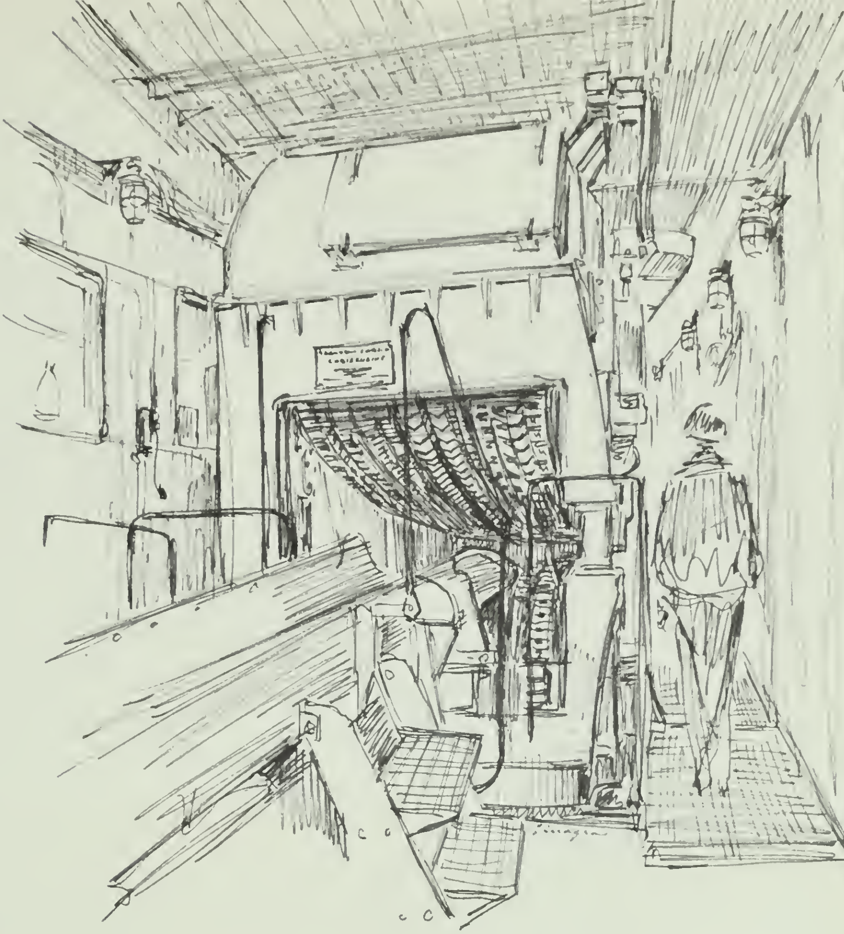

TELEGRAPH COMPANY


NBC Video

Something of the variety of Long Lines activities is depicted on these pages. At left, TV programs are monitored to assure quality in transmission over Bell System circuits. At right, a Plant man checks circuits at a test board; the large meter over his head indicates sound volume in decibels. Below, a common sight at Long Lines Headquarters — a group of telephone friends from overseas looking at the equipment. In this case the visitors are a group of Japanese.

The stern (above) and bow (right) of the Cable Ship *Long Lines*. Designed especially to handle the latest type of armorless undersea cable developed by Bell Laboratories, the *Long Lines* is herself the latest in cable ship design. Equipped with the most modern and sophisticated cable laying equipment, she can carry 2,000 nautical miles of cable in her capacious tanks and cruise 10,000 miles. Since she went into service in 1963, she has laid some 17,000 miles of cable beneath the world's seas. Recently she completed laying the fourth transatlantic cable between the United States and France.

Below, C. S. *Long Lines* loading cable at Western Electric's Baltimore Works. Upper left, cable repeaters on storage racks. They are spliced into cable aboard ship. At right is the 180,000-pound linear cable laying engine which smoothly and gently controls flow of cable and repeaters from tank and storage rack to the bed of the sea. Below right, cable buoys in the hold.



Following Long Lines people at work, the artist found himself in cities and hamlets, in the desert, on mountain tops and on the prairie. He recorded splicers at work on the transcontinental "hardened" cable route (far left) where both cable and communications centers are buried deep for greater protection. Below left, he depicts the door of an underground center which can be sealed tight to protect personnel and equipment against blast and fallout. And, he also sketched a Plant man testing microwave equipment and stopped to paint at a Long Lines computer center (below and left) in upstate New York.

After careful research, the Bell System has developed an updated version of this aid to elementary education

Telezonia

Alix L. L. Ritchie, *Associate Editor*
Bell Telephone Magazine

"Telezonia" — the Bell System's elementary school telephone usage program—is a name that has become familiar to generations of school children over the past 15 years. But, in 15 years a lot can happen. Change—the ubiquitous characteristic of our times—has not only profoundly affected the world of communications but also the rapidity with which young children become acquainted with this world. Now there is a new Telezonia program which has been designed to incorporate these changes. And the indications are that the new program is going to be even more successful than the first one.

The principal purpose of the new Telezonia program is to help the child in the lower elementary grades to form effective telephone habits. Primarily, it concentrates on points of correct and courteous telephone usage and on the method and importance of using the telephone directory. In order to be of significant educa-

These recently developed teaching aids make up the new Telezonia program for elementary schools and are available to teachers free or on loan from local Bell Telephone Companies.

tional value to the schools, the Telezonia program is designed to fit into the subject matter taught at the lower elementary levels. It covers such subject areas as language arts (courtesy and clearness in speech, and alphabetizing), social studies (the child's place in the community, including the role of communications in the community) and science (sound, and how the telephone works). The teacher may use either the language arts, social studies or science approach—or she may combine all three.

Working With the Educators

The first Telezonia program was started in 1950 after a nationwide survey indicated considerable demand for materials on the telephone and its proper use. Recently, when the need for a new program seemed to be indicated, school relations people in the Commercial and Public Relations Departments consulted a number of educators to find out whether a program of this type was still wanted and needed and, if so, what their ideas were on the content and format.

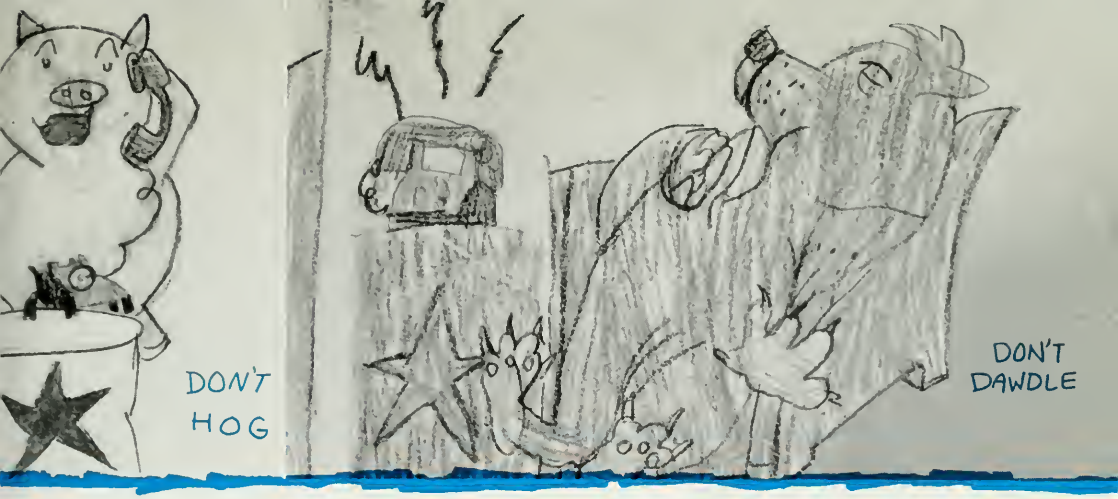
At meetings with the Association for Supervision and Curriculum Development of the National Education Association and with groups of elementary school administrators, there was general agreement that the teaching of proper telephone usage still serves a highly useful purpose. The educators also suggested that the format (film, filmstrips, booklets and practice telephones—or Teletrainer) be retained, but that the program should be aimed at the second and third grade levels, rather than the higher grades, since most children starting school today already use the telephone.

They felt that the approach should be informational, primarily to acquaint students with the proper use of the telephone, and that the various materials should reinforce other subjects being taught—such as courtesy, diction, some aspects of the science behind the telephone, social studies and alphabetization—and should be stimulating to the students. It was also suggested that real people or animation be used in the film, rather than the puppets used in the first program, to avoid the possibility that the children might remember the dramatic story or the puppet characters rather than the lessons being taught. And it was felt that filmstrips were needed which reinforced the important points of the program and which enlarged upon the content of the film. Finally, it was suggested that the teacher's manuals should contain resource material and less detail than the previous one so that teachers could develop their own approaches based on the material supplied.

Objectives

Following these meetings with educators, people from the Commercial, Traffic, and Public Relations Departments and occasionally Marketing Department and Number Services representatives determined what telephone information should be included in the program, the educational approach and the kinds of material to be used. The purpose and objectives of the program were established:

- To explain the place and importance of communications in the past, present and future;



Two 8-year-olds drew these pictures to show some of the things they learned about telephone courtesy: proper tone of voice, letting others use the phone and answering quickly.

- To give basic information that would aid in teaching good habits of telephone communication;
- To present basic facts on how the telephone works and how calls go through, particularly as these apply to proper telephone usage;
- To provide materials that meet educators' needs.

During the actual research and development of the program itself this cooperative effort was continued in conferences with educators and the Bell Operating Company people who administer the program. Parts of the program were also tested very successfully with students and discussed with elementary teachers. And when the materials were near completion, they received a final

Second graders in Charlotte, N.C. answer questions about wall charts which reinforce film and filmstrips on telephone courtesy, how the phone works, getting help in an emergency.

Telezonia

review by curriculum specialists of the National Education Association and the U. S. Office of Education in Washington, and also by experienced school relations people in six Operating Companies and a team of two experienced elementary school teachers. By researching each element in this manner, we have done everything practicable to develop a program that would be flexible, informative and would, above all, meet the educators' standards and educational needs. And, remaining sensitive to the educators' and students' needs, the program will be reviewed and updated when necessary.

The Program Itself

The result, the new Telezonia program itself, incorporates the following concepts: communication is important in family and community living; the telephone is an important means of communication; there are correct ways to use the telephone; good speaking and listening habits improve communication; the telephone directory helps us use the telephone more efficiently; and sound and electricity make the telephone work. There are six items in the program; each is designed to support and relate to the others. All of these teaching aids—or any combination — may be used, as the teacher wishes.

"We Learn About the Telephone," a 25-minute film, is the central element of the program. The film teaches proper use of the telephone, the importance of telephone courtesy, how to find a number in the directory, how the telephone works and the history of communications. Additionally, it teaches how to dial for help in an emergency and the importance of the telephone in the community.

There are also four filmstrips. Each one is closely related to an important segment of the film. "How We Use the Telephone" concentrates on good habits of telephone usage, voice and courtesy. "Communications and the Community" shows how communications joins the community, the nation and the world. "The Alphabet Works for Us" helps teach alphabetizing, finding telephone numbers and facts in reference books. "How the Telephone Works" demonstrates how sound, electricity, magnetism and carbon help make the telephone work. These filmstrips enable the teacher to go into considerable depth in each of these areas. Along with the captions and booklets of suggested narration, they are

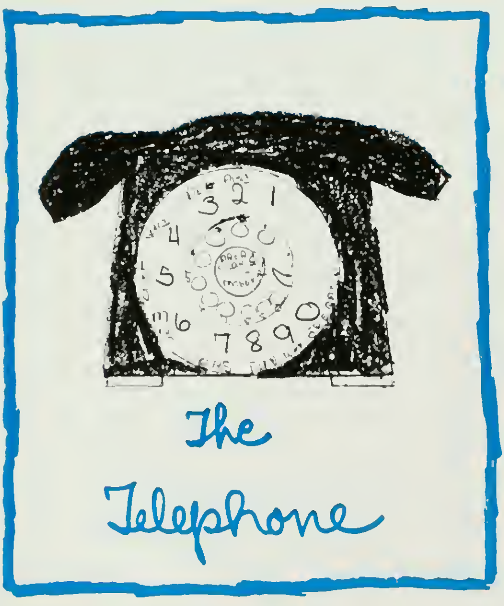
The Telezonia program helps teach elementary pupils many things about using the telephone, from alphabetizing and using the directory, left, to learning how to adjust the bell, right.

Teletrainer unit, part of the Telezonia program, helps develop good calling habits.

designed to stimulate class participation. Also, three wall charts, illustrating how the telephone works, telephone courtesy and how to use the telephone in an emergency, are available as teaching aids.

The pupil's booklet, written at the third grade level, reviews the principal subjects contained in the other parts of the program. It covers how man sent messages before the telephone, the different ways we communicate today, steps in making and receiving a telephone call, how to get help in an emergency, information on alphabetizing and using the directory, what Bell knew about sound waves and how he invented the telephone, and how the telephone works. It is intended as a take-home booklet, and space is provided for the pupil's personal telephone list.

The teacher's guide has been completely redesigned to be considerably shorter than the former one and is divided into sections on language arts, social studies and science. Selected scenes and captions give a highly useful preview of the content of each filmstrip and of the film. There are detailed charts of the teaching points covered by each segment of the program and suggested classroom activities, including elementary science experiments. A section of resource material on communications contains information on Direct Distance Dialing, telephone materials and where they come from, and a biography of Alexander Graham Bell. The guide also contains suggested narration for the filmstrips and Teletrainer instructions and information.



Student drawing was part of school project done in connection with Telezonia program.

The Teletrainer, in addition to practice telephones, is now an integral part of the program and is available in many Bell System communities. This amplifier and control unit produces dial tone, ringing and busy signals, and makes connections between the two telephones which accompany it. Thus, it helps create realistic classroom situations for developing conversational skills. Not only do teachers consider it valuable in teaching correct telephone usage, but the Teletrainer has also proved to be extremely useful in teaching children with speech and hearing handicaps.

An additional part of the program—which has proved very popular with the schools—is a visit to the school by a man from the Plant Department, usually an installer or a lineman, with his truck and equipment. He shows the pupils the importance of safety and neatness in his job and explains the use of his equipment. Where possible, he may also demonstrate how he climbs a pole to connect individual telephones to the network.

Response From Educators

Since the new Telezonia program has been available to schools for such a short time, the story of its usefulness as a teaching aid is just beginning. Yet, even by numbers alone, we have some indication that it is well on its way to success. Since November, 1964 four million copies of the pupil's booklet have been ordered by the Associated Companies. Since that date, 200,000 copies of the teacher's guide, and 185,000 sets of posters have been ordered as well. These items—the booklet, guide and posters—are provided by the local Bell Company to the schools free of charge. Orders also have been placed for 4,200 prints of the film and for 5,700 sets of the filmstrips; indeed, the first orders for the films and sets of filmstrips, 2,000 each, were the largest initial orders for a Bell System film or filmstrip ever placed with Western Electric. And, finally, the Bell Companies have ordered 3,600 Teletrainers through Western since the new Telezonia program has been available. These last items are all provided to the schools on a free loan basis.

Another indication of the success of the new program is the number of students reached. In the 1963-64 school year 3,223,591 elementary school pupils were reached by the original Telezonia program; in the 1964-65 school year, this number jumped to 3,707,089. This increase of nearly half-a-million students is largely attributable to the new Telezonia offering.

But numbers are not the whole story. There is another, much more human, indication that the time and research spent in developing the program were well worth it—the letters coming in from educators around the country. Writes a teacher in New Jersey: "Thank you so very much for the marvelous educational material. . . . The class is so very excited and learning so much that I just had to write to express our gratitude for your generosity and for the excellence of the material itself. The other teachers . . . are equally delighted. I personally wish that more of our academic teaching material were as *well prepared,* not only as *intellectually challenging* but as *socially meaningful.* . . ."

A teacher in Virginia says: "The children enjoyed the program. It helped to develop satisfactory courtesy habits, and how to make emergency calls. This training is a most necessary element which our society today lacks and needs. . . ." Adds another Virginia teacher, "I feel this is a very good learning-through-experience program . . . [making] future citizens aware of the tremendous value of, and help received from, having a full working knowledge of the many uses of the telephone and a keener appreciation of the people who make these services possible. Thank you very much. . . ." And a note from a teacher in Illinois says simply, "Delightful. Great Improvement."

Speaking clearly is another point taught in program as shown in this pupil's drawing.

Students Too

And the students? We get letters from them, too. They tell us, in their own way, that we have been successful in communicating the concepts behind the program.

An 8-year-old Pennsylvania pupil writes: "Thank you for letting some of our students see how we communicated long ago. In our room we were studying about the telephone and how we did without a telephone. In the film I learned the manners when you use the telephone,

Poster and some of experiments suggested in Telezonia teacher's guide help students to learn something about the nature of sound.

they are: 1. Don't talk with your mouth full of food. 2. Don't talk too loud. 3. Don't monkey around with the telephone. 4. Don't talk on the phone too long. 5. Don't roar like a lion. These are the manners that you use when you are on the telephone." A 9-year-old student says: "The film was just so marvelous. And the interesting facts I will remember are: That in the days of Greeks, the Grecian men had to run from city to country to carry messages. Later on when the Roman soldiers (or people) came they discovered horses for sending messages. Then there was the pony express, the smoke signals sent by the Indians. And then there came the telephone invented by Alexander Graham Bell. Now we use them today. The telephone has a transmitter so that you can hear the other person. Thank you for letting us see the lovely film about communication." And a student from the Midwest writes: "I think the telephone has helped our country's economy a lot especially for business from coast to coast. The telephone has helped the other countries also. . . ."

Special Classes

An added dividend has been that the new Telezonia program has also been helpful to teachers who are teaching special classes for retarded or disturbed children. One such teacher tells us: "I am in favor of this program. Many pupils have never had experience with a telephone. If given a number they can complete the call. This is a most practical way to help retarded children have some concept of alphabetical order. . . ." And another teacher notes: "Materials well used. Very adaptable to our needs to help individuals operate on a comfortable level. Reading materials led to further discovery using other materials. Using a tape recorder, we were able to record and then evaluate telephone manners. The teletrainer helped to bring one of the boys out of his inner shell. Very worthwhile experience. . . . Thank you for permitting us to have access to these materials. It was a good learning experience for the children."

Underlying Philosophy

Underlying this program is the basic Bell System philosophy that no force helping the individual or the nation to grow is stronger than education and that, as a basic force for progress, the American educational system deserves to be continually assisted by the intelligent effort of all citizens, private and corporate. In recognizing this responsibility to education, the Bell System endeavors to better understand the aims, accomplishments, problems and needs of our educational system and to help educators and students better understand the aims, accomplishments, problems and needs of our business and through this, the free enterprise system.

The Bell System is also endeavoring to contribute concrete assistance in areas where educators welcome our particular competence. The new Telezonia program is one of the means by which we are trying to meet these objectives. And, judging from all present indications, it is going to be a successful one.

A very popular feature of the Telezonia program in many communities is school visit by telephone lineman or installer who tells pupils about his job and demonstrates equipment.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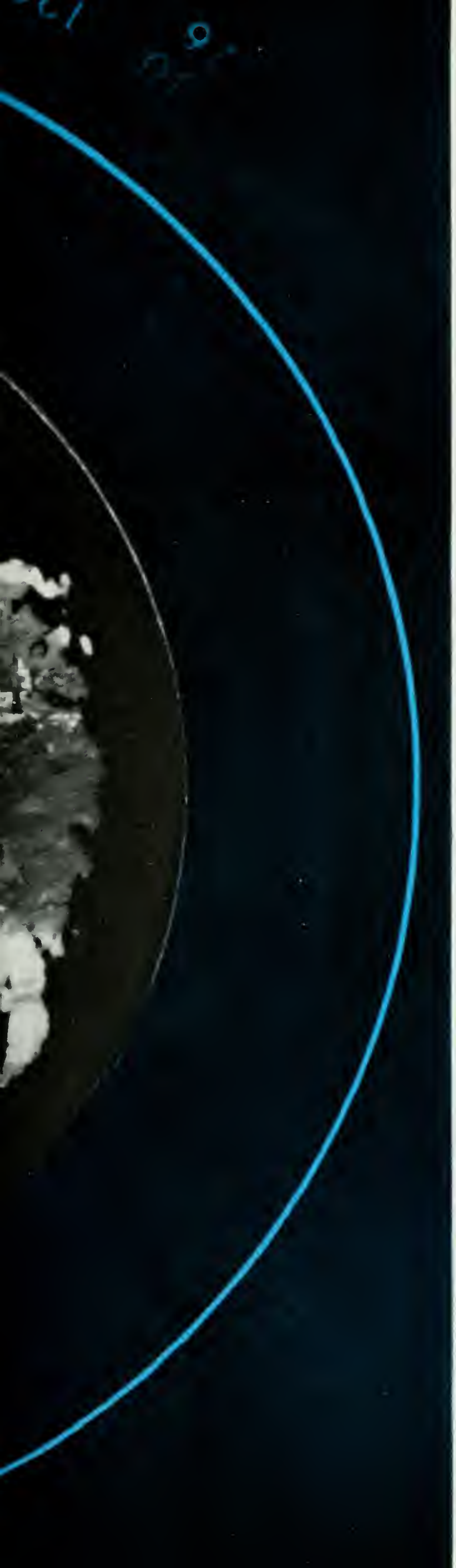
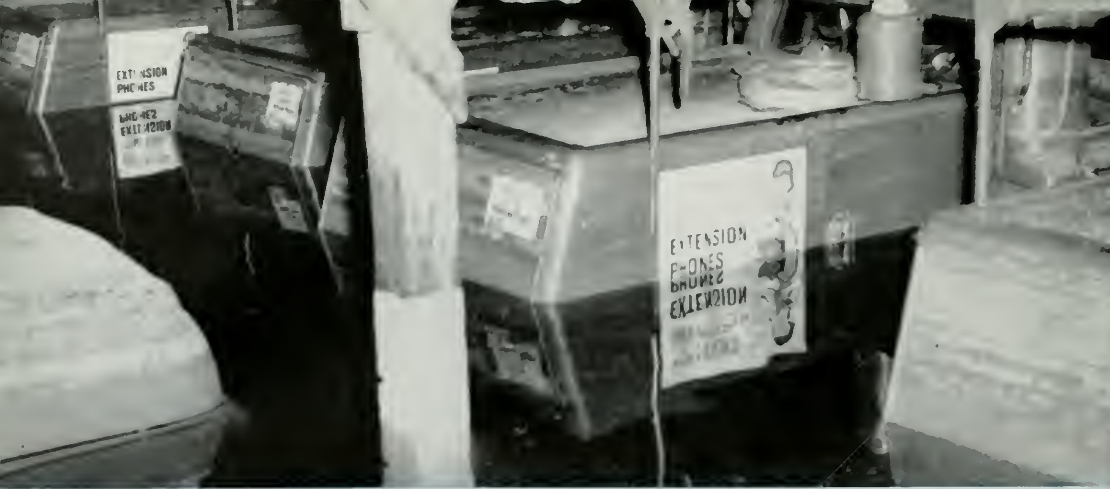


THE WORST ON RECORD

"Betsy" is being retired from the Weather Bureau's list of possible hurricane names for at least 10 years—a rare and dubious honor accorded because of this storm's infamy. And, indeed, Hurricane Betsy spelled disaster. To the Bell System, Betsy stands for the worst storm in terms of telephone damage since the records have been kept. Restoration costs were the highest ever associated with a natural disaster—$16,388,000—as Bell System teamwork sprang into immediate action to bring telephone service to the stricken areas. Below, at A.T.&T. headquarters emergency center, preparation for coordinating restoration effort began with careful plotting of the course of the storm.

In the wake of her course, statistics on the damage wrought by Betsy piled up. Her ravages left 381,000 telephones out of service in Louisiana, 22,000 in Mississippi and 125,000 in Florida. Betsy's savage winds left 64 Bell System communities without long distance service, 9,039 exchange cable breaks and a total of 5,647 poles broken or down.

Weeks before Betsy, Western Electric distributing houses stocked extra supplies and equipment for the hurricane season. And, while the job of assessing Betsy's damage and coordinating the restoration effort continued (below), W.E. rushed tons of equipment and material, more than a million pieces of apparatus, to the area (below, center).


EXTENSION PHONES
EXTENSION PHONES


HOOSIER HELP FOR LOUISIANA
ALABAMA
DALLAS
TELEPHONE MEN
REPAIRING
BETSY'S DAMAGE
HURRICANE "BETSY"
AID from MEMPHIS
H · 4297

With southern Louisiana still reeling from Betsy's blow, telephone restoration work had to get underway immediately. Southern Bell's New Orleans forces needed help; much of their own repair equipment, such as the trucks seen at top left, was damaged. Telephone people from other states and other Bell System companies moved in to get the job done—some of the many trucks are seen at left—backed by a nationwide organization that can call in competent forces and compatible equipment from other areas to meet an emergency. With A.T.&T. coordinating the effort, 184 men and 134 vehicles arrived from other companies to help the hundreds who came in from other Southern Bell areas. Of these, 88 men and 61 vehicles were airlifted, with the cooperation of the Air Force and the Office of Emergency Planning and at Bell System cost, in 38 Air Force Reserve transports from Chicago, Columbus, O., Indianapolis, Atlanta, Charlotte, N.C. and Columbia, S.C. The line of trucks at top right are boarding planes at Indianapolis. An interesting sidelight to this telephone air lift was that a number of Bell System people took part in the role of Air Force Reservists. The repair job went on apace, below left, while the figures kept at the A.T.&T. emergency center, at right, showed restoration efforts had produced impressive results. Eight days after Betsy first hit, all of the phones in Florida and Mississippi were back in working order. In much more badly damaged Louisiana, 11 days after Betsy, only 27,000 phones remained out of service—they were in locations that were destroyed or that will require extensive rebuilding before the phones can be reinstalled.

in this issue...

Lee C. Tait

Charles J. Sentenne

■ In writing on "New Dimensions in Customer Service," (page 2), Lee C. Tait draws upon a wide background of experience in Commercial Operations. He has had many assignments in this and allied fields during his Bell System career prior to his present position as assistant vice president in charge of the Commercial Division of the A.T.&T. Operations Department. He joined the Chesapeake and Potomac Telephone Company in Richmond, Virginia in 1941 as a Commercial representative after receiving the B.S. in Electrical Engineering at Virginia Polytechnic Institute. He then held successive positions in Engineering and Traffic, becoming general Traffic supervisor in 1953.

He spent a year, 1955-56, as a Sloan Fellow at Massachusetts Institute of Technology, where he received the S.M. in Industrial Management. Also, during this time and until 1958, he was division Commercial manager at Richmond. He then came to A.T.&T.'s Administration-R Department, returned to the C&P Companies for two years as general Operations supervisor, comptroller and vice president and director of the West Virginia Company. He came back to A.T.&T. as assistant vice president in Public Relations, and assumed his present position in February of 1963.

■ Charles J. Sentenne, author of "Introducing: The Trimline Telephone (page 8), is responsible for launching the new Trimline phone in the Operating Companies throughout the Bell System. The marketing program has already been presented to half a dozen of the companies and the remainder will receive it by next Spring. This split introduction is being done to tie in with "start-of-sales" schedules, which are spread over a 15 month period.

Mr. Sentenne joined the Wisconsin Telephone Company after receiving the M.B.A. in Marketing at the University of Wisconsin in 1957. He has held various positions in the Marketing and Public Relations Departments in the Wisconsin Company and served as revenue requirements supervisor before assuming his present position as staff representative in A.T.&T.'s Marketing Department in 1964.

■ "Although we have an unprecedented opportunity for growth, from this point on Pioneers must earn the right to grow." So said Clifton W. Phalen, president of the Telephone Pioneers of America, speaking at their General Assembly in Atlantic City last September. Mr. Phalen emphasizes (see "Time and the Triangle," page 12) that he is deeply interested in goals for growth in the Pioneers, and with selection of competent leadership to reach those goals. He speaks with the conviction of his 37 years of Bell System service and many years of association with the Telephone Pioneers.

Mr. Phalen joined the New York Telephone Company in 1928 after receiving the B.S. in Industrial Engineering from Yale University. During the next 11 years he held various positions in the Plant Department, becoming eastern division Plant superintendent in 1939. Four years later he was appointed assistant vice president of Personnel and, the following year, vice president. He then served as vice president of Public Relations before moving in 1948 to A.T.&T. in the same capacity. In 1950 he was appointed vice president in charge of rates and revenues, then of personnel relations and in 1952 was elected president of the Michigan Bell Telephone Company. Four years later he returned to A.T.&T. as executive vice president, and, in 1959, was elected president of the New York Telephone Company. He was elected chairman of the board last July.

■ Interest in the Assessment Center Program for non-management personnel, says Cabot L. Jaffee, author of our article (page 18), has grown extensively in the last two years, both inside and outside the Bell System. And Mr. Jaffee feels that the number of questions concerning the centers he receives from outside the System alone attests to the merits and acceptance of the program. Since he joined A.T.&T. in July, 1964, Mr. Jaffee's major responsibility has been the training of Operating Company personnel in the development and use of assessment techniques, and coordinating Bell System activity in this area.

Having divided his academic career between the North and the South, Mr. Jaffee attended Tulane University, New York University, Columbia University and Florida State University, where he received his Ph.D in Psychology and engaged in teaching and research before

Clifton W. Phalen

Cabot L. Jaffee

Attilio Sinagra

Alix L. L. Ritchie

joining the Bell System as personnel research analyst in A.T.&T.'s Personnel Relations Department. His professional affiliations include memberships in the Florida Psychological Association, Southeastern Psychological Association and the American Psychological Association.

■ "The real thrill and satisfaction is in the sketch that catches 'something.' The machinery is basically static but the figures, the people, are constantly moving about. . . . The fleeting and expressive action happens at unexpected times, and it must be 'grabbed,' so to speak, by the discerning eye of the artist." This is Attilio Sinagra, writing about what he describes as a "unique and exciting assignment" which was to capture the activities of the Long Lines Department in sketches and watercolor paintings for the portfolio in this issue.

Mr. Sinagra received his formal art training at Pratt Institute, where he majored in pictorial illustration and where, for 16 years, he taught evening classes in figure drawing and perspective. He also studied with Harvey Dunn, dean of American illustrators. He has free-lanced for the past 25 years in the field of book illustration and in advertising and editorial media. He has traveled through many countries from Norway to North Africa, painting as an official artist for the U. S. Air Force.

Mr. Sinagra is a member of the Society of Illustrators and currently its treasurer. He has exhibited at the National Watercolor Society, the Society of Casein Painters, the Society of Illustrators, the Allied Artists of America, the National Academy in New York and in museums and galleries both here and abroad.

■ Alix L. L. Ritchie, author of "Telezonia", page 41, has been with the *BTM* since October, 1961 and in her present position as associate editor since November, 1963. Although "Telezonia" is the first article that has carried her by-line it is not by any means the first time her writing has appeared in the Magazine. For example the pictorial feature, "The Worst On Record" on page 50 of this issue is another of her contributions. She also handles the "In The News" department and is the Magazine's chief Guardian of The Language.

After attending Wellesley College, Miss Ritchie received her B.A. from New York University. In 1963 she received the M.A. degree in English from the NYU Graduate School of Arts and Sciences, completing the requirements for the degree while with the *BTM*. Currently, she is a member of the English Graduate Association, the New York University Alumnae Advisory Council on Admissions and the Shakespeare Society of Wellesley College.

in the news...

Transatlantic 50th

75th Million Phone

TAT-4 In Service

Air Force Citation

Lunar Surface Properties

Statewide ETV

Wire Drawing Technique

50 Years Ago, Voices Across The Atlantic

In October, 1915, all was not quiet on the Western Front; the guns boomed with regularity. Atop the Eiffel Tower in Paris, two young American engineers—Herbert E. Shreeve and Austin M. Curtis, both of the Bell Telephone System's Research Staff (now Bell Telephone Laboratories)—had been straining to hear a message from the United States which would establish the first transoceanic radiotelephone transmission.

The man who conceived the idea of making this first test of transoceanic radio telephony was John J. Carty, then chief engineer and a vice president of A.T.&T. It was under his direction that all of the Bell System's preliminary development work in radio telephony had been undertaken, and the Board of Directors of A.T.&T. supported his decision to investigate just how voice communications could be sent across the ocean.

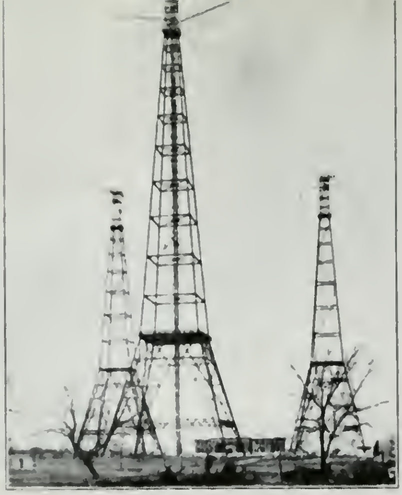
Carty's enthusiasm brought him the support of Naval officials who permitted A.T.&T. engineers to set up listening posts at San Diego, Mare Island Naval Station in California, and in Panama. The Navy also permitted its station at Arlington, Va. to be used as the key transmitting station. A.T.&T. built a receiving station in Honolulu, and with French support, Shreeve and Curtis set up the Paris station.

By late September, all but Paris had reported successful calls. But the goal Carty had set—to talk across the Atlantic—still was not met.

Shreeve and Curtis had arrived in Paris in June to conduct their unique experiment. For four months, all they heard was static.

Finally, on October 9, they heard fragments of speech and then, in the early morning hours of October 21, Shreeve recorded in his journal the unmistakable reception of connected speech: "At 5:20 heard signal letters GH. At 5:37 words 'Hello, hello.' At 5:57 '. . . and so, good night, Shreeve.' " Two days later, the first complete sentence came through: "Hello, Shreeve. How is the weather this morning?"

That single, erratic circuit used to establish a tenuous voice link with the Eiffel Tower



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In October, 1915, Bell System men at the Eiffel Tower in Paris, right, heard the first transatlantic radiotelephone transmission from Bell engineers in Arlington, Va., left.

led to the opening of radiotelephone service across the Atlantic in January, 1927. Today almost 1,500 circuits—by an ever-growing number of undersea cables, and high frequency radio and space satellites—are carrying talk to points around the world, and the volume of calls is running into millions a year.

75th Million Bell System Telephone

Somewhere in the United States, the 75th million Bell System telephone was put into service during the week of October 17, just eight and one-half years after the 50th million was installed in March, 1957. The announcement of the milestone was made by A.T.&T. President H. I. Romnes in an address at the annual convention of the U. S. Independent Telephone Association.

The gain of 25 million telephones since 1957 represents more phones than the Bell System had in service at the beginning of the postwar period 20 years ago, and climaxes two decades of growth and technological achievements in communications. (The figure of 75 million Bell System telephones includes only the phones of companies in which A.T.&T. is the majority shareholder.)

No ceremonies marking the 75th million telephone were held because, as President Romnes told independent telephone company representatives, "We would prefer to reserve our real celebration for a milestone we can mark together: our industry's 100th million telephone which—by my calculation—should be along in the next couple of years. At that time our industry will have compressed within a short span of 15 years as much growth as it achieved in its entire previous history of more than 75 years."

TAT-4 In Service

The first transatlantic cable linking the United States directly to Continental Europe was placed in service September 15. It is the longest single span of cable in the world—3,600 nautical miles, stretching from Tuckerton, N. J. to St. Hilaire-de-Riez, France. This cable was laid by the Bell System cable ship **Long Lines.** The ship completed the undersea operations on September 9. This is the fourth transatlantic cable, and it has a capacity for handling 128 simultaneous voice conversations.

The $50-million cable system is owned jointly by the Long Lines Department of A.T.&T. and the French and German Ministries of Posts and Telecommunications. A.T.&T. shares its ownership with three other U.S. international carriers: ITT World Communications, Inc.; RCA Communications, Inc.; and Western Union International, Inc. Ownership is proportional to circuit usage. A.T.&T. is authorized to own up to 64 circuits; ITT World Communications up to 25; RCA Communications up to 21; and Western Union International up to 16. Two circuits will be made available to the French Cable Company, but without provision for ownership.

A.T.&T. Receives Air Force Citation

A.T.&T. has become the first recipient of a new Air Force Citation honoring those civilian employers supporting and encouraging the participation of Air National Guardsmen and Air Force Reservists in the Air Reserve Forces program.

The citation was presented on September 17 to A.T.&T. President H. I. Romnes by Air Force Chief of Staff General J. P. McConnell who said, "The Air Reserve Program needs . . . the support and recognition extended to our citizen-airmen by their civilian employers. Only with such positive employer support can we maintain the 'Ready Now' Air Reserve Forces which the nation's protection and welfare demand." General McConnell went on to say, "The company chosen to receive this first award is one which, through its well established policy of support, has developed among its nation-wide affiliates and subsidiaries an unexcelled program of assistance to our Reservists."

Bell System Associated Companies recognized for their policies which "support employee participation in both the Air National Guard and the Air Force Reserve" were the Illinois, New England, New York, Ohio, Southern and Southwestern Bell Companies, as well as Western Electric's Oklahoma City Works and the Teletype Corporation in Little Rock, Arkansas.

Properties of Lunar Surface Determined

Characteristics of the moon's surface roughness have been determined by scientists at Bell Telephone Laboratories in Whippany, N. J. The average length, height and slope of surface irregularities were arrived at by bouncing a laser beam off materials prepared in the laboratory and comparing these findings with measurements of microwave reflections from the moon's surface.

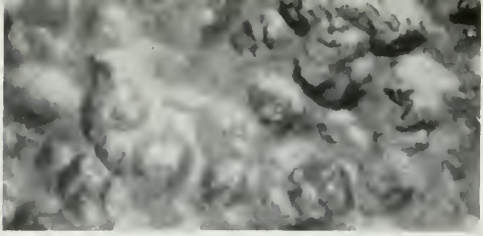
The statistical values match estimates of the average slope of the lunar surface based on photographs taken by the Ranger 7 moon probe. This is the first time that average dimensions for the height and length of lunar irregularities have been reported.

The work has provided not only a basis for determining lunar terrain, but also a method of deducing statistical values for the surface irregularities of planets.

The study of the moon's terrain was an outgrowth of investigations of backscatter phenomena—or what happens when signals are bounced off certain surfaces. Surfaces were needed which had a random distribution of irregularities; this was achieved by blasting blocks of soft aluminum with different size alumina grits. The randomly rough surfaces obtained in this way were electropolished to remove burrs and sharp points. This process has an effect somewhat similar

Shore end of TAT-4 is carefully positioned before being spliced to underground cable.

General J. P. McConnell presents Air Force Citation to A.T.&T. President H. I. Romnes.



Magnified view of aluminum surface used in determining lunar surface irregularities.

to some of the processes believed to have shaped the surface of the moon, specifically, the smoothing of crater edges through bombardment by small meteorites. To study the statistical properties of the surface, a stylus was run over the samples. The tracings, showing the contour of the surfaces, were statistically analyzed on a computer.

Then, in controlled experiments with laser light scattered from these surfaces, the Bell Labs scientists obtained curves showing the energy distribution as a function of the angle of incidence for each surface. The curve for one of their surfaces was almost identical to a curve showing how microwave energy is backscattered from the moon itself.

The values obtained are averages for the full visible surface of the moon. Thus, the number of small irregularities is far greater than the number of really big irregularities, such as the lunar mountains.

In addition to studies of the moon's topography, the Bell Laboratories men calculated the dielectric constant of the lunar surface. They compared the level of energy of laser light backscattered at normal incidence from their aluminum sample with the level of energy backscattered from the moon. This value is similar to the dielectric constant for porous volcanic glass or loose sand.

Statewide ETV

One teacher can face pupils at 161 different schools simultaneously in Delaware, as the nation's first statewide educational television network went into operation this fall.

As school populations exceed the number of qualified teachers, U.S. educators increasingly turn to television to provide the most students with the most education. Although many cities and counties have begun to use ETV as a classroom aid, Delaware—with the help of Western Electric and the Diamond State Telephone Company—was the first state to link all its schools with a closed circuit TV network.

For months, construction men along with W.E. equipment engineers, installers and Distributing House field representatives worked on a rush program to set up the microwave towers and transmission equipment that can send televised lessons up and down the state. Portable multi-channel microwave equipment shelters were manufactured especially for the Delaware ETV project and connected at four of the system's seven tower sites. Equipment was added and modified in existing buildings at the remaining sites. In addition, the Diamond State Company installed about 500 amplifying stations on poles and 380 miles of underground and aerial coaxial cable to carry images into individual schools.

Dover, the centrally-located state capital, will be the TV system's hub. From a main studio and tower site there, live and taped programs on every subject will be sent out over three channels to towers around the state. From the tower sites, programs will be carried by coaxial cable to about 25 "head end" schools, which will act as control and transmitting points for the other schools in the district. The "head end" school will be able to originate local TV programs as well as transmit or record on video tape the central programs as desired.

Two youth rehabilitation schools will also be able to connect with the system, and the University of Delaware and Delaware State College will use it for college extension courses and in-service teacher training.

In the past few years, the number of closed circuit TV networks has jumped to more than 300, and the Bell System has played an important role in ETV development from the outset. This fall, as the children of Delaware use this system, it will be studied for other possible statewide applications.

High-speed Data Set for Unattended Transmission

Bell System DATA-PHONE (service mark of the Bell System) service now enables business machines transmitting at speeds up to 2,000 bits per second (about 2,700 words per minute) to converse with one another without any human intermediary. Operating in conjunction with Bell System 801-type Automatic Calling Units, the 201A DATA-PHONE data set, companies with several puter-to-computer transmissions as well as with machines that transmit punched paper tape, magnetic tape and card media.

With this new feature of the 201A DATA-PHONE data set, companies with several branch offices will be able to poll these offices automatically over the regular telephone switched network for sales, production and other information. By making such polls in off-hours, companies will be able to take advantage of lower evening telephone rates and also reduce the transmission traffic which their telephone service must handle during regular hours.

The typical equipment configuration would consist of an automatic calling unit and a data set at the headquarters location and a data set at each branch, along with the business machines. The telephone numbers of the locations to be polled would be stored in the computer system. At a pre-determined time the computer would begin to feed the numbers in sequence to the automatic calling unit. The calls would then be placed automatically to the location being polled.

The transmitting unit at the branch would then be activated and would start sending data to the central office. This data would have been loaded into the transmitter sometime earlier, perhaps at closing time.

In new machine, wire enters drawing dies through an ultrasonically agitated liquid.

New Wire Drawing Technique

A technique for producing wire with a very smooth surface by drawing it through dies submerged in an ultrasonically agitated liquid has been devised at Bell Telephone Laboratories. The agitated liquid continuously cleans the wire and dies so that the drawn wire is relatively free of embedded particles and surface scratches.

Reduction of surface imperfections in wire improves its properties in some instances. For example, a smooth finish is desirable in those types of magnetic memories that store information on a thin film of metal plated onto a wire. The wire finish should be as smooth as possible so that the film can be deposited evenly.

In the new technique, the ultrasonic energy forms extremely minute vapor cavities in the liquid wherever it contacts a solid surface. The expansion and collapse of these cavities —known as cavitation—"scrubs" the wire clean of foreign particles before it enters the dies to be reduced. The ultrasonic agitation keeps the particles suspended in the liquid and prevents them from collecting in the entry areas of the dies; thus they do not score the wire as it is drawn through the dies.

The discovery of this technique led to the design and construction of an 11-die production-type machine. This machine is capable of drawing high-purity copper and hard nickel-chrome alloys to wire as fine as 0.0007-inch diameter. Pure copper wire can be drawn from 0.01 to 0.003-inch diameter at 1000 feet a minute using nine dies. Each die reduced the cross-section 30 per cent. Conventional drawing to the same size uses 14 dies and 20 per cent reduction per die.

In the laboratory experiments, pure aluminum, one of the most difficult metals to draw

Telephone installers check Project LASA sensor before it is lowered into place.

because of its softness and its abrasive oxide surface layer, was reduced to a 0.003-inch diameter wire. The ultrasonic cleaning removed a substantial amount of this abrasive oxide, thereby increasing the wire's drawability.

This new technique is expected to increase the life of the drawing dies, reduce wire breakage problems, and enable close dimensional control to be maintained over long lengths of wire.

Project "LASA"

Dedication ceremonies for Project LASA (Large Aperture Seismic Array) were held in Billings, Montana in October. The project was developed by Massachusetts Institute of Technology's Lincoln Laboratory to permit detecting underground nuclear explosions anywhere in the world and consists of 21 underground sites scattered over a 600 square mile area. Each site collects vibration data from 20 sensing devices located 200 feet underground and equally spaced from a central vault.

Much of the success of the project depends on communications. A Bell System-designed wideband data transmission system connects the sites to a central computer located in Billings. Synchronous data are transmitted at 19.2 kilobits per second over 525 miles of open wire line and 3,500 channel miles of microwave.

The transmission system was conceived last Fall; the first site went into service May 14, 1965 and the final site on October 1, 1965. A relatively large underground nuclear explosion in Soviet Central Asia on October 8 was clearly detected by the new equipment, although not completely recorded because some of the associated apparatus was not turned on at the time.

Bell Labs Sled Probes Ocean Floor

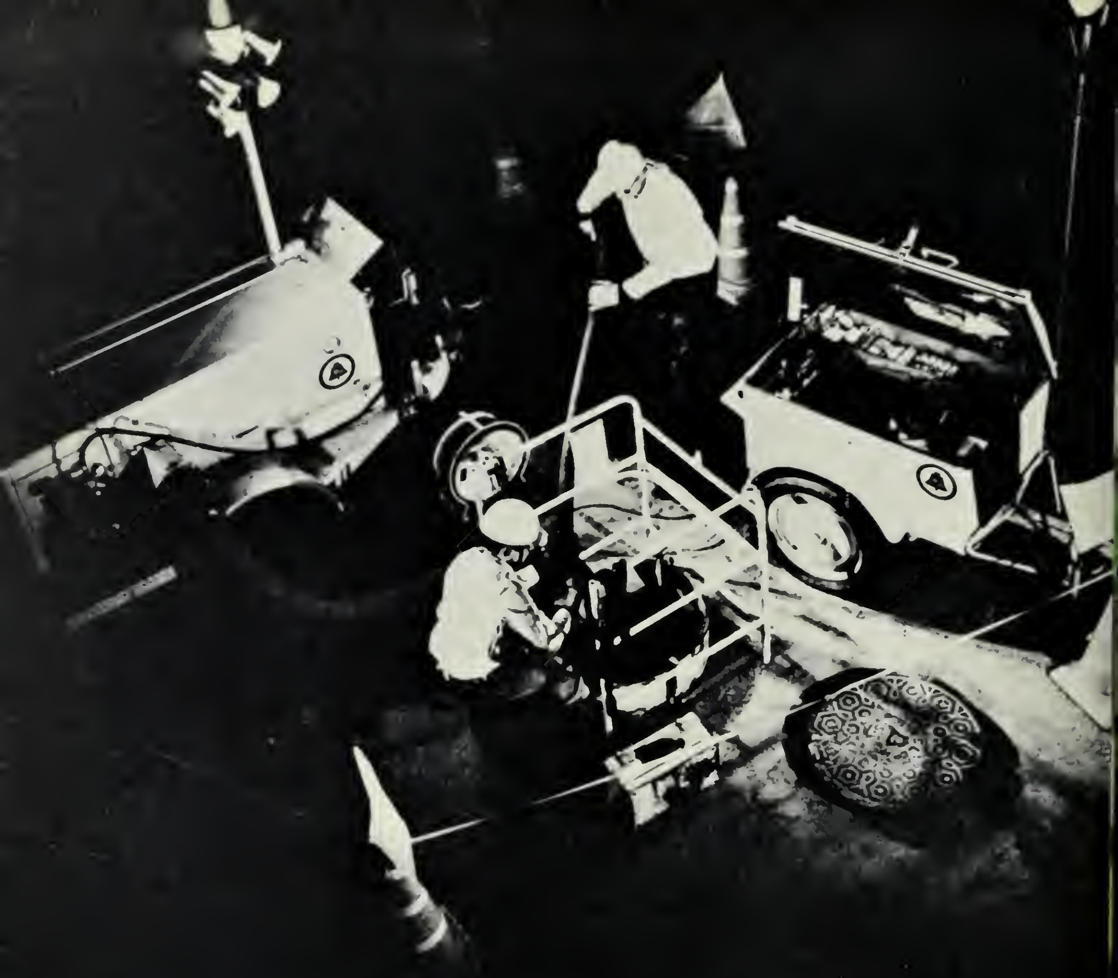
A team of Bell Laboratories scientists has gone to sea with a three-and-a-half ton underwater sled to determine the feasibility of trenching transatlantic telephone cables. Designed by Bell Labs, the sled is being towed by the British cable ship **Cyrus Field,** which is under charter to A.T.&T.

To carry out its mission, the underwater vehicle is equipped with two wheels that measure the consistency of the ocean bottom, two 35mm underwater cameras with powerful strobe flash equipment and a television camera monitored aboard the 223-foot cable ship.

The wheel device attached to the sled consists of a light wheel that rides along the surface of the ocean floor and a heavy one that presumably penetrates the floor's surface. To come up with detailed quantitative information about the nature of the ocean bottom, instruments aboard ship record the difference between the depths of the two wheels as well as the sled's angle of tilt.

Hopefully, this series of experiments will show that the terrain is suitable for trenching, which would provide greater protection for the two transatlantic cables in the Grand Banks area off Newfoundland that are most often cut by fishing vessels. The two are TAT-1 which stretches from Oban, Scotland to Sidney Mines, Nova Scotia and TAT-2, between Sidney Mines and Penmarch, France.

The sled has already completed five runs averaging 200 fathoms, one three miles long and another six miles long, in the Cabot Strait, a 50-mile stretch of water between southwest Newfoundland and Cape Breton. The strait connects the Gulf of St. Lawrence and the Atlantic Ocean. The three other runs were made in an area 200 miles east of St. John's, Newfoundland, where cable damage is also frequent.



BELL TELEPHONE MAGAZINE

WINTER—1965-66

BELL TELEPHONE MAGAZINE

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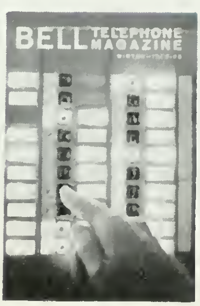
This magazine is published to present significant developments in communications and to interpret Bell System objectives, policies and programs for the management of the Bell System and for leaders of business, education and government.



Cover:

One of the Bell System's contributions to the space age is symbolized in this photograph of the "switchboard for space" which enables NASA officials to set up circuits and conference calls around the world and with astronauts in space. Such communications are the subject of "GLDS," on page eight.

DOCKET NUMBER
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where we stand in the FCC investigation

SINCE THE FEDERAL Communications Commission announced that it would make a sweeping, formal investigation of Bell System interstate rates, there has been a great deal of speculation and some concern, both within and outside the business, as to how this investigation might affect us. While it is still too early to answer all the questions which might come to mind, our views as to the basic issues are clear.

First of all, it should be stated that our business will be guided by the same principles and objectives that have prevailed in the past. Our construction program has not changed. We spent in the order of $3.9 billion for more and better services in 1965. Plans call for expenditures in the same range in 1966. Today as always we are dedicated to giving the best service possible.

Our business is good today and prospects for the future are good. We are confident that we will come out of this investigation as strong and sound as we are now. During the investigation we will give the FCC all relevant facts about the business. These facts will add up to many volumes of testimony. The sum of this vast array of material can only show that our business is now, and has been, conducted in the best interests of the public.

To illustrate this last point, our interstate earnings have averaged about 7.5 per cent on investment for the past several years—well within the range the FCC has deemed satisfactory. Also, interstate telephone rates are 22 per cent lower than they were prior to World War II—a period in which the cost of living generally has increased over 100 per cent. During the last six years alone there have been three major interstate rate reductions. Today, of course, it is possible to call across the continent for $2.00 and for only $1.00 after 8 p.m. and all day Sunday. As a result more people are making more calls at lower prices than ever before.

Good Earnings Mean Progress

But lower rates and increased volume of calls are only part of the picture. The facilities which people use have steadily increased in efficiency. In fact, our interstate network is an outstanding example of how continuing development can bring a new era of convenience, versatility and speed. Obviously, if we are to continue to grow and innovate, good earnings are fundamental. Only through earnings levels which attract the large sums of capital we need, and which give us the financial leeway to innovate and grow, can progress in communications continue into the future. We believe our earnings should be in the range of eight per cent to help us compete for investor capital with unregulated industries whose earnings have risen dramatically in recent years.

A third point which should be stressed is that we are not *against* regulation. We

This map shows how the long distance rate reductions that have been made over the years have made it possible for the nation's telephone users to call farther for less money.

fully accept the fact that public regulation is entirely appropriate for an industry which provides services as vital to the public interest and welfare as ours. As early as 1907, Theodore N. Vail, the president of this Company who was the guiding force in establishing the nationwide system we have today, came out strongly in favor of public regulation for a business such as ours. We fully subscribe to that philosophy and have lived and grown under regulation at all levels of our business through the years.

When we petitioned the FCC to reconsider and revoke its investigation order we did so on the grounds that every aspect of the Bell System's interstate operations are already subject to FCC regulation under long-standing and proven procedures. The "continuing surveillance" method of rate making which the FCC itself has recently strongly supported, has proved to be very much in the interest of the FCC and the public for over 30 years.

The FCC denied our petition on December 23. In a statement accompanying that denial, Chairman E. William Henry said the order did not "imply a determination to require changes in A.T.&T.'s earnings, or in its plans for the financing of expanded investment in new services and new plant. It simply reflects a concern that certain matters must be considered at this time on a public record. It is supported by a confidence that A.T.&T.'s health is sound."

A Two Phase Investigation

The FCC has divided the inquiry into two phases. It has set April 4 as the date for the Bell System to file initial testimony. In Phase One the FCC has ordered us to present the ". . . total interstate and foreign operating results based on the most recent 12 months for which data are available . . . ." They have also asked us to show the rate of return required on our total interstate and foreign operations. One of the areas to be covered in Phase One will be the findings of the Seven-way Cost Study, which we conducted at the direction of the FCC. As a result of the FCC's interpretation of this study, the Commission has suggested that some of our services may be underpriced and that the competitive effect on other communications companies, particularly Western Union, needs to be examined. As A.T.&T. Board Chairman Frederick R. Kappel has pointed out, "In our judgment this study is based on false premises and cannot produce right answers." (See also transcript of testimony presented before the FCC by Dr. James C. Bonbright, page 18.)

One facet of the investigation coming under Phase Two deserving of specific comment is the question of the "reasonableness and propriety" of separations procedures used in the allocation of expenses and revenues between intra- and interstate service. Historically, separations procedures have been arrived at by agreement between the Federal Communications Commission and the National Association of Railroad and Utilities Commissioners. Inasmuch as the FCC has stated separations procedures will be part of the investigation, we feel they should be the first part. NARUC and others petitioned the FCC to deal with separations as the first order of business. A.T.&T., in a subsequent filing, supported NARUC's petition.

NARUC's petition pointed out that separations procedures for allocating investment and associated costs between interstate and intrastate services need to be clearly defined before any meaningful examination of interstate rates can be attempted. Logically, the question of rate base comes before rather than after the question of appropriate rate of return on that rate base.

W.E. Earnings Phase Two of the investigation will include an inquiry into "the reasonableness of the prices and profits of Western Electric," and specifically the question of "whether Western Electric requires a greater rate of return . . . than the rate of return determined to be required with respect to the interstate operations of the Bell System."

Western Electric's price performance is clearly outstanding (see the charts on page 7). This impressive record is possible because Western Electric, as a part of the Bell System, has a continuing policy of manufacturing all of its products at the lowest possible cost. It maintains a continuing cost reduction program which encompasses every branch of the company's operations year in and year out. A dramatic demonstration of the success of this program is the fact that during 1965, Western Electric achieved cost reductions of $30 million in manufacturing operations alone, and in the previous five years reductions ranging from $18 million to $29 million annually were realized.

To an impressive extent these savings have been passed on to the Operating Companies. In 1964 W.E. reduced the prices of its Bell System products by some $44 million on an annual basis and in 1965 there was a further reduction amounting to $33 million.

As a result Western Electric's overall prices to the Operating Companies are considerably lower than those of other telephone manufacturers. For example, since the early 1950's the price of a 500-type telephone to Bell companies has come down from $13.90 to $10.40 as a result of the cost reduction program. The lowest price for a generally available comparable set outside the Bell System is about $20.

As to Western Electric earnings, there are compelling reasons why they should not be held in the same range as those for our interstate operations. In the first place, although Western Electric has the same service objectives as the Operating Companies and closely cooperates with them, its economic structure and needs are quite different. As a manufacturer, Western Electric is exposed to much the same risks as other electrical equipment manufacturers.

However, unlike other producers of capital goods, W.E. is limited in its ability to diversify. As a partner in the Bell System, W.E. is expected to tool up to meet the anticipated demands of the Operating Companies. Estimates of future construction requirements are regularly filed with Western by the other Bell Companies; nevertheless, a shift in growth prospects can, at any time, result in sharp cuts in construction. Under such circumstances it is possible for Operating Company revenues to hold steady or even to rise. For Western Electric, however, construction cuts mean layoffs, underutilization of investment, and idle facilities.

Despite a very real element of risk, Western's earnings are lower than the average of other large manufacturers. Its rate of return on Bell System business over the years 1946-1964 averaged 9.5 per cent—compared with an average of 11.8 per cent for the nation's 50 largest manufacturers and 12.2 per cent for General Electric and Westinghouse. Although W.E. ranked sixth in number of employees and eleventh in sales in *Fortune* magazine's latest directory of the 500 largest U.S. Industrial Corporations, it ranked 262 in profits as a per cent of sales and 235 in profits as a per cent of invested capital.

Procedures During the investigation, there will be evidence presented not only by A.T.&T. but also by the FCC Staff and other interested parties. Some 60 organizations—other communications companies, the U.S. Independent Telephone Association, the National Association of Railroad and Utilities Commissioners and many state commissions—have notified the FCC that they will intervene.

Commissioners Hyde, Bartley and Cox—with a hearing examiner—will preside at the hearings.

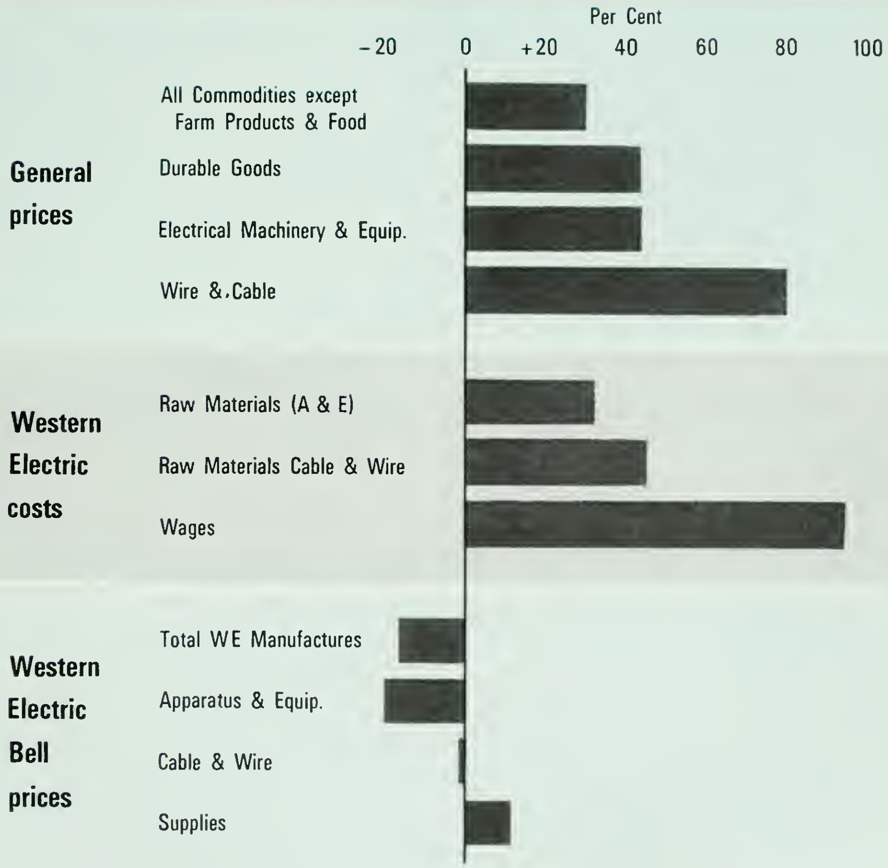
On January 12, 1966 A.T.&T. filed a petition to modify the procedure which the Commission has proposed to follow, under which the FCC Common Carrier Bureau Chief and his staff would act as investigators, prosecutors and judges. They would participate in making Commission decisions free of the restrictions on off the record presentations which apply to others involved. The need for a change is accentuated by the fact that the Common Carrier Bureau in its investigatory and prosecuting functions, has already taken positions adverse to the Bell System position.

At press time the FCC had not acted upon this petition nor on the petition made by NARUC and others that separations be dealt with as the first order of business.

No one knows how long it will take to complete the investigation. But it is apparent that assembling and presenting the vast quantities of factual material required will occupy the time and effort of many Bell System people over a period of many months and probably several years. Those not directly concerned with the case have a broader and equally compelling directive—to maintain a standard of excellence in our service at all times.

The complex matters which are at issue in this investigation are little understood or quickly forgotten by the public—our customers. The manner in which we serve each individual is the criterion by which we are ultimately judged. Good service, now as always, is our true franchise—our license to exist.

Western's price performance is outstanding . . .

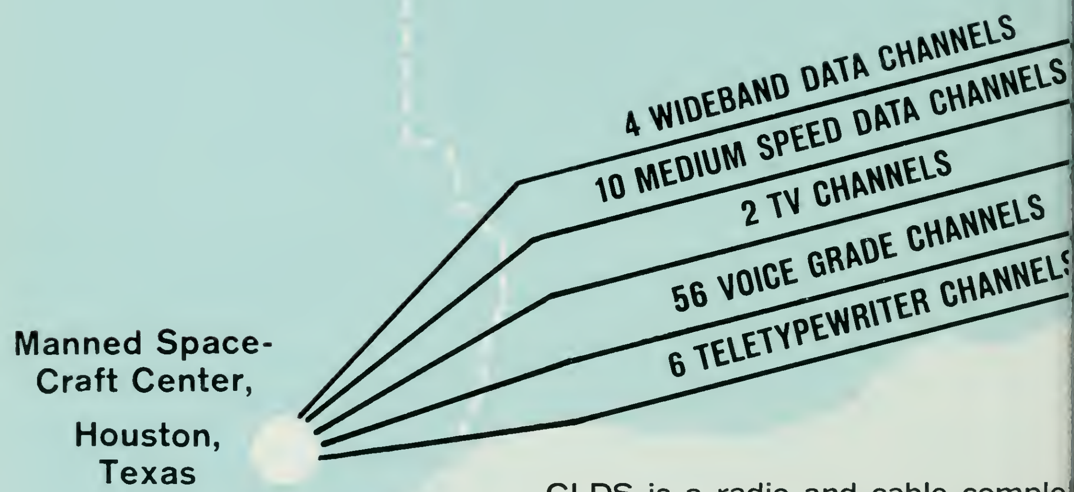


The bars above indicate the per cent change in prices since January 1, 1950.

GLDS

GEMINI LAUNCH DATA SYSTEM

The channel facilities shown below were furnished for the launch of the recent GT-7/6 mission, involving the rendevous of Gemini 7 and Gemini 6.



GLDS is a radio and cable comple of data, television, telephone and tele typewriter circuits built for NASA b the Long Lines Department of A.T.&T and the Bell Telephone Companies wit equipment manufactured by Wester Electric. GLDS is so instantly efficien that flight directors at the Manne Spacecraft Center in Houston, Texa are, for practical purposes, effectivel present in the launch control room a Cape Kennedy a thousand miles away

Formerly, all space missions wer directed from Cape Kennedy. As mis sions grew more complicated, directio was shifted to Houston where there i the maximum space required for deve

›pment of the Apollo man-on-the-moon
›rogram.

The GLDS communications express-/ay is merely one segment of an in-redibly complex system that ties ›gether a worldwide network: the lational Aeronautics & Space Ad-ninistration Communications System NASCOM), which handles message, ata and voice communication on every pace mission. The network has a ervous system that reaches into outer pace and interconnects Mission Con-rol in Houston with launch control at ne Cape and Communications Control t Goddard Space Flight Center in ›reenbelt, Md.

GLDS

For the press at Cape Kennedy, 120 telephones are installed on a mound overlooking the distant launch pad. Radio and TV reporters broadcast from the press site over Bell System circuits.

In TV monitoring room, screens show scenes transmitted by all networks. At right are Long Lines and NASA representatives.

Press representatives have required as many as 820 special telephone circuits to send eyewitness accounts of launches.

Western Electric installers complete equipment, at Southern Bell office near Cape Kennedy, which automatically switches messages to another circuit if there is any service interruption.

GLDS

"Press hill" at Cape Kennedy commands a distant but excellent view of the launch pad, where the now-familiar cloud of smoke marks another blastoff.

Heart of NASA's global communications network is the Goddard Space Flight Center in Maryland, where voice communications are controlled and switched through this special board. Conference calls can be set up instantly with NASA officials around the world, and with astronauts traveling in orbit.

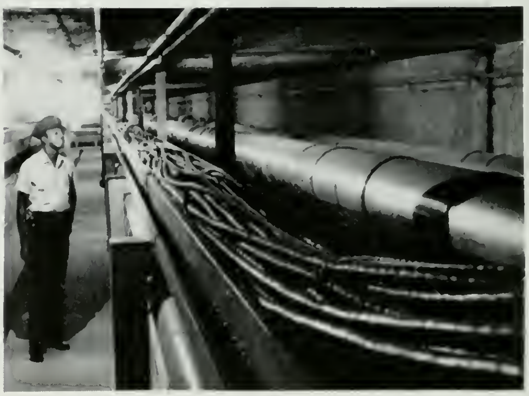
GLDS

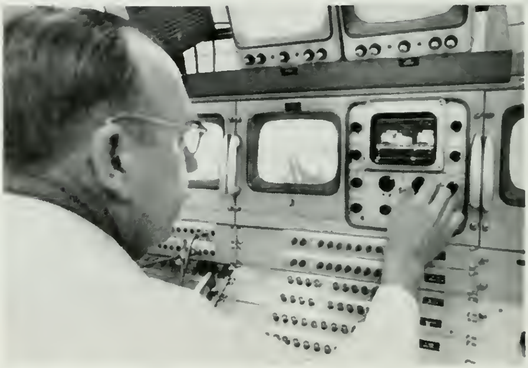
Mission Control Center at Houston, Texas, directs space flights; data on orbiting capsule and all phases of the operation is displayed on the consoles before technicians, who can communicate with astronauts and stations around the world. Gemini Launch Data System links control center with launching facilities at Cape Kennedy. Through GLDS, Flight Director Kraft, lower right, is informed instantly of a mission's progress at launch, and can transmit immediate decisions.

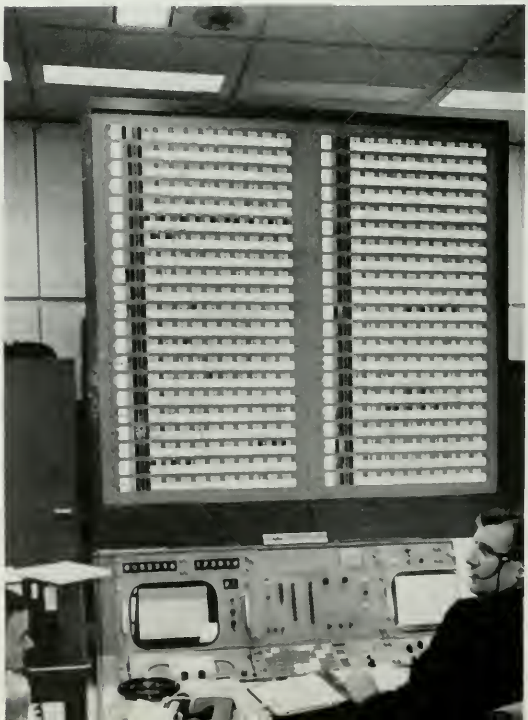
Test room at the toll center in Houston is operated by Southwestern Bell and is dedicated to space communications for NASA.

Flight Director Christopher C. Kraft controls space missions from this console in Houston. GLDS enables him to take instant action.

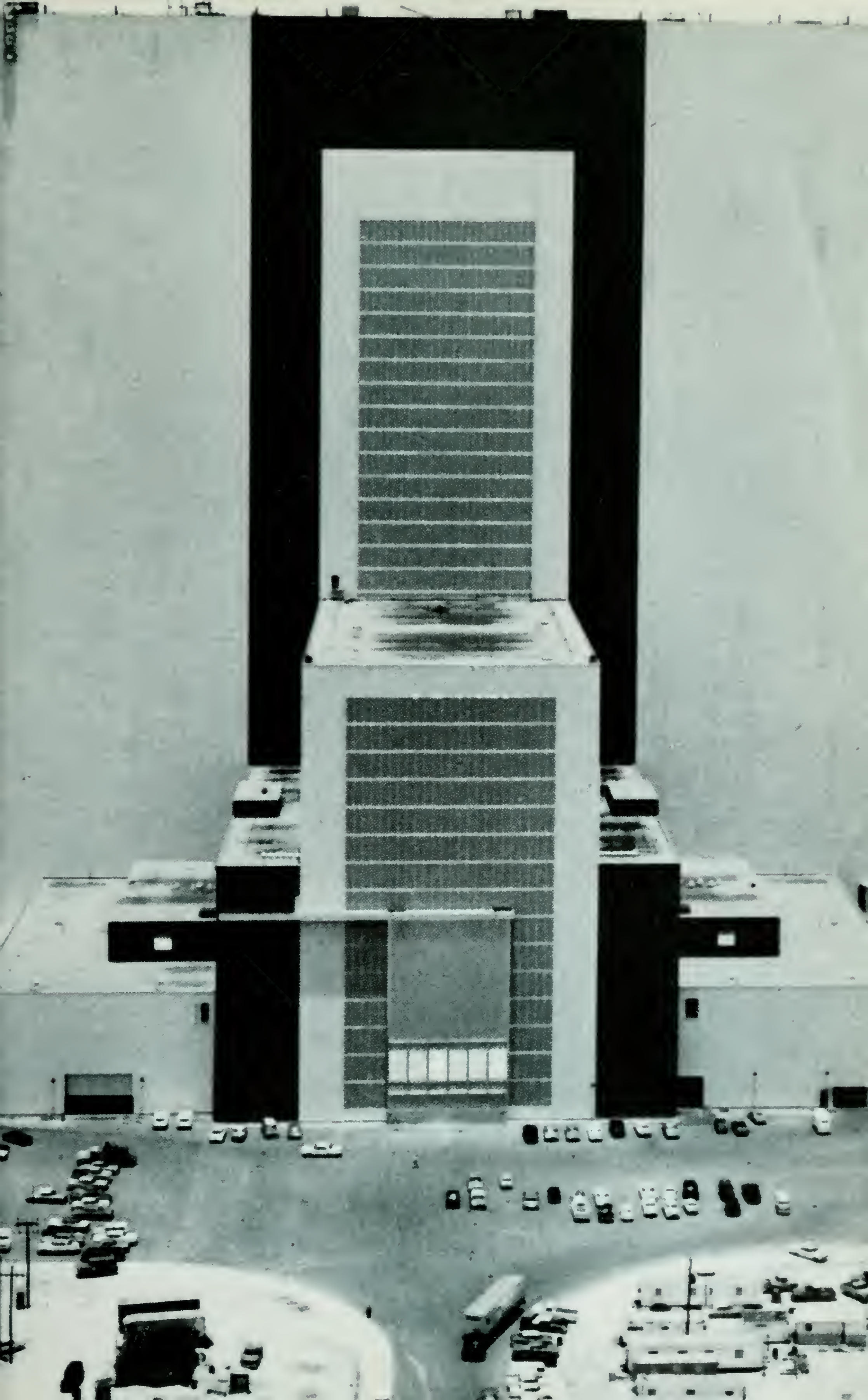
GLDS







(top) Security guard patrols tunnel route of cables connecting Mission Control Room and nearby Long Lines toll center, where space communications circuits start routes around the world. (center) TV coverage of space flights is monitored at Long Lines headquarters in New York. (bottom) NASA's Chief Communications Controller, right, and Long Lines representative, supervise control of communications during space flight; board displays the status of all circuits. (opposite page) World's largest building, the 52-story Vertical Assembly Building, where the Saturn rocket destined for the moon will be assembled before the end of 1969.



These facts are pertinent to Dr. Bonbright's testimony and may serve as helpful background for many readers.

The first reason cited by the FCC in its October 1965 order for a rate investigation was that a special cost study of Bell System interstate services showed wide variations in the earnings levels of the various services. This study, begun in 1963, was undertaken by A.T.&T. at the request of the FCC in connection with the Domestic Telegraph Investigation. As directed by the Commission, the study allocated Bell System interstate revenues into seven categories (hence the sobriquet Seven-Way Cost Study): (1) message toll telephone; (2) Wide Area Telephone Service (WATS); (3) teletypewriter exchange service (TWX); (4) telephone grade private line; (5) telegraph grade private line; (6) Telpak; and (7) "all other."

The study was based on a plant inventory and a 10-day sampling of circuit and switching facility usage in March, 1964; this information was applied to total interstate operations for the 12 months ending August 31, 1964. Preliminary results, presented to the FCC September 10, 1965, showed earnings ratios for the study period ranging from 10.2 per cent for Wide Area Telephone Service to .3 per cent for Telpak and .9 per cent for "all other," the category which includes radio and TV channels. A.T.&T. has cautioned that these results do not provide a basis for judging **current** earnings or even the appropriateness of earnings levels during the study period. In keeping with the FCC's request, the study was based on a full allocation of embedded (or historical) costs. As Dr. Bonbright points out, this approach to determining the cost of particular services is not a valid basis for rate making.

THE SEVEN-WAY COST STUDY

An Economist's View

The following is a transcript of testimony given by Dr. James C. Bonbright before the Federal Communications Commission early in December in connection with the Domestic Telegraph Investigation. Dr. Bonbright is the author of the book, *Principles of Public Utility Rates* (Columbia University Press, 1961). He is Professor Emeritus of Finance at Columbia University, and has served as consultant to the U. S. House of Representatives, Chairman of the New York Power Authority, and Chairman of a special committee of the Tennessee Valley Authority. A professional economist whose special field of interest for many years has been public utility economics, Dr. Bonbright appeared as a witness for the FCC in the Commission's review of Bell System earnings in 1962 and 1963.

THE SUBJECT of my testimony concerns the relevance of the results of the Seven-Way Cost Study in reaching conclusions as to the reasonableness of the rates for the various interstate telecommunications services. Being thus limited in scope, it is not offered as a broad commentary on all considerations that might be urged either in support or in criticism of the existing rate structure. For example, considerations such as the contention that charges by the

Bell System for services directly competitive with those offered by Western Union should be determined by the latter company's revenue requirements are not discussed since they go beyond the purview of a Cost Study intended only to disclose Bell System costs.

Perhaps I should add that this restriction in the scope of my testimony is self-imposed instead of being imposed by the A.T.&T. Company. In requesting me to make the Study, the Company invited me to cover whatever considerations of rate-making policy I felt to be germane to this whole inquiry. But quite aside from the limits of time, I preferred to center attention on the role of cost apportionment or cost allocation in the determination of a sound rate structure. This subject alone is complicated enough at best without being confused by the introduction of non-cost criteria of rate making.

Significance and Limitations of the Cost Study

Before discussing in detail the import of the Cost Study for rate-making purposes, let me state in general terms my view as to its significance for these purposes. On the one hand, I believe that it has real and important significance, especially so because, taken at face value, it raises a serious question whether Bell System charges for certain categories of interstate service have yielded, or can reasonably be expected to yield, revenues that cover the costs of these services including capital-attracting rates of return on allocable investments in plant and equipment. But on the other hand, I believe that this significance is decidedly limited, and this for two quite different reasons: first, that "cost of service," in any acceptable meaning of this highly ambiguous term, is by no means the only proper criterion of reasonable rates or rate relationships; and secondly, because the Cost Study itself is based on principles of measurement that disqualify it as a reliable measure of the profitability of each of the seven categories of service.

The first of these two limitations would apply, not just to the present Cost Study but to any other. For vitally important as are cost criteria to the design of an economically sound structure of utility rates, other criteria (sometimes complementary, sometimes even partly conflicting) are also essential. Among these non-cost considerations are (a) "value of the service" in more than one sense of this ambiguous term, (b) avoidance of undue complexities in the rate structure despite appalling complexities in cost relationships, (c) reasonable stability of the rates over periods of time despite high instability in the comparable costs, and even, on occasion, (d) "public policy" considerations that may arguably impose upon a utility company the obligation to supply certain types of service at rates that fail even to cover out-of-pocket costs.

In a later section of this memorandum, I shall have something more to say about the problem of combining "value-of-service" factors in rate making with "cost-of-service" factors. But for the most part I shall ignore non-cost criteria of rate-making policy in order to center attention on the second limitation of the Bell System Cost Study: namely, its use of principles of cost apportionment that cannot be expected to disclose, even with reasonable approximation, the costs of the particular categories of service that are of most significance as criteria of reasonable rates or rate relationships.

Three Attributes of the Cost Study Which Impair its Reliability as a Measure of the Relevant Costs of Each Category of Bell System Interstate Services

Without attempting a complete critique of the Seven-Way Cost Study—a task which lack of engineering technique in the field of telecommunications would alone make me incompetent to assume—let me note three attributes of the study which, in combination, seem to me to make it quite unreliable as a measure of the costs attributable to the seven different categories of interstate service.

The first of these three attributes is that the Study belongs in the class of cost imputations sometimes known as a fully-distributed cost apportionment, as distinct from a specific-cost allocation. That is to say, it starts out with total cost ascribable to the Bell System interstate business in gross, and it proceeds to apportion this cost among the seven categories of service without reference to the question whether all costs are allocable to each of these categories on a cost-causation or cost-responsibility basis.

The second questionable attribute lies in the fact that what the Study purports to compare is revenues already realized during a test-year period with costs already incurred during this same period—a comparison which raises serious doubts whether the resulting ratios of reported annual net earnings to reported net investments are representative of the rates of return that each service can be expected to yield in the not distant future.

The third attribute that may constitute a deficiency from the standpoint now under review lies in the major extent to which the Study has followed the same principles of common cost and joint-cost apportionment that are called for by the Separations Manual as a means of distinguishing interstate from intrastate operations for jurisdictional purposes. More specifically, dominant employment has been made of a so-called "use" basis of apportionment, largely measured either by minutes of use or else by minute miles. Judged from the standpoint of cost determination for rate-making purposes, this practice is subject to question.

The Three Above-noted Attributes of the Bell System Cost Study are not Necessarily Deficiencies of a Cost Apportionment Designed to Serve the Special Purposes of the Separations Manual

In later paragraphs I shall give my reasons for believing that the three above-noted attributes of the Bell System Cost Study, in combination, seriously detract from the reliability of the results of the Study as bearing on the reasonableness of the System's structure of interstate rates. But before doing so, let me note that attributes of a cost apportionment which would constitute deficiencies if applied for the purposes of rate making, by no means necessarily constitute deficiencies if applied for the very different purposes of the Separations Manual.

Without attempting to state the full import of this distinction in purposes, one may note, first, that, whereas the usefulness of a fully-distributed cost apportionment is at least questionable for rate-structure purposes, such an apportionment is not only permissible but mandatory for the purpose of jurisdictional separations. Here, the apportioner dare not leave any gaps on the one hand nor any overlaps on the other between costs that he assigns to the interstate business and costs that he assigns to the intrastate business. Hence apportionments of total costs are essential, however arbitrary they may be from the standpoint of cost finding or cost analysis. But no such necessity arises in cost analysis for rate-making purposes, since non-cost criteria of reasonable rates and rate relationships can make good the analyst's refusal to impute to given types of service costs that simply cannot be allocated on a cost-causation basis. Moreover, in the apportionment of total costs for the purposes of jurisdictional separation, the acceptance of costs already incurred as a matter of history instead of estimates of future costs, and the reliance on relatively simple but objective bases of apportionment—bases acceptable partly for reasons of practical compromise—may justify the resort to methods of measurement that would be far too crude to be carried over into the extremely complex field of rate-structure design.

Unreliability of Fully Apportioned Costs as Measures of the Costs Attributable to any Given Class of Service

Let me now consider in turn each of those three attributes of the Seven-Way Cost Study which, in my opinion, impair its reliability as a measure of the profitability of each type of service. To be sure, the deficiencies resulting from these attributes are of a compound nature instead of being subject to an arithmetic summation of their total effect. Even so, the attributes can be distinguished for purposes of exposition.

The first attribute to be noted is that the Study belongs in that general class of utility cost imputations called a "fully-distributed cost" apportionment as distinct from a cost allocation designed to measure the cost-causing responsibility of any particular type and amount of service. Unlike an allocation of the latter type, the apportionment starts with the total costs of operating a utility business (or else, as is the case with the Study under review, with some grand division of total costs) and then proceeds to distribute this total among the various classes or units of service in such a way that the sum of the imputed specific costs equals the total costs, no more and no less.

Any of various methods or combinations of methods may be used in the apportionment of those costs that are incurred jointly or in common for the production of more than one class of service. But since, by the very nature of the assignment, "the sum of the parts must equal the whole," *all* costs must be apportioned even if, as in the case of strictly joint costs, they are literally unallocable for purposes of true cost determination. Moreover, since no direct account is taken of the likelihood that some combinations of services can take advantage of economies of large-scale production ("economies of scale"), the costs apportioned among these services are likely to exceed the sum of the incremental costs of the same services.

The fact that a total cost apportionment equates the sum of the imputed class costs with the total costs makes a resort to this kind of cost imputation, however arbitrary, all but mandatory for certain purposes including the purposes that have led to the development of the Separations Manual. And the same convenient attribute of the apportionment lends to it an appealing attractiveness even for rate-structure purposes under any standard of rate regulation which undertakes to make rates as a whole cover costs as a whole. But the attractiveness is a specious one, since the apparent equality between total costs and the sum of the separate costs is attained only by resort to factitious methods of cost imputation—methods which, save under somewhat unusual conditions, cannot be expected to reveal the costs of supplying any given service in any given amount as distinct from the costs that also aid in the supply of other services.

A recognition of the fact that fully-distributed costs cannot be expected to reflect the costs of any specific operation of an integrated business has led the staff of the Interstate Commerce Commission to draw a sharp distinction between those railroad operating and capital costs that it regards as varying with volumes of traffic, and those remaining costs or revenue requirements that it treats as constant or as unresponsive to changes in traffic. In arriving at what it calls the "long-run out-of-pocket costs" (a term akin to the academic economists' "long-run marginal costs") of railroad full-carload-lot freight traffic, it allocates only the "variable costs." But it then apportions the residues of total revenue requirements in a manner *which makes no pretense* that such costs are allocable on a cost-responsibility basis.

The above-noted infirmity of a total cost apportionment when offered as a guide to rate-making decisions has been recognized, in effect though not always in words, by the very experts who have made cost analyses of this nature as exhibits for introduction into the record of rate cases before public service commissions. For these experts are likely to concede that some services may profitably be sold at rates that fail to cover the very costs imputed to them. But this concession amounts to a contradiction in terms. For how can rates be fully compensatory, or even more than compensatory, if they are below the costs of providing the service in question? The truth is, of course, that the costs which the rates may fail to cover are arbitrarily apportioned shares of total costs, not actual costs in an economically significant sense of that word.

An often repeated statement, made by the very persons who criticize the acceptance of fully-distributed cost apportionments as a measure of reasonable rates, is the statement that costs are not alone to be taken into account in the design of a sound rate structure. This statement is quite correct as far as it goes. But what it may be taken to imply is that fully apportioned costs can be assumed to measure true costs and hence that any rate-making deviations from the cost apportionments can be justified, if at all, only on non-cost considerations. The wide acceptance of any such false implication would be most unfortunate for the theory and practice of public utility rate regulation.

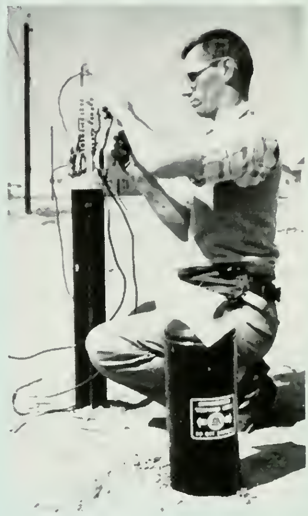
The alternative, or at least the essential supplement, to a fully-distributed cost apportionment such as the one now under review, is a cost analysis designed to estimate the costs expressly allocable to particular classes of service on a cost-responsibility basis. Such a study begins with the postulate that, when various products or services are produced by a joint operation, the only cost that can be attributed expressly to service A *as distinct from* the costs also atributable to the other services, are the increments in total cost imposed upon a company by the addition of this service to its other services, or else the savings in cost that the company could enjoy if it were to abandon this one service. These last two measures of allocable cost may differ markedly. But with a growing utility enterprise, where plant requirements are expanding, not contracting, the incremental costs are the relevant costs for rate-making purposes. On occasion, incremental costs may exceed the so-called "full costs" (a misnomer, by the way) that would be reflected by a fully-distributed-cost apportionment. But more often than not, they will fall short of the apportioned costs.

Since, in the absence of special reasons pointing to a contrary conclusion, the sum of the incremental costs of all classes of service cannot be expected to equal total costs including a capital-attracting rate of return, rates set at these costs could not be counted on fully to meet corporate revenue requirements. Despite this fact, incremental costs play a vitally important part in rate making. For properly estimated, they set the dividing line between compensatory and non-compensatory rates for any given class of service, between profit and loss on this service, between rates that will yield revenues which help to support the supply of other services and rates that throw a burden on other services. The same significance cannot be claimed for costs that are apportioned among services in the manner employed by the Seven-Way Cost Study—not unless these apportioned costs should happen to approximate incremental costs, an approximation which they could not be expected to attain except under unusual circumstances.

(Continued on page 45)

Heritage

and Harmony



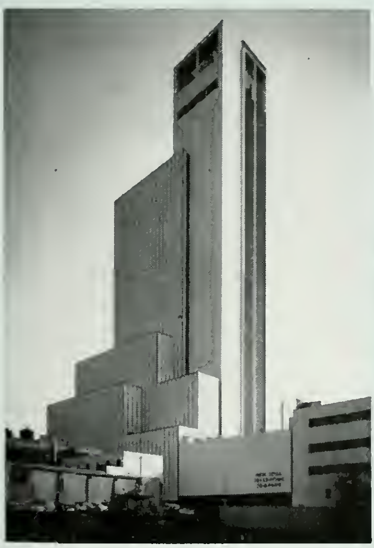
Today's healthy interest in preserving America's beauty finds wholehearted support in the Bell System. In fact, as the following pages indicate, the appearance of its plant and buildings has been of traditional concern to the Bell Companies. One of the major areas in which steady progress has been made in the last decade is buried cable. New housing starts served by buried cable increased from one per cent in 1957 to nearly fifty per cent last year. New materials and methods have made this advance technically and economically feasible. The Bell System goal: buried cable for all new housing developments by 1970. After cable is laid, left, nothing is visible except the terminals, right and below, where the phone cables connect with wires from homes.


PACIFIC TELEPHONE

The Bell System's sense of responsibility, as a business, for aesthetic values can be seen embodied in the buildings at left—from top to bottom, in Franklin, La. (Southern Bell), Mt. Vernon, Va. (Chesapeake and Potomac Telephone Co. of Va.) and Menlo Park, Calif. (Pacific Telephone)—and the New England Telephone Co. building in Lenox, Mass., below. All illustrate the Bell System policy that, as good neighbors, telephone buildings should not only be worthy of public regard in fulfilling their functional requirements but should also, by their compatibility with surroundings, indicate respect for the heritage, the present and future of the community itself.

Plant garages in Rosenberg, Texas (Southwestern Bell) and El Paso, Texas (Mountain States Telephone Co.) show what Bell Companies are doing to solve the difficult problem of building company garages which complement country and community. Buildings at base of microwave towers which relay long distance calls are another problem; A.T.&T.'s Long Lines Dept. designed building near Salt Lake City, below, to fit in with local architecture.

Nor are large buildings excluded from these concerns: excellent architecture and landscaping make the Southfield, Mich. (Michigan Bell) office above not only fit in, but also enhance, the community. Functionally, the buildings below—in New York City (New York Telephone Co.), left, and in West Palm Beach, Fla. (Southern Bell), right—are the same; they house large masses of switching equipment. Yet each expresses its function differently, in terms of its locality.



◆1966 Honor Award

1966 Merit Awa

Microwave towers in downtown locations pose particular problems. Towers shown here—top right, Bartlesville, Okla. (Southwestern Bell); lower right, Los Angeles (Pacific Telephone); left, Seattle (Pacific Northwest Bell)—are each examples of attractive, individual solutions which harmonize with both their building and locale.

1966 Honor Award

1966 Award Winners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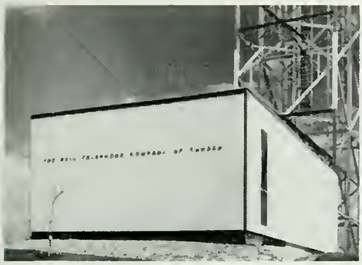
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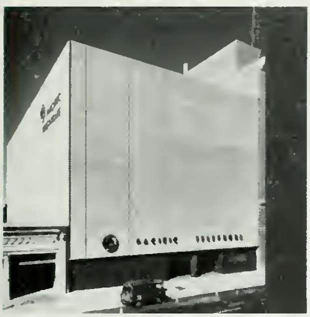
To encourage excellence in the architectural design and planning of Bell System buildings, A.T.&T. has held biennial Architectural Reviews, in which buildings are judged by a jury of prominent architects. Many of those shown on the preceding pages have been winners in previous contests, and this year's winners have been noted. The buildings on this page were Honor Award winners in the 1966 Review. They are: (1) Houston, Texas (Southwestern Bell); (2) Toronto, Canada (Bell of Canada); (3) Fresno, Calif. (Pacific Telephone); (4) Houston, Texas (Southwestern Bell); (5) Dracut, Mass. (New England Telephone); (6) Penns Neck, N.J. (New Jersey Bell); (7) Dallas, Texas (Southwestern Bell).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BLACKOUT

■ DURING THE NIGHT of November 9, 1965, and the following day, 30,000,000 people in the northeastern part of the United States learned two facts: first, that the electric power for that 80,000-square-mile area is provided through an interlocking interdependent system (a power grid, or *intertie*) extending from New York City into Canada, and second, that the telephone could still be depended upon to work during history's biggest power blackout.

The first of these facts came as a complete surprise for most of the area's population. But surprise is not the word to describe the public's reaction to the fact that, groping though they were in darkness, they still could use the telephone. After it was all over, hundreds of letters to the Bell Telephone Companies and many articles in the press testified to the general feeling of gratitude that communications remained virtually intact. Public sentiment can be summed up in one woman's letter to the New England Telephone and Telegraph Company: ". . . I am writing by candlelight. It is frightening to be without electric lights for so long. Having the good old faithful telephone in service is a godsend. I am 82 years old. . . ."

Most people think of the telephone—and quite properly—as an electric device. Normally, power used to operate telephone equipment is drawn from local commercial power sources. This is the standard 110-120 volt alternating current used by everyone in homes and offices throughout most of the country. Rectifiers in telephone central offices convert this power to direct current (DC), which operates the switching equipment. It also continually charges banks of large storage batteries which can supply adequate power to keep the office operating, even at peak loads, if the normal AC power supply should fail.

Master Plan

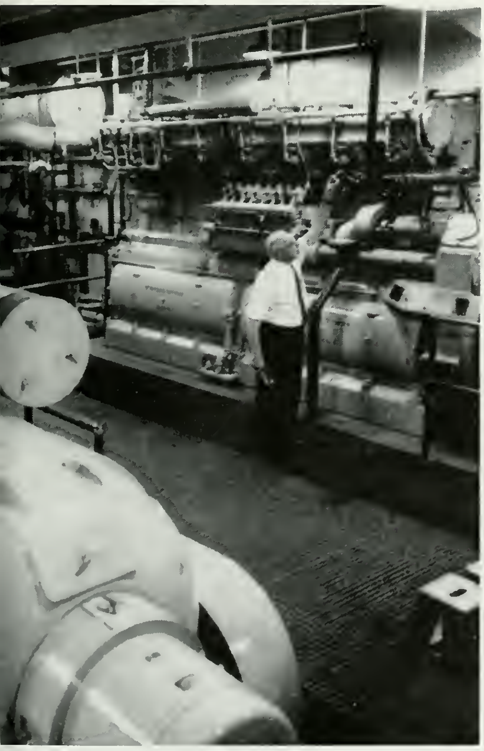
On that memorable night when an eighth of the nation was suddenly trapped at the height of the commuting hour in a totally unforseen emergency, service was maintained because the necessary facilities were on hand. Plans for action were long pre-arranged, and trained, responsible people were ready to put them into effect.

Dependability of telephone service may usually be taken for granted by the public, but it has never been, and never can be, taken for granted by the men and women who provide that service. The communications story of the Northeast's power blackout is a story of planning and preparedness. All Bell System central offices and communications centers are equipped with emergency power arrangements. Every office has banks of batteries mentioned above. Most also have auxiliary power plants, driven by Diesel or gasoline engines. These take over the job of charging the batteries, through the rectifiers, as well as providing power for lights, elevators, ventilating equipment, etc., when a power failure occurs. Within the continental United States, the Bell System has about 8,376 buildings housing central office equipment of many sizes and several types. Every one is equipped with emergency generators in addition to an ample reserve of battery power. This reserve, in the larger offices, is designed to provide three to eight hours of operation; the

New York Telephone Company powerman switches to the emergency power which is kept on standby in all central offices.

larger offices also have permanently installed emergency engines. Battery reserve in smaller central offices and in remote locations is engineered for up to 12 hours of operation, allowing plenty of time for connection of portable generators to take over the load. Altogether, the System has a total of about 6,600 stationary and 2,000 portable emergency power generators. The installed cost of this equipment is over $136,000,000; new power generators are being purchased at the rate of about $6,000,000 per year. The installed cost of storage batteries in the Bell System amounts to approximately $200,000,000, and new ones are being purchased by the telephone companies at a rate of about $14,000,000 a year.

Simply having on hand these physical means of coping with a power failure is not enough. There are regular, rigorous inspection, test and maintenance routines which insure that, if the emergency equipment is needed, it will work. All central office batteries are checked and inspected periodically for both voltage and specific gravity requirements. All standby generators are started and run weekly for an hour to insure that they will start and run properly and that maintenance forces are familiar with their operation. Craftsmen receive mandatory training in operating the standby equipment. In addition to the tests mentioned, there is a transfer once every month from commercial power to emergency power and a semi-annual "load" test run for an extended period. As a further precaution, all fuel tanks for the engine generators



Big, Diesel-driven generators such as those shown above charge the batteries and provide AC for ringing, signaling, lights, etc.

Massive batteries in Bell Telephone Company central offices provide the DC needed for transmitting, switching, receiving calls.

are required to be kept at least at 75 per cent of capacity, which, in conjunction with the battery reserve, will keep central offices operating for from two to four days. Standing arrangements with suppliers of fuel for emergency delivery insure that, if necessary, the central offices can operate on auxiliary power indefinitely.

The Proof of The Pudding

Fortunately for the millions of trapped and groping citizens in the Northeast, the electric power failure on November 9th was not "indefinite"—although, under such conditions, 12 hours can seem an eternity. Shortly before 5:30 p.m. on that day, 1,380 Bell System locations throughout the affected area switched to emergency power—and nearly 16,000,000 telephones continued to work. So did the intercity long distance network and overseas circuits. The prudence of thoroughly-planned, well-rehearsed provisions for emergency telephone operation has been demonstrated on many occasions, but never before so dramatically as on that night. New York City's Police Commissioner Vincent L. Broderick stated that the city would have fallen into "complete chaos" if telephone service had failed along with electric power.

As further insurance that the service will not fail, there is a reserve supply of portable emergency generators which can be dispatched to any key locations where conditions indicate they may be needed. These are standbys *behind* the standbys: an extra margin of safety always held at the ready. And that back-up equipment was put to good use during the blackout. That night, 15 emergency centers were activated in the darkened region. Telephone personnel in these centers, among many other things, directed the dispatch of portable standby generating equipment and arranged for the loan of auxiliary power units to essential customers, such as hospitals, railroad and airline terminals, fire and police departments and the press. Specifically, portable generators provided by the New York Telephone Company furnished light at Grand Central Station in Manhattan, at the Pan Am Flight Information Center and in the control tower at La Guardia airport. They insured adequate power for telephone switchboards at Roosevelt, Beth Israel, Lebanon, Gouveneur and other hospitals. At Lebanon Hospital in the Bronx, they also powered the refrigeration unit, helping to sustain the blood bank supply. Installers, repairmen and foremen spent the night at 20 other hospitals, 80 police stations and five police communication centers to help assure continuity of service. In Manhattan, two repairmen carried a 175-pound generator up eight flights of stairs to maintain power in the telephone room of the New York *Daily News*. In Stamford, Connecticut, a convalescent home obtained power during the emergency from a Southern New England Telephone Company portable generator.

Scenes like this were duplicated in many central offices as operators handled a record 25 million calls during the 12-hour blackout.

Successful coordination of these and other activities was achieved through the emergency centers mentioned above. There are four permanent centers which operate around the clock every day in the year, sensing the operating condition of the entire Bell System network. Other centers are activated immediately as needed. On the night of November 9, the 15 centers in the Northeast collected facts on the emergency, maintained liaison with government agencies and power companies and also directed building security measures throughout the area, as well as coordinating the use of the portable power units.

The Problem of Traffic

It was no surprise to telephone people that hundreds of thousands of stranded commuters took to their lifelines of communications to produce a volume of calls without precedent at that hour of the night. Lines a block long formed at public telephone booths as people waited patiently to tell family and friends of their whereabouts. Most could not see to dial numbers, and so dialed Operator. And the operator was there—many who stayed on into the night beyond their regular day shifts, many who returned to work after reaching home, even some

Telephones at general headquarters of Associated Press in New York were constantly busy during night of November 9, 1965, as photo editors directed picture coverage. Reporters phoned stories to the AP's Washington office for nationwide transmission by teletypewriter.

who were retired employees but who came in to volunteer their help.

Inevitably, there were some cases where the heavy calling caused delays. When this happened, special equipment, known as line load control, was applied as needed to keep lines clear for priority service. In an emergency such as the power blackout, it is imperative that lines essential to public safety and defense be kept open and instantly available. Line load control maintained adequate originating service for essential agencies and public telephone lines.

At the same time, network management controls enabled Bell System people to keep constant watch over nationwide calling patterns and volumes, in order to insure the most efficient use of the long distance network. Telephone traffic is much like vehicular traffic on the roads in this sense: the greater the number of calls (or the greater the number of cars), the greater the potential traffic jam when something goes wrong. Congestion builds up quickly and unexpectedly. Experienced network managers in A.T.&T.'s Network Management Center at Long Lines in New York and at 12 regional centers in the United States and Canada worked from pre-planned emergency procedures to control congestion and prevent it from spreading. They gave preference to calls from the affected areas, changed call-routing patterns across the nation to protect service in non-affected areas and used recorded announcements to inform customers when all circuits were busy to avoid or reduce the frustration of repeated attempts.

In addition to the general public, there are many vitally important government agencies served by Bell System private line facilities. The Strategic Air Command, the Defense Communications Agency Status Center, the Air Defense Command, Federal Aviation Agency and others all had no loss of command function during the blackout. The complex communications network for the Power Authority of the State of New York—including radio telephone channels, telemetering circuits, administrative tie lines and high-speed protective relay channels—continued to operate throughout the general power failure.

Radio and television—the nation's mass news media—were kept going as well. When the TV networks' New York studios were silenced, the Bell System made the necessary switches and furnished facilities so that programs could originate in Los Angeles, Washington and Chicago. Similar switching enabled radio networks to originate programs in other cities when New York went off the air. Even in the blacked-out city, some radio stations were able to establish links via regular telephone lines to their transmitters in New Jersey and so keep an extemporaneous account of the emergency flowing from candle-lit microphones to astonished and confused millions among whom pocket transistor radios were suddenly at a premium.

The Primary Mission

From what has been said, it is clear that the uninterrupted telephone service

Telephone companies' emergency transportation plan used trucks and chartered busses.

which helped avert a major disaster was not just a lucky accident. Years of detailed planning and preparation determined the outcome of the communications story that night and on many other occasions. Bell System management has planned to give dependable telephone service not only day-to-day but also in any emergency that has—or that might—beset the public it serves: hurricane, sleet, snow, flood, fire, tornado, enemy attack. We have experienced every one of these except attack—and we are prepared even for that. The recently completed transcontinental "hardened cable," with underground switching centers and repeater stations; separated routes and diversified circuit routings, diversified facilities; experienced people trained and rehearsed to keep the service going under the most severe conditions—all these do everything possible to insure that the Bell System can fulfill its primary mission: to provide dependable telephone service.

On November 9, 1965, that mission was accomplished because we have adequate facilities, including some $336,000,000 worth of standby power units; we have standard operating practices, network management techniques and dedicated, well-trained people. And we have the unified organization—A.T.&T., the associated telephone companies, Western Electric and Bell Telephone Laboratories—all working together as parts of one system.

Meeting service needs in an emergency like the great blackout would have been practically impossible if the operating units and the manufacturing and supply unit of the Bell System had not been teamed together. The value of this kind of unified communications organization can be seen every day, but it is especially apparent in times of emergency. Western Electric Company, as the manufacturing and supply arm of the System, can quickly move needed supplies from strategically located distribution centers. Since equipment and methods are the same in all companies, telephone people are familiar with them and can go to work without delay. Much of Western Electric's work in the blackout was actually done long before November 9. Because Western has had the responsibility, over the years, of supplying the right kinds of standby power units for the telephone companies, these units—like all telephone equipment, interchangeable between com-

Building and Supplies men set up cots in lounge at headquarters of New York Telephone to serve as emergency dormitory for operators relieved from long, busy stint at switchboard.

panies if necessary—were ready.

"Planning" and "preparation" have been two key words in describing the Bell System's operation in emergencies. It should be pointed out that we could not have the plant to do the job if we did not have the financial ability with which to engineer, build and buy these facilities. Only a sound business with good earnings can give service such as we were able to provide during the blackout. If our earnings over the past few years had forced us to plan and build on a piecemeal, short range basis, we wouldn't be able to provide the quality of service we furnish in normal times, much less during emergencies.

In the Winter '63-'64 issue of this magazine, J. D. Ward, then Plant toll and switching administrator, wrote, "Every action we take to cope with present trouble improves our survivability in the event of something worse. These actions are not like some insurance policy which can't be cashed until Armageddon. They pay off now by providing today's customer with the increased protection he must have from service interruptions."

After the recent power failure, one of today's customers wrote to Frederick R. Kappel, chairman of the board of A.T.&T.: ". . . perhaps it is your greatest compliment that you were so much taken for granted. Your long-planned emergency standby preparations really saved the city from complete chaos. . . ."

No one among the millions who lived through the night the lights went off will soon forget it. There were more than 15,000 telephone men and women—5,000 more than were normally scheduled—on duty that night who will not forget it, either. And, yet, in a sense, it was all in the day's work for them. They had done it before. Everyone hopes that such a massive power failure can never recur. But if it ever should, the Bell System then, as it has been before, will be ready.

A Tradition of Service

The telephone operator's long and proud tradition of putting service ahead of self during critical times was never more in evidence than during three major emergencies which occurred during the year just past. One was the power blackout in the Northeast. The others were the riots in the Watts area of Los Angeles and Hurricane Betsy.

During the Watts riots, which took place from a Friday evening through Sunday night, the only people on duty in the besieged area were the police, National Guard, firemen, hospital and ambulance employees, and those telephone people responsible for handling calls. There were practically no women working in or near the riot area except telephone operators, and virtually all of these women were on duty. There were offices located on the periphery as well as one office directly in the center of the curfew area. Operators had to travel to and from work on their own, since protection by police or other government agencies was unavailable. Some operators were escorted by fathers, brothers, husbands and boy friends, while others went to and from their offices, even after dark, unescorted. These were women who did this.

In one office, 145 out of a force of 195 lived in the area where destruction was greatest. Their concern for their homes and loved ones was great, but they came to work. Other operators had to pass through this hazardous locality to get to and from their jobs.

In another calamity, when disastrous Hurricane Betsy struck Florida and the Gulf Coast, Louisiana bore the brunt of her destruction. The towns to the south of New Orleans where telephone ex-

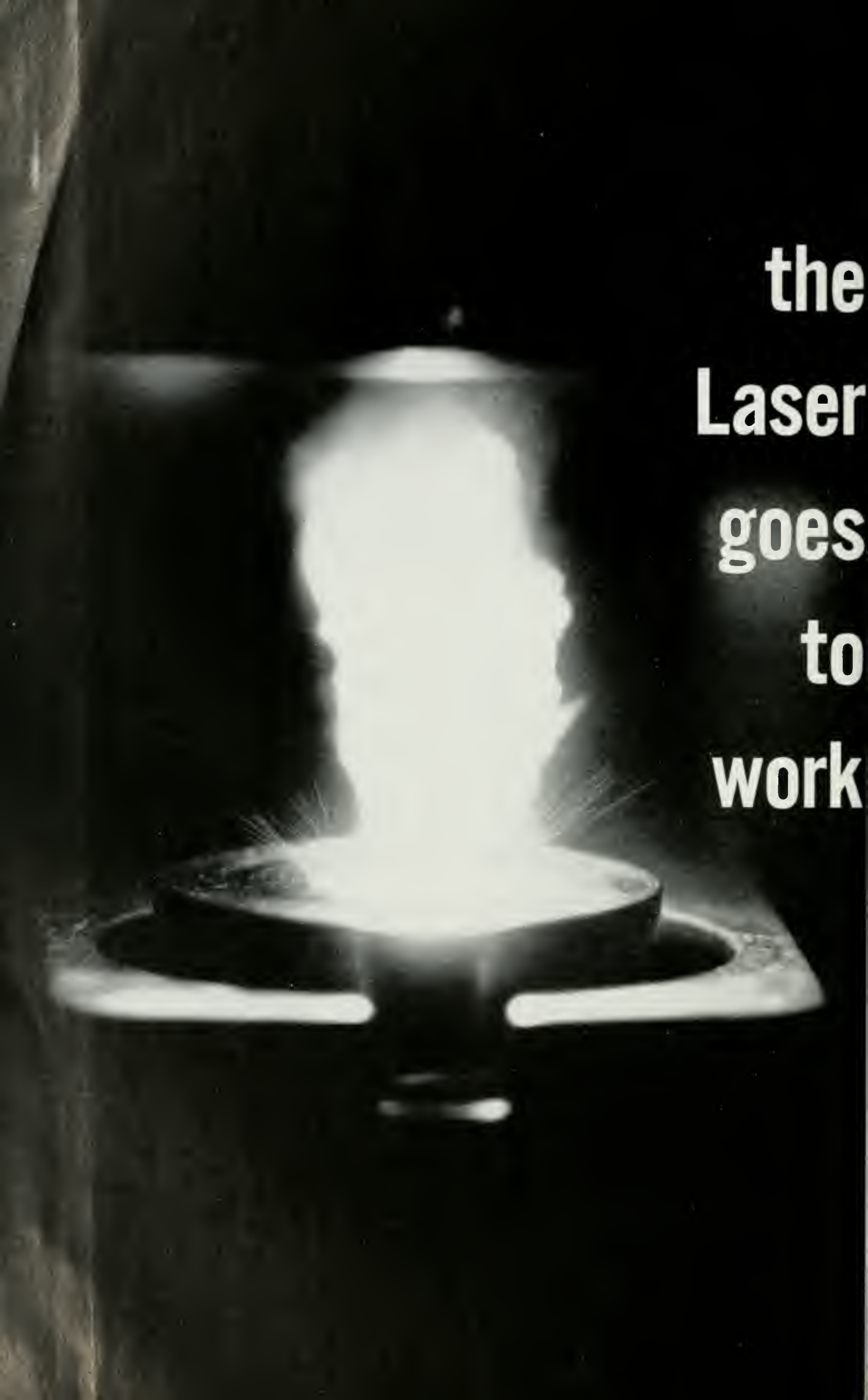
Information operator works by portable electric light during blackout.

changes are maintained took a tremendous lashing from the winds and tides. Many of the employees living in these areas had their homes destroyed or severely damaged. Despite this, they continued to work. Operators literally risked their lives many times in getting to their offices. They had to wade through flood waters, avoid live wires, dodge falling trees, but in spite of everything they got in to handle the deluge of calls that came to their switchboards.

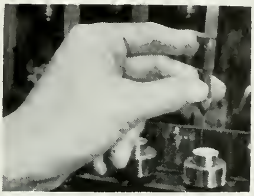
In the blackout emergency in the Northeast, operators worked long hours under trying conditions handling the heavy surge of calls. Time and time again they answered signals that turned out to be emergency calls. They gave reassurance to the frightened elderly, the frantic housewife, and countless others during the power failure. The volume of coin telephone calls was extremely heavy. Many users could not see to dial and had to ask the operator to complete calls they generally dialed themselves. The operator provided normalcy in an abnormal world by her presence on the job. Employees who had worked earlier in the day, or who were on a day off, or who were on vacation, voluntarily returned to their offices to work. Retired operators offered their help either in handling calls or preparing and serving food to the working operators. Employees working in other departments, who had formerly worked in the Traffic Department, also volunteered, put headsets back on, and worked at the switchboards. Many employees stayed in the buildings through the night and were available to handle the early morning flood of calls.

In this age when the motto seems to be "don't get involved," the telephone operator stands ready to give service to the customer under the most trying conditions. The knowledge that she is at her post lends courage to the faltering heart, and the knowledge that she is needed gives meaning to her dedication.

the Laser goes to work



The tremendous light energy of the laser has been tamed and put to work as a mass production tool in this Western Electric plant



IN THE FIRST known industrial use of the laser for mass production, concentrated light beams are drilling holes in the diamond dies used to manufacture hair-like telephone wire for the Bell System. Heretofore chiefly a scientific research tool, the laser was put to work in the Buffalo, N.Y., plant of Western Electric, where more than 30 million miles of telephone wire are produced in a year.

By slashing the time previously required for boring holes in the dies, the laser is expected to reduce production costs. It is already proving itself in the manufacture of one delicate type of wire which is used for winding the coils of telephone ringer mechanisms, relays and armatures. This wire is half the thickness of a human hair, and Western Electric makes enough of it every year to stretch ten times to the moon. For such superfine wire, only diamonds are hard enough to squeeze the copper into its proper diameter.

But first the trick is to put the drawing hole in the diamond. This is a full-time job for twelve employees at the Western Electric Buffalo plant, where at any one time 4,000 diamond dies are in use, and 30,000 are re-sized every year because of wear.

Left. Smoke rises as light energy of laser beam "bites" its way through diamond die.

Traditionally, drilling a diamond die is accomplished in two phases: first, piercing the diamond and roughing out the opening; second, smoothing and polishing to achieve proper diameter and cross-section with a prescribed finish. Both operations are performed with a steel tool, charged with a varying grade of diamond dust suspended in olive oil.

The laser has changed that. With bursts of tremendous energy, brought to focus at a microscopic point, it vaporizes a bit of the diamond each time in a series of "bites," finally piercing it. The laser takes only a few minutes, as compared to days by the mechanical method. The hole is then polished and smoothed in the customary manner.

Shooting With Light

This Western Electric laser looks something like a modernistic oven. It is mounted on a desk-style workbench, and is operated by a woman who watches what is happening inside by means of closed-circuit television.

Since the laser shots must be accurately positioned on a tiny area of the diamond, the operator's view as she chips away with the laser beam must be clear enough for her to adjust the die, deter-

Diamond dies for drawing fine telephone wire are shown with loose industrial diamonds. Drilling diamonds for dies was a slow and laborious process before the application of the laser.

mine whether or not she is "on target" and follow the progress of the job.

The operation starts when the girl opens a small "oven door" in the machine and clamps the diamond die in a movable fixture. Outside is a control knob, which she manipulates to bring the diamond into target position. Her movements of the knob are stepped down by means of a pantograph arrangement, which makes the minute changes in direction required to position the diamond. The target position is indicated on the operator's television screen, where she watches the diamond, greatly magnified, as she moves it into place.

When ready to fire, the operator pushes a button on a control panel, and the shot is fired. The laser can be set to fire manually, or automatically at intervals of one, five or ten seconds.

Western Electric's Engineering Research Center at Princeton, N.J., and engineers at the Buffalo plant jointly developed the diamond-drilling laser. Besides the savings in time, effort and diamond dust (less of which now has to be used), the laser in Buffalo may trigger ideas for other uses of technology's newest tool.

Die is put in oven for drilling by laser. Operator will watch by closed-circuit TV.

(Continued from page 23)

Deficiencies of Test-Year Data of Costs and Revenues as Indicating the Future Profitability of Each Category of Service

As a general proposition the rates that are at issue in a rate-making inquiry are the rates that should be charged in the future. This being the situation, the question whether any disputed rate for utility service must be deemed too high or too low when judged by a fair-return standard must be decided by a comparison of the revenues and costs that may fairly be anticipated during the not distant future.

Under some circumstances, to be sure, the best estimate of future rates of return may be based on the assumption that "history will repeat itself" and that rates which have averaged a given rate of return during the past several years will continue to yield about the same return in the future. This assumption might even be justified for some of the larger and long-established classes of telephone service such as local service, although here the application of trend-line projections might be preferable. But when it comes to newer and smaller groups of service, or to service undergoing unusually rapid growth in demand combined with rapid changes in the technique of production, a record of rates of return already realized in a past year may be quite untrustworthy as an index of rates of return to be anticipated in the near future.

In pointing to the limitations of a cost of service study based on records of revenues already received and costs already incurred during a test-year period, let me note the important difference between this situation and the comparable situation that arises in a rate case in which the general level of rates is at issue. In the latter type of case, in any jurisdiction which applies a historical-cost or net-investment measure of the rate base, the relevant costs of plant and equipment are embedded costs, and the calculations of anticipated revenues and revenue requirements are based largely on test-year data. Even here, to be sure, these data are subject to adjustment if they are found no longer to reflect costs which can be anticipated in the future. But the adjustments that a commission will accept in a general rate-level case are pretty well restricted in view of a natural and proper desire to rely as far as feasible on factual records rather than on fallible estimates made by interested parties.

But the situation which warrants such heavy reliance on accounting records, on historical costs, in a general rate-level case is quite different from the situation which would apply to the design of the rate structure. Because of the remarkable stability of the annual over-all earnings of most utility companies, more reliance can be placed on past earnings as a guide to total future earnings than can be placed on earnings derived from any one type of service, especially if this service is still in a period of rapid promotion. Illustrations of services of this nature are house heating services in the electric utility field and data communications services in the telephone industry. If the prices to be set for these and other comparable services had to be based on rates of earnings realized in previous years, utility managements would be severely handicapped in their use of promotional rates as a means of reducing unit costs through improvements in load factors and through the rapid introduction of modern equipment.

Fallacy of the Implicit Assumption that Most Costs Vary in Direct Proportion to "Use" Measured By Minutes or By Minute Miles

Finally I come to the third attribute of the Seven-Way Cost Study which may impair the reliability of its results as measures of the rates of return earned on each of the seven categories of service.

This attribute is the predominant reliance on a "use" basis of cost apportionment as measured, for example, in minutes (for switching equipment) or in minute miles (for the DDD network). Here, the question may fairly be raised whether this basis of apportionment has not been applied even to important types of plant costs and operating expenses which are not functions of "use" in this particular sense of the word.

A different procedure is followed in those cost analyses usually applied to electric or gas utility companies. Thus, in electric utility cost apportionments a distinction is drawn between (a) "energy" costs (costs held to vary with kilowatt-hour output), (b) "customer" costs (costs held to vary with the number of customers regardless of their consumption of power), and (c) "capacity" costs or "demand" costs (costs held to vary with plant capacity and hence indirectly with the peak load requirements of the system).

One of the most important advantages claimed for this "functional" type of cost apportionment lies in the distinction that it draws between the higher costs of serving customers at the time of system peak or "rush hours," and the much lower cost of supplying the same kind of service at off-peak hours.

In their details of application, these functional cost apportionments have been subject to much controversy, and the above-noted threefold breakdown has even been criticized for its failure to recognize more than three costs dimensions or cost parameters. But the necessity of some kind of a functional breakdown has been generally recognized.

The Seven-Way Cost Study may therefore be subject to criticism for relying so largely on a "use" basis on which to apportion joint or common costs. But the seriousness of this infirmity is open to question since even the "use" basis of cost apportionment can be so applied as to take account of the important difference between the peak-load costs of supplying a given amount of service and the off-peak costs of supplying the same amount of service. Such an application has already been made by the present study in its submission of an alternative, "Busy Hour" apportionment of common costs among those three types of service making use of the DDD network. This is certainly a preferable alternative to the "Total Day" basis for the purpose of cost determination among individual categories of service.

For the reason just suggested, I am in some doubt as to whether the study, while adhering to the principle of a full apportionment of embedded costs, could be made more reliable by the mere introduction of a variety of multiple cost functions akin to those used in electric utility cost analyses. Total cost apportionments are so arbitrary at best that an attempt to reduce their deficiencies by this method alone would be of dubious value and might even make matters worse.

A different problem would present itself, however, in a study designed to allocate costs to specific classes and subclasses of service on an incremental cost basis. Such a study would justify the use of finer instruments of analysis that may seem out of place in a full-cost distribution.

Comments on the FCC Staff's Support of Fully Apportioned Costs as Measures of Minimum Rates

The preceding sections of this testimony were prepared prior to my receipt of a copy of the recently issued "Report of the Common Carrier Bureau of the Federal Communications Commission in the Domestic Telegraph Investigation," Docket No. 14650. Since much of this extensive report is concerned with recommendations beyond the limited scope of my testimony, any comments by me on such recommendations would be inappropriate. But throughout the report one notes a general approval of fully-distributed-cost apportionments and a general rejection of incremental cost allocations as primary measures of reasonable minimum rates. This position seems to reveal such a basic difference in rate-making philosophy between the views of the Bureau and the views which I share with other economists, that a direct commentary on the Bureau's position may be in order.

A. The Bureau's Implications That the Seven-Way Cost Study Marks the Dividing Line Between Compensatory and Non-Compensatory Charges for the Different Categories of Service

Elsewhere I have stressed the point, which I believe to be generally accepted among professional economists, that an apportionment of the total costs of a public utility business among the various classes of service cannot be relied upon to mark the dividing line between compensatory and non-compensatory charges for each service. Even the Bureau Report contains sentences which support the same conclusion. Thus, on page 184 the Report notes that fully-distributed costs "involve arbitrary judgments regarding the assignment of joint and common costs," that "they tend to disregard the obvious fact that fixed unit costs are price-determined rather than price-determining," and that they "tend to impede the efficient allocation of resources among alternative uses."

But these serious, acknowledged shortcomings of a full-cost apportionment are passed by throughout most portions of the Report. For example, in referring to the Seven-Way Cost Study, the Report declares (at page 180): "But it is equally important to affirm that the basic objective of the study was to express net earnings by interstate service as a percentage of assignable net investment, and this it does *with a high degree of accuracy*" (my italics). Yet the "high degree of accuracy" can refer only to the accuracy with which the Cost Study applies specified arbitrary bases of common and joint-cost apportionment.

B. The Importance Attached by the Bureau to Rate Relationships That Will Properly Guide Consumer Choice

In various portions of its Report the Bureau properly lays stress on the desirability of an interrelationship among telecommunication rates expressly designed to guide consumers toward the choice of whatever alternative services are most appropriate for their needs in view of relative costs of production. Thus, referring to the decline in the national use of message telegraph service, the Bureau remarks (at page 3):

> "If the relative prices were genuinely representative of these characteristics ['inherent value' and 'cost-of-service characteristics' of the various services], then we could assume that the decline in public message telegraph usage was the result of consumer choice, and that the valuation placed upon the service in the market had declined in proportion. But if there were forces which distorted these rate relationships, then consumer diversion was not the product of legitimate choice, but rather a reaction to imperfection in the system of prices."

But fully apportioned total costs, all the more so when such costs are "sunk costs" rather than current costs, cannot be relied upon to guide consumer choice in the purchase of alternative types of service. For this purpose, the relevant costs are relative incremental costs in their special form of marginal costs (unit costs of small increments of service). The Bureau Report itself seems to have recognized this deficiency of fully apportioned costs by noting (on page 184) that "fully allocated or distributed costs tend to impede the efficient allocation of resources among alternative uses." But this recognition does not deter the Bureau from supporting fully distributed, embedded costs as basic criteria of minimum rates for telecommunication services.*

C. Fully Apportioned Total Costs Are Not Usually Accepted as Measures of *Minimum Rates*

Under any system of rate regulation which undertakes to make rates as a whole cover costs as a whole, including a fair rate of return on capital investment, the significance of incremental or marginal costs lies, not in its acceptance as a measure of the precise rate that should be charged for any given service, but rather in its acceptance as a basis of *minimum* rates—of rates below which no service should be offered, not even if a still lower rate would be required to meet competition.

On the other hand, a different role is usually claimed for fully-distributed total costs as a rate-making guide. Here, whatever claim such costs may have for acceptance must rest on their supposed usefulness as marking a first step, not to the setting of a rate-making floor but rather to the fixation of the rate itself. This hypothetical, first-step rate is then to be used as a point of departure from which the finally accepted rate will deviate *upwards or downwards* in response to various non-cost considerations including, notably, considerations of value of service (relative price elasticity of demand).

To be sure, interested parties to a contested rate case, such as truck or water carriers in opposing the setting of competitive railroad rates, have at times insisted that these rates should not be allowed to go below what is erroneously called the "full costs" of the railroad service (that is, fully-distributed total costs). But the motivation behind these contentions is obvious.

I have therefore read with some surprise what seems to be the contention of the Bureau that fully apportioned costs should serve, not just as points of departure for upward or downward adjustments in rates, but rather as rate-making minima applicable to every class of Bell System services. One may wonder what would happen to Bell System over-all earnings if such minima were to go into effect. Barring the unlikely event that every class of service would then yield just the required minimum rate of earnings and no more, the System's over-all rate of return would exceed a rate of return deemed adequate. If such a result is contemplated by the Bureau, it has not been so stated in any section of its Report coming to my attention.

D. The Acceptance of a Fully-Distributed-Cost Concept of Cost of Service Creates Serious Confusion Between "Cost" Criteria and "Value" Criteria of Reasonable Utility Rates

Despite the importance that the Bureau Report attaches, and rightly attaches, to cost of service as a factor in the design of a proper rate structure, it also recognizes, and with respect to Western Union stresses, the importance of promotionality considerations and of value-of-service factors in rate making. But the proneness of the Report to identify "cost of service" with fully-distributed total costs may well prove to be a source of much confusion as to the proper interplay between cost and value components in rate determination. How, for example should a regulating commission decide a rate case if the "cost"

* If I interpret its Report correctly, the Bureau, in the setting of specific rates of charge within any one class of service, would not apply a fully apportioned cost test of minimum rates except to the competitive private-line services. But it would apply this test to the earnings requirement of each class of service in gross, even including the switched services. See Report, pp. 361-64.

of the service in question were found to be $1 per unit, whereas the "value" were held to be $1.50 on the one hand or only 90¢ on the other hand?

The modern theory of public utility rates has gone a long way toward resolving this confusion, in principle, by withdrawing the concept of fully apportioned cost in favor of the concept of incremental or marginal cost. Whenever incremental cost per unit of service is lower than average or fully-distributed cost, let the incremental cost set the lower limit of the proposed rate. But let the extent to which the actual rate should exceed this lower limit be decided primarily by value-of-service considerations. Thus, instead of being somehow mixed together like the ingredients of a Hungarian goulash, the value fixed component of the rate is superimposed on the cost component. This former component is viewed as a kind of a surtax, designed to determine the rate of contribution of each quantity or class of service to the coverage of the unallocable portions of a company's total revenue requirements.

To be sure, the above-noted distinction between the role of (incremental) cost as setting a rate-making floor, and the role of "value" considerations in determining how high the rates should be set above this floor oversimplifies a theory of optimum rate design that is unavoidably extremely complex in all of its ramifications. For, despite some incautious published statements to the contrary, the usefulness of marginal costs is not strictly limited to the setting of *minimum* rates. In addition, there is the principle that *relative* rates should be properly related to the *relative* marginal costs of alternative services—a somewhat ambiguous and still controversial principle of modern utility rate theory.* But even here, the relevant cost comparisons are between *relative marginal costs,* not between fully apportioned costs.

* This principle is discussed in Chapter 19 of my book on Principles of Public Utility Rates.

E. The Special Problem of Imposing Minimum Price Limits on Directly Competitive Services

Let me turn finally to what is perhaps the most difficult of all of the rate-making problems raised in the Bureau Report. It concerns the question what standard or standards of minimum rates should be set for those private line services that are directly competitive as between the Bell System and Western Union—services which, in the opinion of the Bureau, should be encouraged to remain competitive if feasible. What here gives rise to such difficulty is not merely the existence of rivalry between two regulated enterprises, and not even merely the fact that the two competitors are far from evenly matched in financial resources, but also that both enterprises are presumed by the Bureau Report to be supplying their services under conditions of declining unit costs—under economies of scale. This is a condition often assumed to characterize a "natural monopoly." The problem, then, may be thought of as one of maintaining, through special governmental restrictions, a significant degree of partial competition which, if left to the untrammeled action of the rivals, might well fade out of existence sooner or later.

Under these special conditions, and under the Bureau assumed public policy of maintaining private line competition between the two carriers, a plausible case can be made for the establishment by regulation of a floor of minimum rates higher than mere incremental or marginal costs and hence higher than would otherwise be in the public interest. Unless this were done, both companies might feel constrained to hold or lower their competitive rates down close to, or right at, barely incremental cost levels. If this should be the actual experience, the revenues from the competitive services would yield little or no contribution to the coverage of the unallocable corporate overhead costs—an undesirable result which might have serious long-run consequences.

It is with such considerations in mind that the Bureau Report lays special stress on what it believes to be the need for rate-making floors for directly competitive services higher than those that would be set by estimates of incremental costs. The particular alternative proposed by the Bureau is the acceptance of fully-distributed costs as rate-making minima, the actual limit being set by the lower of Bell System costs or of Western Union costs. To be sure, fully-distributed costs are arbitrary figures and hence would constitute arbitrary lower limits. But one may argue that arbitrary "rules of the game" would be called for by any effort artificially to preserve a semblance of viable competition between two regulated enterprises with the cost functions said to be characteristic both of the Bell System and of Western Union.

In price fixing, however, arbitrary restrictions should be applied, if at all, only as a regrettable necessity; and they should therefore not be accepted without a careful canvass of more flexible alternatives. Among these alternatives, serious consideration should be given to the proposal that incremental costs should be retained, even here, as the only definite rate-making floors but that actual rates be set at levels reasonably designed to maximize the combined net earnings of the two regulated telecommunications systems on their directly competitive business. True, rates so fixed would be designed deliberately to eliminate *price* competition between the two otherwise competing enterprises. But they would not constitute "monopoly prices," since they would presumably be held within reasonable upper limits by the competition of the manufacturers and vendors of private telecommunication equipment. The role of the Federal Communications Commission would be to make determinations of the factors necessary to achieve these rate-making objectives.

Even, however, in the event of the adoption of a fully apportioned cost standard of minimum rates for the directly competitive private services, I would seriously question both the feasibility and the desirability of a calculation of total costs which include the embedded costs of the older, outmoded wire facilities whose installation preceded the development of long distance communication by microwave or by coaxial cable. Aside from the fact that prices based on such out-of-date "sunk costs" are not designed to secure a desirable allocation of economic resources, there is the immediately "practical" question whether both A.T.&T. and Western Union might not be seriously and unfairly handicapped in competition with the unregulated suppliers of telecommunications facilities. Hence, even if the use of some type of fully apportioned costs were to be approved in its special application to the competitive, private line services, the costs to be apportioned should probably be estimated current costs, not recorded historical costs.

Conclusions

In this testimony I have attempted to summarize my reasons for believing that the Seven-Way Cost Study cannot be relied upon of itself to indicate even with reasonable approximation the costs incurred and earnings realized by the Bell System in supplying each of the seven different categories of interstate telecommunication services. This belief does not rest on any doubt as to the care and skill with which the Study has been made in accordance with its assignment; nor does it rest on the fact that significant changes have taken place since the date of the Study, as noted in the September 10 hearing. It rests, instead, on the fundamental infirmities of a type of total cost apportionment not properly designed to disclose allocable costs of different classes of service.

What is needed, then, is a series of further studies expressly designed, among other things, to confirm or disprove the present Study's apparent indication that some categories of service are being underpriced if judged by a cost-of-service standard. Such studies call for reasonable estimates of incremental costs, since no other definitions of cost will serve the purposes of the inquiry.

True, even if these further studies should indicate that the existing or contemplated rates of Bell System interstate services are fully adequate to cover incremental costs, it would not follow as a matter of course that the rates are therefore fair or reasonable. The question would still arise whether the rates for any given class of service will yield earnings *sufficiently in excess* of allocable, incremental costs to carry their "fair share" of Bell System's over-all revenue requirements.

How to determine this "fair share," or even how to define the relevant standards of "fairness," is no easy problem; and this testimony makes no pretense of offering a solution beyond suggesting that, with directly competitive services, which must be priced at rates low enough effectively to meet unregulated competition, a 'fair share" of the burden of covering overhead costs should mean as large a share as market forces under competitive conditions make feasible.

But in any event, I am somewhat skeptical about the significance of a fully-distributed cost in serving even as a useful guide to the determination of these "fair shares." The trouble here is that, as long as a rate can be made to yield incremental costs, how much more it can and should be made to yield depends largely on value-of-service factors, on consumer responsiveness to changes in the rates that he is required to pay ("price elasticity of demand" in the jargon of the professional economists). Yet total cost apportionments—at least those of the type represented by the Seven-Way Cost Study—do not take account of value-of-service factors and are not even supposed to do so. On the other hand, since even their apportionments of cost are arbitrary to a considerable degree, their significance for rate-making purposes is open to serious question.

in the news...

Roundup: 1965

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High-Speed PCM

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Speed Hearing

Roundup 1965

The Bell System spent a record $3.9 billion on construction in 1965 and it appears that expenditures for this year will be at about the same level, Frederick R. Kappel, board chairman of A.T.&T., announced in a year-end statement on the events of 1965 and the prospects for 1966 in the telephone business. Mr. Kappel stated:

"The country's communications needs continue to grow and that means the year just beginning will be one of continued growth for our business.

"More important, it will be a year of further progress in the way we serve our customers as communications technology provides us with new tools and new ways to use them."

The 1965 construction expenditure marked the third consecutive year in which construction outlays for the Bell System exceeded $3 billion. Mr. Kappel noted that the money was spent in expanding and improving service at all levels, from the nationwide long distance network to the local exchanges.

"Day-to-day telephone service for the local customer is a prime concern in our planning," he said. "Our aim is to give him the best service we can and keep the cost to him as low as possible."

Mr. Kappel reported that in 1965, the Bell System recorded a net gain of 3.85 million telephones, a new high for one year. Bell Companies now serve 75,900,000 telephones throughout the country.

At the end of the year, there were 93,600,000 telephones in the United States. And 1965 figures indicated that Americans were using them more than ever before. On the average day, Bell System facilities handled 279 million local and long distance calls, and for the year, the message traffic totaled 92.3 billion calls, an increase of 6 billion over 1964. Long distance messages increased about 12 per cent over the previous year.

Nearly nine out of ten Bell System customers can dial their long distance calls directly. During 1965, the total increased from 84 to 87 per cent. A total of 99.7 per cent of the customers dial local calls.

Bell System physical facilities (telephones, telephone lines, equipment, buildings, etc.)

Bell System construction program provides for expanding, improving service at all levels; here, for example, extra floors are being added to an office to increase switching capacity.

represent a net investment of about $27,700,000,000 compared with $25,595,000,000 at the end of 1964.

The Bell System, at year's end, employed about 800,000 men and women, including those in Western Electric and Bell Telephone Laboratories, spread throughout every state in the continental U.S. plus Alaska.

In 1965, the Bell System raised slightly in excess of $1 billion in new capital. Among the major sources were six debt issues of subsidiary companies, and the employee stock plan purchases.

There are now over 2.84 million A.T.&T. share owners. There are more than 529.7 million shares of A.T.&T. stock outstanding, compared with some 522.4 million at the end of 1964.

A quarterly dividend of 55 cents per share was paid on January 3, to A.T.&T. share owners of record on December 1, 1965. This is 10 per cent more than the previous rate of 50 cents which was established in the spring of 1964.

Custom Calling Services

The everyday telephone will offer a broad new range of services for a number of Northwestern Bell Telephone Company customers in the Morningside section of Sioux City, Iowa beginning February 1. Besides adding new convenience to telephone calling, the innovations will constitute a significant "first" for the Bell System.

On this date, these customers will have their choice—for an additional monthly charge—of one, all or a combination of these new calling services: "speed calling" (as many as eight frequently-called numbers can be reached by dialing only one digit to reach each number, even if it is a long distance number); "call waiting" (a tone signals a customer who is using his phone that another caller is trying to reach him, at which point he can hold the first call on the line and answer the second); "three-way calling" (any customer in the local calling area can be added to an existing conversation already in progress by simply dialing the number of the customer to be added on), and "call transfer" (calls coming to a customer's phone can be directed to ring at another phone in the local calling area).

The new features, called Custom Calling Services, are made possible by a "memory" unit, which has been designed by Bell Telephone Laboratories and manufactured by Western Electric for the Bell Operating Companies. The unit sets in motion central office equipment that actually does the work. The unit itself is activated by customer dialing of special codes or flashing of the telephone switchhook. This tells the "memory" what the customer wants done.

Custom Calling Services are available now in only one other community served by the Bell System—Succasunna, N.J., site of the System's first electronic central office. The offering there is limited to 200 customers on a trial basis. Customers in Sioux City will be the first to be offered Custom Calling Services through standard electro-mechanical central offices on a regular commercial basis.

Extension of the services to other Northwestern Bell areas and eventually throughout the Bell System will depend in part on customer reaction in the two cities. Rates for the new calling features have not been set yet, but total cost to the customer will depend on how many of the offerings he selects. "Package" arrangements—special combinations of the services—will be offered to both residential and business customers.

Easy Move Plan

The "one-System" nature of our business is helping us to deal with the increasing mobility of our customers through the new Easy Move Plan which is designed to assist customers when they move from the area of one Bell System Company to another. The plan is expected to become effective in April, 1966.

The plan provides for extending an offer to negotiate new service at the time a customer contacts the business office to discontinue service at his present location. Provision is also made for the furnishing of customer account information from one Company to another. These arrangements are made only when the customer is moving within the United States and to an area served by another Bell System Company.

The plan has several advantages for both the customer and the Bell Companies. The customer will realize improved service since installation can be made after he arrives in his new community without the need for additional calls or visits to the business office. He will also receive consistent deposit application and account collection action. The business office handling the new connection request will receive customer information that will assist in planning a more complete and personalized service and sales presentation. In addition, the Plant Department will benefit from the advanced receipt of the order for installation of service.

Nationwide LETS

Law enforcement communications will take another dramatic step forward early this year when a new, fully automatic teletypewriter network is placed in operation to permit closer coordination between law enforcement agencies across the country. The new teletypewriter network will link police authorities throughout the United States by a unified communications system that will enable message time between participating agencies to be reduced from days and hours to minutes.

Known as Law Enforcement Teletypewriter Service (LETS), the network was developed by the Bell System in cooperation with local and state police authorities to provide better communications between law enforcement agencies.

The increasing mobility of today's law breakers, coupled with the nation's growing crime rate, has necessitated a greater need for fast, efficient communications between state and municipal law enforcement agencies. Participation in this new network will enable police officials to operate more effectively by having an extensive, direct communications service at their disposal.

Headquarters for the network will be in Phoenix, Arizona. This control center will be designed to route messages automatically and maintain a speedy, efficient flow of LETS traffic. It will be capable of sending a single message simultaneously to multiple locations, holding a message until a busy line becomes available and giving transmission precedence to priority messages.

Another feature of the LETS network will be the fully automatic police teletypewriter, eliminating the need for attendants—at either transmitting or receiving locations—to stand by for message pick-up and delivery, thus permitting more efficient use of personnel. The LETS network will be a 24-hour operation, providing instant all-station broadcast of urgent messages and secrecy in transmission. In addition, it will provide selective station calling to enable law enforcement agencies to pinpoint receiving stations.

Recognizing the need for fast, efficient written communications among law enforcement agencies in the U.S. led to the first LETS systems. By the mid-1950's a number of intrastate systems were in use. These developed into interstate arrangements to aid law officers. The next logical step was expansion of LETS to regional networks. The new LETS network will join these regional communications systems to provide police with a completely automatic nationwide law enforcement network.

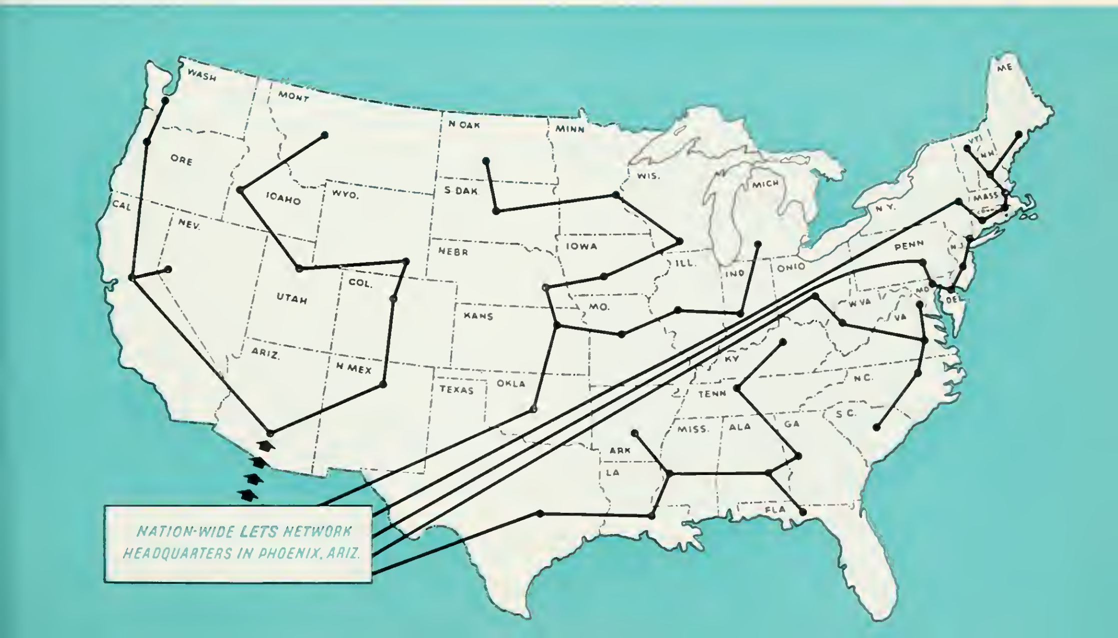
High-Speed PCM

All the information contained in a 10,000 volume library can be transmitted in 15 minutes over an experimental system recently designed at Bell Telephone Laboratories.

The system can send 3456 telephone calls or two television programs over the same transmission path using a technique called Pulse Code Modulation (PCM). PCM is already being used commercially for transmitting 24 telephone calls, or comparable amounts of data, over distances of up to 50 miles on a pair of wires. The new high-speed PCM system, when fully developed, will be able to transmit voice, television and data signals of the highest quality from coast to coast over coaxial cable.

In PCM, the varying electrical signals that represent sound or picture information are not sent in their entirety but, instead, are sampled many times a second and encoded into groups of nine electrical pulses. These pulses are sent over the cable at a rate of 224 million pulses per second. Because pulses are sent, the codes of many different signals—voices, data and pictures—can be easily interleaved on the same transmission path. At the far end of the line the pulses are sorted out and converted back into voice and television signals, and then into sound and pictures with no loss in quality.

LETS network was developed by the Bell System working with local, state police authorities.



Along the route signals can be added or taken off the main stream of pulses as desired. The performance of this experimental high-speed PCM system indicates that even higher speed systems—with greater information capacity—are possible.

New Coin Phone

A new model of the Bell System's public phone, going into production at Western Electric's Oklahoma City plant, will contain a handful of pleasant surprises for customers—and some unpleasant ones for vandals who attempt to burglarize phone booths.

The new set contains the largest number of changes ever made at one time in the familiar coin phone. The sound of gongs and chimes as nickels, dimes and quarters are deposited is giving way to electronic beeps of tone that will indicate to operators the number and type of coins.

The three coin slots, standard on coin telephones for more than 50 years, have been replaced by a single slot in the upper left hand corner of the face plate. If a coin should stick, there is no plunger to push; a lever releases the coin and allows it to fall into a return box, which now pushes in instead of pulling out. Other features include a handset that hangs over the dial, much like the present wall telephone set; a new plastic dial with a more comfortable feel, and printed dialing information contained right on the face plate, rather than above it.

Bell Telephone Laboratories designers and Western Electric engineers have been considering most of these changes for nearly a decade. In recent years, greater numbers of public telephones have been exposed to a wider variety of environmental conditions. Tomorrow's coin phones will have to be even more convenient to use, easier to service and harder to fool.

The single-slot pay phone eliminates coin juggling and prevents the user from dropping coins in the wrong slot. The new method of coin signaling simplifies the operator's task of recognizing and counting coins deposited.

Under the cover, other changes provide the new phone with a high degree of serviceability and security. Plug-in components permit most repairs to be made on the spot. The phone accepts either of two coin-receptacles—one half again as large as the standard item, for use in heavy traffic areas. The new phone is approximately the same size and weight as present coin telephones and will fit any type of both or shelf set-up.

After final assembly, new coin telephones are individually tested on audio console.

Under its attractive green or black and chrome exterior, the phone is sheathed in layers of welded steel. This tough housing affords the phone maximum protection against weather, vandals and damage from other causes. A new locking mechanism and an armored steel handset cord also help make it more theft-resistant.

A number of test trials of the new public phone were conducted before it went into production. The new model can be converted for TOUCH-TONE ® calling, and a panel version is planned for manufacture. Western Electric is scheduled to make 1,200 single slot pay phones in the first year and estimates the annual production at 170,000 in less than five years.

Speed Hearing

An electronic device to allow "speed hearing" of recorded speech has been developed by Bell Telephone Laboratories.

Designs for the device, called the harmonic compressor, have been given to the American Foundation for the Blind for possible use in making recordings.

The harmonic compressor permits making recordings of the human voice which can be played at twice their normal speed while retaining normal voice pitch. The device eliminates the high-pitched "Donald Duck" babble that results when an ordinary record is speeded up. Because the device would permit blind persons to listen to recorded material at the same rate as many sighted persons speed-read (300 to 400 words per minute), the American Foundation for the Blind is studying possible applications in its programs of tape and disc recordings for the blind.

The harmonic compressor divides in half the frequency components (harmonics) in a voice recording while preserving the original time duration. By doubling the speed of this half-frequency recording, the frequency components are restored to their original values. If an ordinary record is simply played at twice normal speed, the original frequency components are doubled and distortion occurs.

The American Foundation for the Blind now records "Talking Book" records for the U.S. Library of Congress for free distribution to blind persons throughout the country. Those recordings containing informational material, such as magazine articles, could be speed-heard without loss of comprehension.

The Foundation had asked Bell Laboratories whether it was possible to speed up recorded speech without distorting it. Previously, Bell Laboratories scientists had thought of the harmonic compressor while studying frequency compression as a possible means for reducing the transmission bandwidth required in voice communications. They adapted the harmonic compressor to the needs of the Foundation. The device was simulated on a digital computer which proved the effectiveness of the design without requiring actual equipment to be built.

Meanwhile, Bell Laboratories is continuing to investigate frequency compression for its telephone communications possibilities. By reducing the amount of bandwidth required to transmit a given amount of information, even more efficient and economical use could be made of communications channels.

Second No. 1 ESS

The second No. 1 Electronic Switching System (ESS) in the Bell System was placed in service on January 16, at the Chase office of the Chesapeake and Potomac Company of Maryland. The system serves about 2,900 stations.

Chase is a suburban community about thirteen miles northeast of Baltimore. Prior to cutover it was served by a step-by-step office. The replacing No. 1 ESS will provide a number of local service improvements such as uniform 7 digit dialing into the Baltimore metropolitan area and will permit the offering of Custom Calling Services (see above) to the subscribers in this exchange in the near future. This location was chosen for the second installation because of the size and growth pattern of the area served. The features and capabilities of the Chase office are similar to those of the initial installation at Succasunna. Indications are that the system is performing satisfactorily.

The next No. 1 ESS office scheduled for service will be the PE 6 office at West 36th Street in New York City. This office will feature the initial use of signal processors for increasing the call handling capacity of the No. 1 ESS.

Sensicall

A new device now promises to allow the seriously handicapped person to communicate with someone by telephone. Named the Sensicall, the new phone substitutes sense of touch or the sense of sight for speech and hearing. It is being produced in limited amounts by Western Electric for the New York Telephone Company, one of whose engineers developed it.

The device has successfully undergone tests in homes and at a school for the deaf and is now available to customers. Two models are available, one for persons who are deaf and blind and the other for persons who cannot hear, but can see.

The first uses a small magnetically controlled button which vibrates whenever a sound comes over the telephone line. The

New York Telephone Company engineer, Ralph Serafinn, developer of Sensicall, discusses assembly of the special phone for the handicapped at W.E.'s New York Distributing House.

handicapped person places his finger on the button to feel the vibration. Since he is able to sense the duration of the sound, a code for communication can be set up using short and long sounds such as dots and dashes of the Morse Code. The person calling can transmit signals by humming, whistling or tapping on the mouthpiece of his phone.

The Sensicall designed for persons who can see is equipped with a small lamp that converts long and short sounds into long and short blinks of light.

Each Sensicall is equipped with a transmitting button which, when pressed, sends a buzzer tone over the line. The handicapped person is thus able to send and receive signals to and from any other telephone. A combination on-off switch and control regulates the intensity of light or vibration.

World's Telephones

Americans have begun talking by telephone for the first time with people in the Cook Islands, a Pacific Ocean archipelago, and the Republic of Liberia on the West Coast of Africa. At the same time, they're talking more than ever before with people at more familiar stations along the worldwide communications network.

According to the 1965 edition of "The World's Telephones," released by A.T.&T. overseas calling from the United States increased over 20 per cent to a record high of 6,400,000 calls at the beginning of the year. (Figures are dated as of January 1, 1965 because it takes almost a year to collect data from world-wide sources.)

Giving continuing impetus to the rise is the addition of new communications pathways, both under the ocean and, beginning in June 1965, through space. Comsat's launch of the Early Bird satellite into commercial operation was a forward stride in telephone calling by satellite. Another step ahead was the beginning of service for the Bell System's fourth transatlantic cable in September 1965; it increases cable circuit capacity across the Atlantic by more than 20 per cent.

Two other cable systems, put into operation in late 1964, carried an increasingly heavy volume of calls during the year. One connects Florida and St. Thomas in the Virgin Islands, and the other, Guam and the Phillipine Islands. This is part of the link between the U.S. and the Orient.

With the addition of the 436 telephones serving the Cook Islands, and the 3,000 in Liberia, U.S. telephone users can now connect to any one of 176,300,000 telephones in the world, about 97 per cent of the total.

As of January 1, 1965, the total of the world's telephones was 182,500,000, an increase of 11,500,000 over the previous year. The gain was the largest one-year addition of telephones in the world in history and capped a decade of growth in which the world's telephones almost doubled in number.

North America, with 95,500,000 on January 1, 1965, has as many telephones as all the world had the same date in 1955. Most of the North American total is in the U.S., which counted 88,785,000 telephones at the beginning of 1965. Japan held second place with a total of 12,251,000. Others among the first 10 nations on the list are: the United Kingdom, West Germany, USSR, Canada, France, Italy, Sweden and Australia.

Trawler Damage To Cables

Mutual problems which arise when trawlers damage or break ocean cables while fishing were discussed by the Long Lines Department of A.T.&T. at the Third International Fishery Trade Fair held in Gothenburg, Sweden. A Long Lines representative pointed out that, because of trawler activity in the northwest Atlantic, the six submarine cables in that region had suffered interruptions in the past seven years.

To show the great cost involved in such damage, he cited a break in a cable to France which occurred last July. An amplifier valued at $50,000 had to be replaced, and the total cost to the international communications organizations was approximately $150,000. On the other hand, the fishing industry also experiences losses in such incidents. Last July, for example, a complete trawl net estimated to be worth $8,000 was recovered, tangled with a broken cable.

It was explained that cable routes were shown on special navigation charts made available free to all fishermen and that a Cable Damage Committee, with headquarters in London, sent out information and charts all over the world. The Long Lines representative also suggested that another international committee be formed, composed of both communications organizations and the fishing industry, to pool knowledge, to work toward greater cooperation and to consider improvements in equipment.

A display presenting the Bell System story was seen by visitors from 40 countries involved in fishing, fishing gear, ship design and equipment as well as editors of fishing publications and diplomatic representatives.

Unique Goggles

Faster than the blink of an eye, a new type of goggles can shut out the radiated light from a nuclear explosion and protect the vision of U.S. airmen against flash blindness.

The goggles employ a colloidal mixture of graphite suspended in a fluid, which is stored in a reservoir above the double lenses. When an intense flash occurs which threatens serious eye damage, it is detected by a photo sensor in the airman's helmet. The sensor triggers a pencil-sized explosive, which propels the opaque mixture into a narrow gap between the front and rear lens plates of the goggles. The graphite covers the lens in the few microseconds before the light has time to damage a pilot's eyes—in less time than it takes to wink. After the danger has passed, the blackened goggles can be replaced with clear ones.

The unique device works by means of a system designed and developed at the Sandia Corporation, a subsidiary of the Western Electric Company, which has an important role in America's nuclear defenses. Sandia—with scientific laboratories and facilities at Albuquerque, N.M. and Livermore, Calif.—con-

Airman demonstrates new goggles designed to protect eyesight from a nuclear flash.

ducts special projects for the Atomic Energy Commission under a non-profit contract, and was asked to work on the eye protection system because of its experience in developing explosive devices.

Typesetting System

A system of generating and setting any style of type—in any language—on the screen of a cathode ray tube has been invented at Bell Telephone Laboratories.

The system has been used to generate 150 letters a second of typewriter quality. The method has the potential of generating and setting several thousand characters a second —much faster than any other way of setting type—with a quality comparable to that of book type.

The new system also makes it possible to produce a great variety of type faces, line drawings, mathematical equations, musical scores and scientific graphs. Images or letters displayed on the screen are photographed and the film negative then can be used to make, by conventional techniques, a plate for subsequent printing.

The system is considerably more flexible than any other way of setting type. In other methods of type setting, type faces are stored as shapes on metal, glass or film. To change styles, it is necessary to manipulate metal forms, glass wheels or strips of film. In the new Bell Laboratories system, the type faces are stored in digital form. To change type faces, only the program instruction must be changed. A change could be made quickly, for example, from English to Chinese characters.

The new system has been implemented at Bell Laboratories in an experimental set-up that includes a digital logic network, a cathode ray tube and a camera. In this system, copy is typed on a keyboard directly connected to the logic network. The operator first indicates the type style desired; the network selects the style from its memory, and then, as the copy is typed, the network generates the copy on the cathode ray tube screen in justified columns (in which the type fills the width of the column).

Overhead camera photographs letters generated on screen of this cathode ray tube.

Put yourself in Pedro's place and decide what you would do!

Pedro Rodriguez is a resourceful 8-year-old who lives in New York City.

Last spring, Pedro went to spend his Easter vacation with relatives in Boonton, N. J. A few days later, he grew homesick, so he slipped away on the bicycle he had with him and started for New York.

After seven long hours of pedaling through strange streets and towns, he realized he was hopelessly lost. It was ten o'clock at night and he had only 15¢ in his pocket.

Through the darkness, Pedro saw the friendly light of a phone booth, dropped his lone dime in the slot and dialed "Operator." Mrs. Anna Appleton, Night Chief Operator in Bloomfield, N. J., took over the handling of his call.

Pedro knew few English words and Mrs. Appleton couldn't understand his frantic Spanish. But her calm voice reassured the boy and she held him on the line while she enlisted the help of a Spanish-speaking student at a nearby college. Patiently, they pieced together Pedro's story.

But how do you find a boy in a booth who has no idea where he is? Mrs. Appleton knew only that the call must be coming from one of five adjacent communities. In quick succession, she called the police in each town and asked them to check.

The Fairfield police found Pedro in a booth only a block from their headquarters. His mother came to get him and the story had a happy ending—thanks to a boy who knew enough to dial and an operator who lived up to the Bell System's long tradition of serving and helping, whatever the need.

Have you trained *your* children to dial "O for Operator" in case of emergency?

Bell System
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