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# BELL TELEPHONE MAGAZINE

SPRING 1966

*A patient at the Institute of Physical Medicine and Rehabilitation at New York University Medical Center uses a special elastic cuff with a dialing pencil to make speakerphone calls. Looking on are Gale Smith, A.T.&T. Company engineer, and Mrs. Joy Cordery, senior occupational therapist in research at the Institute. As part of a joint research project of A.T.&T. and the Institute, Mrs. Cordery devotes six hours a day to working with and observing disabled persons as they try to make and receive telephone calls with standard or slightly modified telephone equipment. The long-range objective of the project is to improve communications for the disabled. Dr. Howard A. Rusk, director of the Institute, feels the project will have world-wide importance for rehabilitation programs.*

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# 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:**

Students at the Carnegie Institute of Technology use teletypewriters in a classroom as they learn the sophisticated techniques of time-sharing for programing and retrieval of computer-stored information. The use of computers and communications, which is creating vast changes in the field of education, is the subject of the article "Communications for Education," in this issue.

Historical perspective on America's way of assuring the public adequate communications service at reasonable rates

# REGULATION

*(A BTM staff report)*

AWAY BACK in 1820 Congress conferred upon the city of Washington the power "to regulate the rates of wharfage and the sweeping of chimneys."

While this power of regulation bears little resemblance to the type of regulatory powers wielded by Federal and State Commissions over the communications industry today, the brief flashback into history does indicate that Federal regulation of private enterprise is nothing new.

Regulation is America's way of assuring that the public gets adequate service at reasonable rates. Government agencies like the Federal Communications Commission, which currently is conducting a full-scale investigation of the Bell System's charges for interstate services, were created not to operate the telephone companies, but to regulate them in the public interest.

In 1877 the Supreme Court defined the "public interest" concept for regulating business. The Court approved an Illinois law that fixed maximum storage rates for grain elevators on the grounds that a state could regulate "a business that is public in nature though privately owned and managed."

## Regulation by Legislatures

Regulation began because of a desire to set up some form of legal control over the operation of so-called natural monopolies engaged in very essential forms of public service. It started out as regulation of essential public services by legislatures under statutes primarily concerned with adequacy of service and avoidance of preference or discrimination.

Obviously, with changing conditions, this early type of direct regulation by legislatures inevitably broke down. It was inflexible; it became unworkable. Laws had to be amended as economic conditions changed and modern technology developed. Continuous regulation was impossible because legislatures held sessions at only certain times during the year. State legislators also lacked specialized knowledge of regulatory problems. The increasing burden of other legislative duties and the growth in the number of utilities made it increasingly cumbersome for legislative bodies to effectively exercise regulatory responsibilities.

Demand grew for more effective methods of regulation, ones capable of adapting to an increasingly complex society and of safeguarding the interests of both consumers and the utility companies. The states turned to regulatory commissions.

The first commission was set up in 1891 by the State of North Carolina. By 1920, more than two-thirds of the states had regulatory commissions. Today, every state in the Union

—as well as the District of Columbia—has a state public utility commission, public service commission, commerce commission or railroad commission, which regulates intrastate aspects of utilities' operations. However, communications services in all the cities and towns in Texas are regulated by municipal government.

In addition, there are a number of Federal commissions with jurisdiction over industries involved in interstate commerce. These include the Civil Aeronautics Board, Interstate Commerce Commission, Federal Power Commission, Federal Communications Commission, and many more.

## New Concepts Developed

The state regulatory commissions, during nearly a half century, proceeded to give regulation depth. They developed new tools, new concepts which have furnished real muscle and effectiveness to regulation.

Federal public utility regulation started with the creation of the Interstate Commerce Commission in 1887. Congress created this first Federal regulatory agency to regulate the railroads. The ICC's authority was expanded to include the prescription of a uniform system of accounts for telephone and telegraph companies in 1910 and then the regulation of interstate depreciation rates and charges to customers in 1920.

In 1927, with the sharp increase in various types of radio stations, the Federal Radio Commission was formed with powers over the allocation of radio frequencies and licensing of stations. Both the ICC and FRC were forerunners of the FCC.

Six years later, an interdepartmental committee was set up by President Franklin D. Roosevelt to study communications regulation. The interdepartmental committee reported that overlapping regulation existed and said:

"Communications services should be regulated by a single agency."

President Roosevelt sent a special message to Congress on February 26, 1934, urging the creation of such an agency. Four months later the President signed the act creating the Federal Communications Commission.

## The FCC

The FCC regulates interstate and foreign communications, common carriers' earnings, system of accounts, depreciation, construction, radio licenses, tariff rates and regulations, separation of investment, expenses and revenue between interstate and intrastate operations, discontinuance of service, and many other aspects of operations.

Under the Communications Act of 1934 carriers are required to furnish service to customers upon reasonable request. All rates, practices, classifications and regulations must be "just and reasonable." The Commission also regulates radio and television broadcasting and safety and certain other special radio services, but this regulation does not include rates and earnings. It consists primarily of issuing licenses to operate and allocating frequency assignments.

The FCC is composed of seven commissioners, not more than four from the same political party, all of whom are appointed by the President of the United States and confirmed by the Senate. The commissioners' term of office is seven years, with one term expiring each year. The Commission chairman is appointed by the President from among the commissioners. Each commissioner has a personal staff usually consisting of a legal assistant, engineering assistant and clerical assistants. The staff of the FCC is composed of about 1,500 people. It includes subdivisions appropriate to the various functions the Commission performs, such as Common Carrier Bureau, Broadcast Bureau, etc.

## Continuing Surveillance

Shortly after its creation, the FCC initiated the most extensive regulatory investigation ever undertaken up to that time. This four-and-a-half-year investigation of the telephone industry was completed in 1939.

This first FCC investigation covered practically every aspect of common carriers' business operations. As a result of the nvestigation, the Commission reached major conclusions that ave since guided its approach to telephone regulation.

The report of one task force which conducted the investigaion led to the Commission's adoption of a policy of regulation vhich has come to be known as "continuing surveillance." Jnder this policy, which has been used for almost 30 years to egulate the interstate services of the Bell System, the FCC s constantly kept informed of the Bell System's interstate perations through continuous acquisition of basic factual data nd its prompt analysis.

The Commission also concluded that regulating the Bell ystem is a big job, but is simplified by reason of the System's nified organizational structure.

Hundreds of reports on interstate operations and earnings re provided on a recurring basis and scores of special studies re conducted on request. Periodic meetings are held with the

FCC to provide up-to-the-minute knowledge of operations and earnings, and the Commission maintains three field offices in New York City, St. Louis and San Francisco, which inspect and audit Bell System operations throughout the country.

The company, on a day-to-day basis, keeps the FCC informed of the many complex factors and changing technology that must be taken into account in regulating a technically dynamic business. When necessary, rate adjustments are made to keep Bell System interstate earnings within what the FCC considers "a range of reasonableness."

In addition, many formal investigations of particular Bell System services and rates have been conducted by the FCC. There were a number of formal proceedings in process at the end of last year.

Down through the years, the FCC has been a strong advocate of the continuing surveillance method of regulation.

This policy has been a boon to the public's pocketbook. There have been numerous changes in telephone rates under this policy, the result of which has been an overall net savings to the public of more than $1.5 billion annually, based on current volumes of business. And interstate message toll telephone rates today are 22 per cent lower than in 1940.

There is a definite trend among all regulatory commissions, both Federal and state, towards a policy of continuing surveillance of public utilities, especially for rate making, in lieu of the cumbersome and more costly process of formal investigations. The trend is a result of a need for regulation to accommodate itself to changing conditions just as it is necessary for the utilities themselves to move with the trend of technical and economic development.

The chief advantage of informal, continuous regulatory procedures is the flexibility which permits the regulatory commission to keep up to the minute on operations, earnings and rates and to move promptly when necessary. Such procedures proved to be valuable, modern, regulatory tools, increasingly compatible with the swift growth and complicated economic patterns developed by the dynamic public utility operations in the United States.

## Court Upholds Policy

The policy of continuing surveillance as used by the FCC to regulate interstate earnings of the Bell System was upheld recently in a decision rendered by the United States Court of Appeals for the 9th Circuit. Use of the policy had been challenged by the California Public Utilities Commission.

And two public utilities authorities offer these views:

Francis X. Welch, editor of *Public Utilities Fortnightly,* believes the "increasing complexity of regulation will require constant regulation—regular reporting, informal conferences and settlements." Fred W. Henck, editor of *Telecommunications Digest,* says "there are many imponderables in regulation. In the long pull, we can expect a mixture of what we have now (continuing surveillance and periodic investigations)."

## Living With Regulation

The Bell System has lived with state regulation for more than half a century and with Federal regulation for more than 30 years. There are clear necessities for regulation, both from economic and legal standpoints, and we recognize them.

In a recent address in Michigan, A.T.&T. Board Chairman Frederick R. Kappel said ". . . communications service to the general public should be under public regulation."

"The ideal situation," he said, "would be one where we who operate this regulated business would do our job so well that the regulators wouldn't have anything left to regulate. This is our goal and it is just as realistic and important as any I could mention." It means, Mr. Kappel emphasized, that we who manage the telephone business should have a sense of responsibility for the public interest that is just as strong as that of the most zealous public servant.

Our acceptance of regulation, Mr. Kappel added, "does not mean that public authority should try to manage communications service . . . I think the evidence is conclusive that private enterprise management, working with reasonable freedom under regulation, has given this country consistent leadership in communications. I am confident also that this leadership will be maintained as long as the same conditions prevail."

As long ago as 1908, then A.T.&T. President Theodore N. Vail, the man who did so much to shape the organization and policies of the Bell System as we know it today, suggested governmental regulation of our business.

When regulation by commission was introduced, Mr. Vail said that control by such a body "had many advantages over that exercised through legislative bodies or committees. To encourage the highest possible standards," Mr. Vail continued, "regulation should allow rates that will warrant the highest wages for the best service, some reward for high efficiency in administration, and such certainty of return on investment as will induce investors not only to retain their securities, but to supply at all times the capital needed to meet the demands of the public."

## The Policy Applies Today

Mr. Kappel has reaffirmed this policy:

"A business like ours, which doesn't have competition in the same degree as many others, has to be regulated. But that doesn't make us different from other people . . . we too need freedom—under regulation—to do our very best."

Concerning the current FCC investigation of the Bell System's rates for interstate services, which got under way last month in Washington, D.C., Mr. Kappel has expressed confidence in the outcome. He told shareowners at last month's annual meeting that A.T.&T. would do everything possible to help the proceedings move swiftly and would do "our utmost to demonstrate the continuing need for earnings in the range of eight per cent."

In the course of the investigation, the Bell System also wants to earn public understanding that:

• Our business has been and will continue to be operated in the public interest.

• Our reason for being as a business is to serve our customers—not just with service that is good technically, but with service genuinely responsive to the wants and needs of the individual.

There is overwhelming evidence that the U.S. system of entrusting the development and operation of the communications services to private enterprise under public regulation has been effective. Telephone service has expanded rapidly—the Bell System's interstate services have grown more than ten per cent a year. Service has improved and new services have been introduced.

The chief testimony to the success of this arrangement is the general agreement around the world that the United States has the best telephone service. Much of the credit, of course belongs to Bell System scientists, managers and employees But there is little doubt that unenlightened and oppressive regulation could have drastically hamstrung our efforts.

Regulation is an evolutionary process. It is necessary fo regulation to accommodate itself to changing conditions jus as it is necessary for the utilities themselves to move with th trend of technical and economic development. The classica concept of a public utility as a sheltered natural monopoly protected from area competition and, therefore, requiring som form of government controls to protect the consuming and in vesting public has been changing rapidly in recent years. Ad vances in communications technology—microwave, satellites electronic switching, computers—are providing increasing com petition to and among common carriers.

## Time for Change in Concept

This increasing competition has taken away much of the shelter communications common carriers may have enjoyed and has greatly increased their risks. Regulatory concepts, it follows, need to be adjusted to the changing character of regulated utilities. There is need for continuing revaluation of the concept of what constitutes a reasonable rate of return.

There is no slide-rule formula for computing the reasonableness of earnings. The determination of an appropriate earnings level is a matter of broad, informed judgment.

But the need for Bell System earnings to be comparable to those of alternative investments was emphasized in written testimony recently presented by witnesses in the FCC's rate inquiry.

F. J. McDiarmid, manager of the Securities Department of The Lincoln National Life Insurance Company, commented:

"Regulation should not be so restrictive in its thinking that the utility is prevented from earning on its common equity at rates comparable to the alternative investments in other progressive well-managed firms. Only on this basis will the utility be able to attract funds from insurance companies and other investors over the long run and provide service to customers when needed."

## Bell System and the Economy

Dr. Paul W. McCracken, formerly a member of the President's Council of Economic Advisers and now professor of business administration, University of Michigan, stressed these points:

- "The objectives of economic policy, inevitably evolutionary in character, do quite explicitly commit the government to use all of its programs to attain maximum employment, production and purchasing power.
- "We are facing a period when the economy must grow at an unprecedented rate if jobs are to be created rapidly enough to absorb our fast-growing labor force.
- "The dynamic processes by which our economy has organized itself to achieve progress by holding out the lure of higher rewards to those who lead the parade . . . impose corresponding profit penalties (and even extinction) on those who lag behind."

Dr. McCracken also noted that national policy has been "to promote maximum employment, production and purchasing power." He said there can be little doubt that "the total contribution of the Bell System to the vitality of our economic system is quite explicitly germane to the regulation issue."

Looking backward briefly, we trace the evolution of the growing array of new products and services which are making telephone service more convenient, more versatile and more valuable

# a decade of new products

William S. Brown, Jr., *Product Marketing Supervisor*
*Marketing Department, A.T.&T. Co.*

After World War II and the conflict in Korea, it was apparent to all industry that a new day indeed had dawned. After years of wartime austerity people were no longer satisfied with ordinary products which merely performed a function well. It was not enough for manufacturers to re-tool their plants from production lines for tanks, guns and aircraft engines to lines for automobiles, refrigerators and washing machines. The customers wanted some of the "trimmings" they had been so long denied. They were ready for automobiles with new and daring body designs, new and refreshing colors, automatic gear shifts, FM radio. In their new homes they wanted air conditioning, television, high fidelity music, back-yard swimming pools and barbecues; more country clubs, better eating places. For their travels they wanted faster, more comfortable airliners serving luxury meals.

To be sure, some of these wants were created by the things themselves—by the products of accelerated technologies. The telephone industry was no exception. For several post-war years the Bell System's energies were devoted—necessarily — to fulfilling the fundamental mission of the business: simply to provide basic telephone service for everyone who wanted it; and there were hundreds of thousands waiting. By the time that tremendous backlog had been cleared up, new things began to emerge from Bell Telephone Laboratories. And the offering of these new things was the reflection of a major change in policy in our approach to serving the telephone customer.

Frederick R. Kappel, chairman of the board of A.T.&T., in his book *Vitality in a Business Enterprise*, wrote: " . . . The Bell System has a big new goal. For more than eighty years we have been working to bring the arts of transmission and switching to the point where we could serve everybody over a big, reliable, basic network . . . . This was the first necessity, and it has taken that long. But now we have reached that point and we want to take off from there.

"So we have a new goal.

"I can describe it in a very few words. It is to give our customers the broadest possible range of choice in services available through our network, and I mean a range of choice that will be fully comparable to the choices or options offered consumers by non-regulated, competitive industry. . . ."

Although these words were published in 1960, they actually re-stated a policy e Interphone, 1956

Touch-Tone Trimline phone, 1966


which already had been formed and actively pursued for several years. In the early 1950's, the decision had been made to create an entirely new telephone set with a new shape and a new size; it was called the 500 set. Since we knew that our customers then wanted something more than just a black telephone in one location in the home, we hastened to fill the need. The public had refrigerators, stoves, cars, radios in a wide choice of colors; why not telephones? In 1954 we brought out the 500 set in a range of decorator colors with matching spring cords. Sales of the new sets demonstrated customers' readiness to accept new and refreshing things in telephones, too.

Almost coincident with the introduction of color, a new Merchandising Department was formed at A.T.&T. in New York. At first, emphasis on sales of the color sets was so great that many people defined "merchandising" simply as selling telephones in colors. That may have been true to some extent, but it was a matter of emphasis only; for, by 1956, product testing was well under way on a number of other new products and services. Prominent among these were the Home Interphone, Princess® phone, noisy location set, impaired hearing phone, a new type of private branch exchange switchboard (PBX) known as the 756 which utilized crossbar switches and "common control" similar to the newer central offices, a new key telephone system, a special emergency reporting phone and educational television. During the next couple of years, many of these were introduced on a "fully available" basis to the Operating Companies, and were soon joined by the Call Director® and direct inward dialing (DID), which permits incoming calls to large business offices to be dialed directly to extensions without going through the PBX operator.

*Data-Phone*

*Director*

*Speakerphone*

*Princess phone*

## Marketing

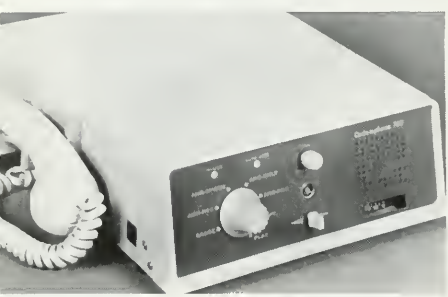
By 1959 much of the marketing test work of earlier years was becoming fruitful, and the still-new Merchandising departments throughout the Bell System were being re-grouped under the more general name of Marketing. At about that same time, Mr. Kappel remarked, "We are facing competition in science, in technical development, in the services we devise and offer, in the way we price them, in our skills of marketing and salesmanship, in the character and dependability of our service every day and every hour." The Bell System was now committed to a full-scale, full-time program of selling its products and services —and devising new ones to sell. The motive was to meet our obligation to provide complete, up-to-date communications services with, as Mr. Kappel had said earlier, "the broadest possible range of choice" and also to meet competition for the customer's dollar in the nation's market places.

### The Princess Phone

One of the first System-wide programs, the introduction of the Princess telephone, was begun in 1959. Now a common-place item in the telephone line, the graceful little telephone then was a radical departure from traditional telephone design. In that same year we also introduced a speakerphone for hands-free calling, another new console for PBX attendants, the Bell Chime* ringer, Data-Phone** data communications service, the Bellboy® pocket signaling set and the automatic call distributor which automatically distributes incoming calls (without a switchboard attendant)

*Trademark of the Bell System
**Service mark of the Bell System

*Touch-Tone calling*



*Code-a-phone*

to many phones such as those for shop-by-phone sales clerks.

In 1960 still more new products began to roll from Western Electric's assembly lines to the Bell Companies as the overall Marketing effort gained momentum. We had by this time produced and offered a new speakerphone which was superior to the earlier model; the electronic artificial larynx, which gave a voice to those made voiceless by nature, accident or surgery; a new PBX console and a newly-designed universal switchboard; farm interphone and improved home interphone systems. National Yellow Pages service began to emerge, allowing major nationwide subscribers to the service to place a single order for multiple listings in any number of cities. In 1960 Western Electric production of Princess phones topped 1,800,000, an all-time production peak. By the end of last summer, more than 4,000,000 Princess phones were in service.

## Centrex

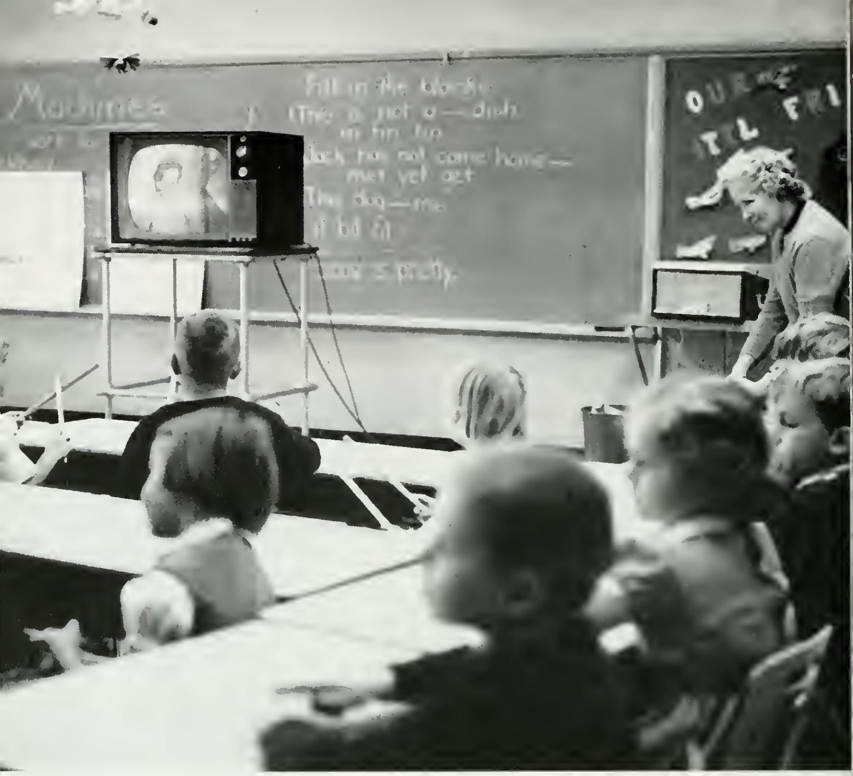
A new service for business called centrex arrived in 1961, offering in-out dialing, call transfer, console operation and other attractive features. The equipment for the new service could be located on telephone company premises, and, therefore, save space for the customer; but it could also use the customary PBX equipment located on customer-owned space if so desired. That same year saw the introduction of WATS (Wide Area Telephone Service) and telpak, a package offering of broadband communications channels carrying many different kinds of services, all at a flat rate.

By 1962, we had decided that our "incidental" station equipment, too, should be available in colors, and so cables, terminals, buzzers and apparatus boxes were offered in light gray and ivory. We also introduced a line of automatic dialers, including the Rapidial[1]

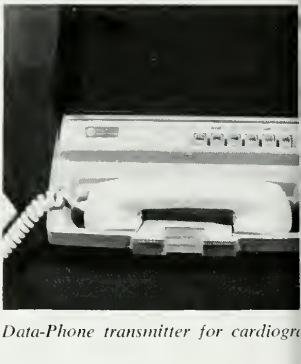
[1]Registered trademark of McGraw-Edison Co.


*Magicall*

*Card dialer*



*Educational television*



*Data-Phone transmitter for cardiogr*

*Panel phone*

repertory dialer, a magnetic recording device with a capacity of 290 names and numbers, and the card dialer, which used small, plastic pre-punched cards to send dial impulses by means of a special mechanism in the phone itself. To fill an evident need for a compact dial switching system to replace small manual PBX systems, we offered the 20-40 dial pak, the name being derived from the range in the number of telephones that it can serve. The system offered in-out dialing to a limited number of selected telephones and two-digit communication between phones. Coincident with the 20-40 (but not associated with it), business customers were offered the Spokesman* transistorized telephone loudspeaker designed for small group listening. We also joined the trend to built-in appliances with a recessed panel phone having a cord retracting on a spring reel and an attractive, newly-designed switch-hook. In the fall of 1962 we produced a full marketing program for educational television. This new service offering was presented to the Bell Telephone Companies with the aid of a documentary color film covering the many such services being offered throughout the country.

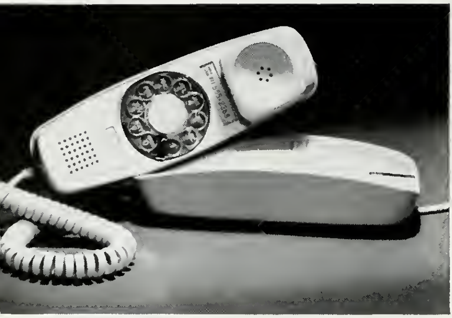
## Touch-Tone® Calling

The year 1963 may well remain conspicuous in Bell System history for the introduction of Touch-Tone calling. This new service came out of the testing stage and into public use as the year faded into 1964. Many millions of visitors to the New York World's Fair in 1964-65 became acquainted for the first time with Touch-Tone calling, since all the Fair's phones were equipped with the new push-buttons in place of dials. Visitors also found the buttons much faster than the dial in making a call. Development of the new service has proceeded rapidly; by the middle of 1965 we had installed 315,000 Touch-Tone phones and passed the three-quarter-million mark at the close of the year. By 1970, we hope to offer Touch-Tone calling to 90 per cent of our customers, and plan to make it 100 per cent with the projected completion of System-wide electronic switching by the year 2000.

Although 1963 is memorable for the advent of Touch-Tone calling, that year also saw many other new service offerings. Among these were another new PBX, the 757A, which, like the 756, employed crossbar switching and common control; the No. 101 electronic switching system, which provided great flexibility in choice of custom service features; two new automatic call distributor systems; a new handset for noisy locations; municipal reporting service for fire, police, ambulance and other town and city functions; school-to-home service to enable shut-in students to attend classes via telephone; tele-lecture, which provides a telephone hook-up between a lecturer at one location and student audiences in many distant places; and automatic answering systems —a new Electronic Secretary[2] and Code-a-phone.[3]

In 1964 the Bell System introduced business interphone, combining the hands-free speakerphone feature and a system with a capacity of from two to 18 dial codes with up to five extensions on each code, and providing conferencing arrangements. It found a ready market among hospitals, clinics, garages and many small business firms. Picturephone** see-while-you-talk service made its debut between New York, Chicago and Washington (installed in special public booths) and at the World's Fair. That year also saw introduction of the guest dial pak for small motels and the offering of the Magical[4] repertory dialer.

*Trademark of the Bell System
[2]Registered trademark of Automatic Electric Co. (1962)
[3]Registered trademark of Code-a-phone Electronics Corp.
[4]Registered trademark of Dasa Corp.
**Service mark of the Bell System



*Trimline telephone*

*Call-A-Matic dialer*

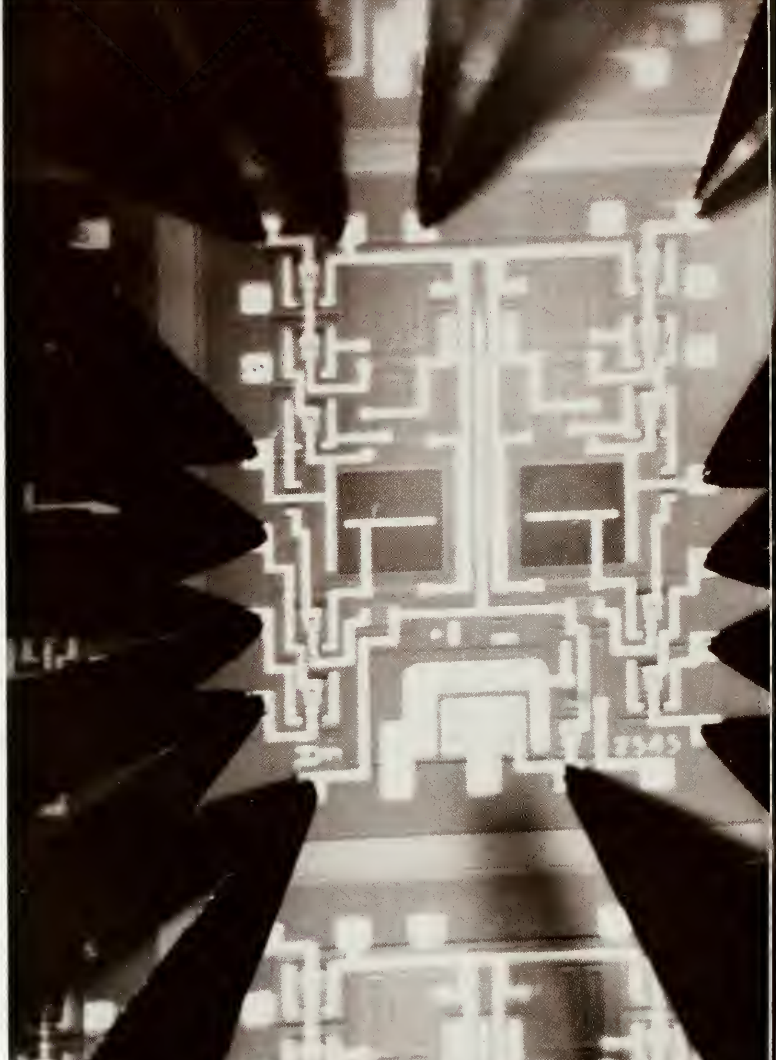
## Trimline® Telephone Set

In 1965 came the fruition of a long period of design, trials and testing when the Trimline telephone was first offered. In the Trimline phone, the dial, receiver and transmitter are all built into one small, lightweight unit which rests in the hand. The new phone was introduced in Michigan early in August of 1965, and before the month had ended, orders for Trimline phones exceeded the initial forecast by several times. In fact, Michigan's successful sales program caused a complete reforecasting of the entire marketing program for the Trimline telephone. Indiana Bell began selling it September 1, and was followed by the Cincinnati and Suburban, Ohio Bell and Northwestern Companies in the fourth quarter of 1965. Many of the other Bell Telephone Companies are offering the new Trimline phones in 1966. The Touch-Tone calling version of the Trimline phone will start to become available late in 1966.

During 1965 we will also introduce a hospital interphone system, the Call-A-Matic® dialer with Touch-Tone dialing and the new Alarm Reporting Telephone. (See "In The News" page 57)

This brief, retrospective view of a decade or so of new products is not by any means a complete list. That is merely a result of the restrictions imposed by brevity itself. Behind each new product or service, there is the story of much hard work by many skilled and imaginative people—people in the Bell Telephone Laboratories, in Western Electric, in all the Bell Operating Companies and at A.T.&T. And the work goes on. Many more new products and services, and new models of existing products, are constantly under development and refinement so that these, too, can be offered to our customers. In the pages immediately following, we look into the future where we can discern the outlines, at least, of still more new things.

*Picturephone see-while-you-talk service*



**The preceding pages chronicle briefly the past decade of telephone products. Here, in a forward glance we find seeds of future achievement in present techniques**

# LOOKING AHEAD...

Recently a well-known editor and writer of science fiction remarked that his trade, fathered about a century ago by Jules Verne, was rapidly dying out. Fiction, he said, has been overtaken by fact at such an accelerated rate that people are now inured to marvels—marvels that appear in the daily press, not in magazines like the old *Amazing Stories*. The best of science fiction was based on extrapolation: projection by inference into an unexplored situation from observations in an explored field. The gap between the explored and the unexplored has narrowed to the point where the science fiction writer's projections are little more astonishing than the latest announcement from any one of the nation's industrial or academic laboratories.

What follows here—a brief examination of new telephone products and services for the next decade or so to come—falls neither into the category of fiction nor that of fact. It is, rather, extrapolation as defined above. Some of these things are on the verge of realization; others are less than accomplishment but more than dream. All are based solidly on present technology, and are being developed in response to contemporary customer demands. While most do not have specific date tags attached, they will probably be offered some day, quite prosaically, in telephone company tariffs.

There are, for instance, the comparatively new techniques of micro-miniaturization in thin film and integrated circuit design. These are not, and never will be, tariff items in themselves, any more than is the transistor in itself; but they will lead to new kinds of tangible hardware. We can foresee a complete line of equipment to be located on customer premises—PBX consoles, call distributors, intercom systems, the telephones themselves—which utilize the new micro-miniature solid state electronics. These will not only make possible much more compact design of the visible equipment but will also provide great flexibility and easy maintenance: the electronic components are tiny, assembled units, which are plugged in, and are disposable if trouble should occur in any one of them. The faulty unit—switch, logic circuit, memory unit, amplifier, whatever it may be—is simply unplugged and a new one substituted in an instant. Micro-miniature techniques enable engineers to put all the elements of a complete electrical circuit—an amplifier, for example—in a space about the size of a match head. Moreover, these are encapsulated in plastic so that they are rugged and have a new order of reliability. Simple and efficient modular design is one logical product of these miniature electronic building-blocks. In the Touch-Tone® Trimline® telephone, tiny thin-film circuits may be used for the dialing mechanism. "Mechanism" is perhaps no longer an accurate word in this application, since the process of calling a number will be entirely electronic, in-

*Microscopic view of thin film integrated circuit under test at Bell Telephone Laboratories.*

volving no moving parts.

This will be true also in key telephone systems. Multi-line telephones will have non-mechanical line-selection buttons—perhaps capacitor-operated touch buttons similar to those now found in many self-service elevators. Furthermore, key telephone systems will be integrated in package designs—much as PBX systems are now being offered as service packages, rather than as lists of their component hardware (See *BTM*, Summer '63). Operation of PBX and answering service consoles will be simplified and mechanized. *Automated* might be a better word, for here again the attendant's job will be made easier through electronic, not mechanical, means.

Among other things now visible on the horizon is a complete family of sophisticated, practically effortless automatic dialers. The repertory of numbers will probably be stored in thin-film circuit units, and such present repertory devices as punched plastic cards, magnetic tape or drums may be obsolete as the dinosaur. Obsolete also will be present installation methods—and this applies to all equipment on customer premises. A *systems engineering* approach to all such installations is part of the shape of things to come—even for installations in a single room, be it office or home.

"Effortless" is one of the operative words in the preceding paragraph. One abiding truth, in the future as in the present, is the fact that the customer is the most important person in our business. Service for the customer is our reason for being. Immense amounts of engineering skill will be spent—and are now being spent—on making that service varied, flexible and, above all, simple and easy to use. There are now in progress trials of Custom Calling Services, offering new service features individually or in a variety of packages. One feature is *Speed Calling* (or *abbreviated dialing*), which, under present arrangements, enables the customer to reach any of eight frequently called numbers by dialing only one digit instead of the usual seven or ten. By reducing the number of operations necessary to establish a call, such developments may some day lead to direct station selection, whereby a large number—perhaps any desired number—of phones can be reached simply by touching a button.

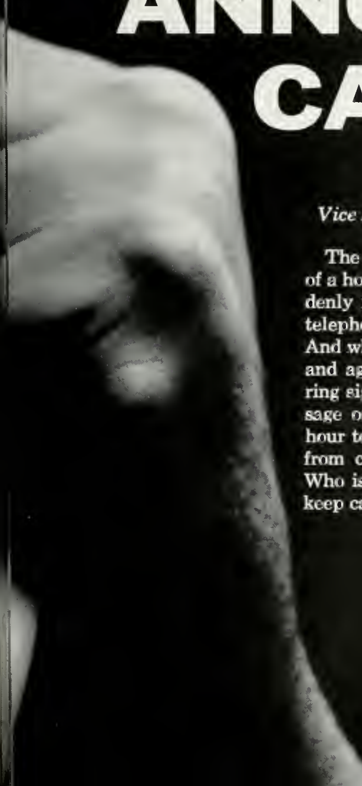
Other new service features are now somewhere between drawing board and laboratory test bench. Suppose, for instance, that you are in New York and want to make a call to someone in Sacramento. Perhaps you get a report that all circuits to Sacramento are busy, or perhaps the individual phone on the West Coast is busy. Sometime in the future electronic equipment will automatically make a second and third attempt to reach the number without any further effort on your part. Suppose also that your call is part of a telephone conference involving several people. Future service features will offer you the option of setting up conference arrangements at any and all distances—interoffice, inter-building, inter-city, interstate — quickly, simply, and with improved audio-visual links which can be envisioned as an extension of today's PICTUREPHONE see-while-you-talk service.

Still with the customer's convenience in mind, engineers are looking toward fulfilling the potential of Touch-Tone calling by expanding the phone's capacity to 12, perhaps even 16 buttons, which in turn would expand the number and kind of things you will be able to do with it. Today, in a few places and on a limited basis, customers with Touch-Tone phones can pay bills and keep their bank accounts straight by tapping digits into the bank's computer. Tomorrow, they may be able to do the day's shopping at an automated, computerized supermarket without leaving the easy chair in the living room.

Most of the things described above have the slightly romantic aura of blue sky about them. They are desirable and pleasant to contemplate. Engineers, however, consider them not only desirable but also inevitable. Equally inevitable to the people who must do the planning and figure the cost are other things behind the scenes—things the customer may never see or even know about. The huge Bell System network has always been much like the iceberg: only a fraction of the whole is visible. Among those technical necessities not visible to the customer will be such things as wide-band and extra-wide-band switching: sophisticated techniques which will be needed to quickly rearrange and efficiently utilize the tremendous communications capacity and frequency ranges of future broad-band communications channels. The customer will experience directly other new features like the Automatic Intercept center, where a continuously-updated computer will tell him, via voice-response, of any change in the number he is calling. Similarly, a Semi-automatic Information Bureau will provide him with rapid information service; an operator, handling his request, queries a computer through a combined keyboard and cathode-ray tube display device, and gives him the desired number more quickly and efficiently than she can now by flipping the pages of an information directory. The directory which the customer uses at home or in the office may be printed directly from computer tape. These last three items—intercept, information and directory printing—are already under trial in some parts of the Bell System.

The computer—that ubiquitous tool of the new electronic age—will find increasing employment behind the scenes of the telephone business as it will in many others. It will be the heart of a System-wide business information system (B.I.S., *BTM*, Summer '65). With the development of computer programs to analyze basic data on economic and population growth, the computer will be used to help locate and time the construction of new central offices and wire centers. It will also contribute its microsecond calculations to studies for new trunk routes and to engineering studies for future communications needs. Through time-sharing techniques which are now in active use, centralized computers will serve many users in many places and with many different kinds of problems. And all the raw materials of communications —voice, data, picture—may be carried across the country by means of new transmission systems such as waveguides or pulse code modulation. Both of these, now in experimental stages, have clearly demonstrated their immense future potential. And, of course, there are the near-science-fiction capacities of the laser, which almost daily shows through laboratory doors the shapes of future possibilities.

The future also holds new shapes for such familiar things as the telephone itself. There will be significant improvements in what is known today as the speakerphone—instrumentalities for hands-free calling. And with those improvements may come telephones that don't look like telephones at all. They may, in fact, not be visible at all. Engineers, practical though they must be, today can shrug with Gallic eloquence and say that, technically, there is no reason why transmitter and receiver should not be concealed somewhere in living room, study, kitchen, or office—in a piece of furniture, a ventilator or almost any other fairly permanent part of the customer's physical surroundings. There are even indications that some day we may have equipment entirely free of wires—PBX consoles and telephones. So, the next time you see the Man from U.N.C.L.E. unclip a slender, pencil-like object from his pocket, extend the tip an inch or so and say softly, "Channel D, please," you may smile in tolerant amusement if you wish, but don't laugh too loudly—it could happen.



**Harassing, obscene, abusive and threatening calls are an increasingly serious problem — one which the Bell System is trying to combat in every way possible**

# ANNOYANCE CALLS

Hubert L. Kertz,
*Vice President, Operations, A.T.&T. Co.*

The relative calm of the daily routine of a housewife is abruptly shattered. Suddenly it starts — with just a ring of the telephone — an obscene telephone call. And whoever it is keeps on calling. Again and again the telephone rings, and each ring signals her increasing fear. The passage of time — from minute to minute, hour to hour — becomes a dreadful crawl from call to call, from terror to panic. Who is it; where is he; how long will he keep calling; what else might he do; what


could she do to stop this frightening, anonymous voice?

Is this woman's plight overstated? It is not. Nor is it a singular, one-of-a-kind situation. It symbolizes an increasingly serious problem—one which the Bell System is trying to combat—the growing number of annoyance calls received by our customers. The number of complaints about such calls has increased steadily in recent years and it can be assumed that many more customers receive similar calls but never report them.

Annoyance calls can be roughly divided into three groups: abusive calls (such as the one cited above), including obscene, harassing, threatening or interference calls; commercial solicitation calls, including sales, promotional solicitation or survey calls; or calls that are misdirected.

When such calls are received, when the telephone becomes an instrument of annoyance, unpleasantness or terror, it is a matter of serious concern to us. Removing sources of customer irritation is an integral part of providing high quality service to our customers.

Thus, to the stated and oft-quoted Bell System service policy of providing the best possible telephone service, A.T.&T. has recommended that an expressed policy regarding annoyance calling should be that the Bell System will use every available legitimate means to combat annoyance calling.

#### Abusive calls

Abusive calls are the most distressing to a customer and constitute the most serious problem. Calls in this category are made with the intent to frighten, annoy or embarrass the called customer. They include obscene, harassing, threatening and interference calls. The interference call, for example, is made with the intent of hindering the called person in the use of his service by calling and not breaking the connection.

Substantiating the growing seriousness of this abusive call problem is the fact that, since 1955, states have enacted or broadened statutes penalizing one or more varieties of such calling. A majority of states, plus Canada, now have such criminal statutes. If the calling number is identified, the telephone company can, under most circumstances, properly reveal it to the person called or to law enforcement authorities with the consent of that person.

Thus, there appears to be no compelling reason why a Bell Operating Company should not attempt to identify the line from which an abusive call is made if the called customer so consents. And there are significant reasons why such calls should be identified—not the least of which is the hope that successful identification of the calling line and the ensuing publicity might substantially deter abusive calling by removing the cloak of anonymity which now hides and emboldens most callers.

#### Procedures

Procedures have been devised to reinforce our efforts in dealing with this especially difficult problem. Much of the activity in dealing with these annoyance calls takes place "behind the scenes"—in areas where specific technical procedures have been developed which the customer never sees. But one place where the customer is aware of what is being done is in the telephone company business office; here is where his complaints should come.

The receipt of abusive calls is a serious matter to us, as well as to the customer. He must be made aware that we are concerned and that we will make every effort to solve his problem and help correct misuse of telephone service. Business office people have a responsibility to indicate to the customer that we have a genuine and sympathetic interest in his problem, that the problem is understood and that we do want to—and frequently can—do something about it.

What happens when the customer calls the business office? The service representative, by intelligent questioning, must develop the facts needed to make a proper analysis of whatever steps are necessary in solving any particular complaint. The discussion with the customer should generally result in the service representative having developed the following information: frequency of calls; time of day the calls are received; variations, if any, in the calling pattern; relationship of calling time to members of the family being at home; or any recent publicity in newspapers or magazines about a member of the family. Evaluation of this information will aid the representative in determining what further steps are necessary to solve the customer's problem.

When only one or two abusive calls have been received and the threat of bodily harm is not involved, our experience is that such calls are usually discontinued after a few attempts. This is particularly true if the person called refuses to give the caller any satisfaction and hangs up immediately.

If there have been a number of calls over a period of time, the service representative may request the customer to keep a record of all abusive calls received during the next several days, and an appointment is made to discuss the logged information. During the log-keeping period, we often find that the calling has stopped, that it was a temporary condition. In this case, if the customer agrees, the case is considered closed, with the customer being assured of our cooperation if the calling should start again. Where the customer reports receiving very few calls, between one and three and following no apparent pattern, during the logged period, a temporary or permanent number change or transfer may be suggested to him.

If the customer has recorded more than three calls on the log, and if the information developed indicates that it is appropriate, there will be times when an attempt will be made to identify the calling number. In these cases, consent of the person called must first be obtained. The ensuing action may involve the Plant, Security and Legal Departments. Great care is taken at each step in the process to fully cooperate with the customer and, with his authorization, to provide full information to the appropriate law enforcement authorities.

When a request is received to identify a call after the receipt of a serious threat —bodily harm, kidnapping or damage to property—immediate action is taken. Recognizing the seriousness and urgency of the situation, we will cooperate to the fullest possible extent as swiftly as we possibly can.

## Sales and Survey Calls

Another source of annoyance calling is found in the intrusive or inconsiderate


sales, promotional solicitation or survey calls. Included in this category are calls placed indiscriminately to residence customers in an attempt to sell a variety of products or services or to request information for research purposes. Such calls are annoying when received at inconvenient times, when the caller is discourteous or overly aggressive, when the person called objects to receiving any calls of this nature, or when the person called objects to the nature of the questions asked by an interviewer.

However, telephone sales calls between businesses are part of the day-to-day routine through which our economy functions. When used properly, the telephone is an effective sales tool, and business expects and appreciates this use.

Telephone solicitation of our residence customers is another matter and can, if abused, constitute a serious annoyance call problem. Many of these calls annoy people and intrude on the privacy of the home.

But distinctions must be made between these calls and the "abusive" calls, as defined above. Most commercial solicitation calls are made for the legitimate purpose of selling a product or service, and the identity of the caller or his product is disclosed to the person called, whereas most abusive calls are made for an illegitimate, improper or indecent purpose and are anonymous. The telephone company is required by law to provide telephone service for any lawful purpose—and selling by telephone is, of course, lawful. Yet there is a line of good taste which, everyone agrees, selling and soliciting by telephone should not cross. Telephone selling, after all, should always aim at the mutual advantage of buyer and seller.

### What Can Be Done

What, then, can be done? Generally, the best remedy for handling a solicitor who is rude or persistent is simply to terminate the call. However, at the same time we will do all we can to help our business customers improve their telephone selling so that it will not annoy our other customers. When it is apparent, for instance, that complaints are being received from numerous customers concerning a particular solicitor, the business office manager may contact the caller directly or refer the case to Marketing Department people who are trained in dealing with customers who make telephone sales calls.

Upon receipt of a complaint about a sales or solicitation call, for example, these people would visit the caller, point out that he has offended his potential customers and explain that there is a proven, successful program for planned and proper use of the telephone in selling which stresses such requirements as sensible selection of prospects, timeliness, truth and good manners. This program works to the mutual advantage of all concerned (seller, buyer and the telephone company) by eliminating the cause of the complaints, while improving the results of the customer's selling efforts.

### Misdirected Calls

The last of the categories of annoyance calls, misdirected calls, are those where the caller attempted to reach someone other than the person who actually received the call. Generally, they result from incorrect dialing of the number. They are also, on some occasions, caused by the number appearing in error in another customer's advertisement or being listed in a current directory under a prior customer's name.

Where attempts to reach someone who had the number previously are at fault, a number change with an intercept of calls may be offered. However, it has been our experience that such conditions are usually temporary in nature.

In those cases where the customer's number appears in error on another customer's stationery, cards or in an advertisement, the service representative will contact the customer responsible for the misprinted information and request that its distribution be discontinued. The customer receiving these calls in error will be offered a number change, with an intercept, where the volume of calls being received constitutes a sufficient annoyance.

And, finally, there are those cases in which the customer's current number is similar to another and frequently called number, such as a cab company, hospital or fire department. In this case, their number is changed and their former number is marked to prevent reassignment.

### Summing Up

Highlighting the seriousness which we attach to these annoyance call complaints, Frederick R. Kappel, chairman of the board of A.T.&T., speaking in the 1965 Annual Report, summed up the Bell System position which stands behind many of the concrete steps and policies discussed here:

"A considerable number of people have been troubled by receiving harassing, abusive, obscene or threatening telephone calls. We want it known that in every instance we are anxious to help and will do so to the limit of our ability. Such calls violate state laws and we are strongly in favor of prosecution of violators. Sometimes the problem is difficult. But difficult or not, we invite customers to ask our help. We shall take every appropriate action, and stay with the problem until it is worked out.

"Residential sales canvassing by telephone is also a frequent source of irritation. So much of economic life depends on selling that few people would make absolute rules against it. However, the most exasperated recipient of an obnoxious sales pitch is no more opposed to intrusive, inconsiderate telephone selling than we are. If people will tell us who it is that is bothering them (and when sales calls are received this is not hard to ascertain) we will do our best to help.

"In our own sales work we are guided by these principles: First, only if the customer obtains added value should he buy. Second, only if the value continues will the sale last. Third, only if the sale lasts will it benefit both buyer and seller.

"We think these are sound principles but in addition, real consideration for the other fellow is always the first essential. So we say again—if you are distressed by calls that are failing in courtesy and good taste, please let us know. We will try to improve the situation."

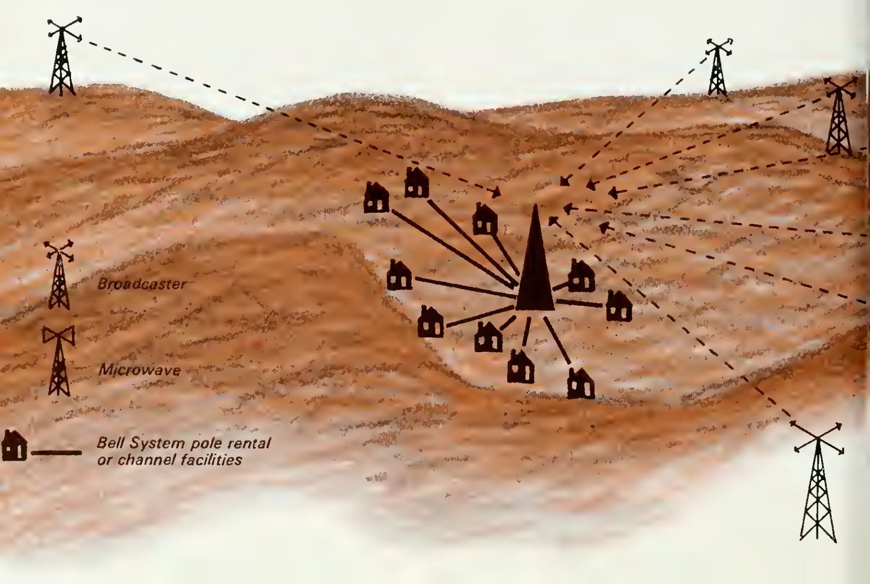
This effort, and all such efforts to alleviate the problem of annoyance calls, entails close coordination among all departments of the telephone company and can often be an exceedingly difficult and complex procedure. The results, however, can be well worth the efforts—by decreasing such annoyance calling, the telephone will become, as it should be, even more of an instrument of service and pleasure.

**Because of our unique experience in the transmission of visual images we are especially well equipped to help this vigorous young industry**

# The Bell System and CATV

CATV—Community Antenna Television—is one of the newest Bell System customers for television channel communication service. And a fast growing one. In the first ten years of its existence to 1960, the CATV industry sprouted from one to some 800 systems serving 750,000 customers. The last five years have seen the number of systems double and their subscribers increase almost threefold. Right now, CATV is not only expanding in the small towns and rural areas where television reception is poor, but it is also moving into the city.

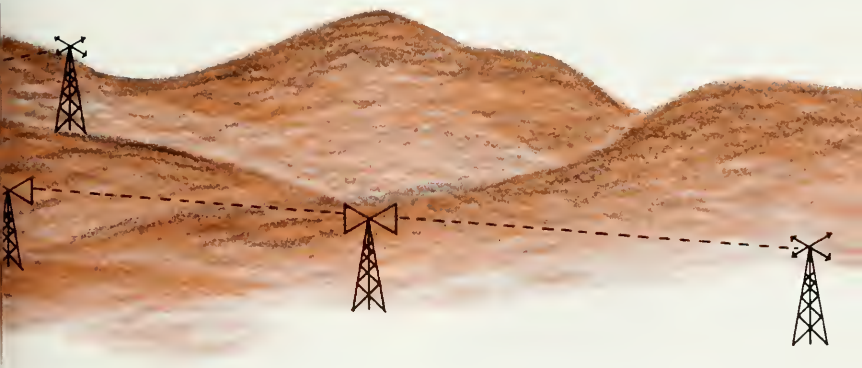
CATV is an enterprise designed to bring television broadcasts into homes which can't get adequate reception in terms of quality of picture, quantity of stations, or both. The CATV operator picks signals of TV stations out of the air with a large antenna, amplifies them and pipes them to his customers.



Gordon N. Thayer, *Vice President, Planning Department, A.T.&T. Co.*

CATV first developed in communities situated in valleys and other places where unfavorable terrain prevented TV reception by way of conventional roof top antennas. The freeze imposed by the Federal Communications Commission, from 1948 to 1952, on the establishment of any new broadcast television stations added stimulus to its early growth in those communities not served by television at that time. Later, it gained acceptance in communities served by only one or two of the three national television networks because of its ability to deliver a greater number of different television signals to its subscribers.

Today, CATV is finding public acceptance in several of the largest cities where the variety and quality of broadcast signals available up to now have been considered acceptable. Apparently, however, a large segment of the public wants a



*In a town where normal TV reception is poor because surrounding hills block line-of-sight microwave signals from remote TV antennas, the CATV operator's antenna can pick up the TV signals from the distant transmitters. The TV signals are then carried via channel transmission service provided by the Bell System to the homes of the CATV operator's patrons.*

*Lineman installs equipment for Bell Company-provided channel service for the CATV operator.*

greater diversity of signals and superior technical quality, particularly where color reception is involved. CATV can provide for both of these desires.

The Bell System's role in connection with the CATV industry can best be seen against a brief background of the System's experience in the transmission of visual images. In 1925, the Bell System first provided telephotograph channel service for the transmission of still pictures. As early as 1927 Bell Laboratories transmitted black and white television over telephone lines and had demonstrated color TV by 1929.

Following World War II the television broadcast industry greatly expanded and along with it the Bell System began construction of its nation-wide communications system for video signal transmission of network broadcasting. In 1964 video message service began with the inauguration of commercial PICTUREPHONE see-while-you-talk service between Washington, Chicago and New York. Today the Bell Companies also provide communication facilities used in television transmission services for education, industry and the government.

The Bell System's recent tariff offerings of local television transmission channels for use by the CATV industry represents a continuing expansion in the diversity of the system's television channel service offerings designed to meet the special needs of its different customers.

CATV service is distributed to subscribers in a community either by means of television channels furnished by the local telephone company or by means of a cable system built and maintained by the CATV operator. In the latter case, some CATV operators prefer to construct an entire system consisting of both the cable and supporting pole structures. Other operators lease space on the existing poles belonging to electric and telephone companies for attachment of their CATV cables.

When CATV first developed in the early 1950's the Bell System was not in a position to furnish the local television channel service required by this new industry. At the time the System's manpower and resources were being devoted principally to the task of trying to satisfy the post World War II pent-up customer demand for both basic and better grades of telephone service. At the same time the conflict in Korea was creating new shortages of copper, a basic material required in meeting this demand.

Although unable to provide channel service for CATV, the Bell Companies did give their assistance to this developing industry by leasing pole space for the attachment of their distribution cables. This permitted the CATV operator to provide television reception service without exhausting his resources for pole investment. The limited exception granted to CATV companies to use telephone company poles marked a major change in the Bell System's long-standing policy against pole rentals, outside of use by other public utilities and certain governmental agencies.

The Bell Companies felt that the expense and inconvenience of granting pole attachment privileges to CATV companies were outweighed by the benefit to the public of being able to receive television in as many communities as possible. This exception for CATV attachment has never been expanded to permit pole attachments for other purposes, such as the transmission of pay-TV, wired music, or private communication and signaling systems.

Consistent with the Bell Companies' policy of cooperating with development of CATV, the pole rental charges originally established represented merely token payment for use of the pole space involved. This was almost a necessity in the early years, as many CATV operators had only modest financial resources and uncertain public support in the smaller communities they first began to serve. With the subsequent emergence of CATV as a financially established industry, these charges have generally been revised upward toward a more compensatory level so that the cost of providing such facilities is not borne by telephone company subscribers or investors. Where the necessary upward revision of the rental charges was of a significant percentage, the total increase has usually been applied gradually over a period of two to three years.

At the present time there is little compelling need for continuing the CATV pole attachment policy for the reason for which it was originally established. Broadcast television is available in all populous areas and the isolated communities which originally lacked any form of basic television are now, for the most part, being served by CATV. Moreover, most Bell Companies are now able to provide channel service, at what we feel to be competitive and desirable rates, to those operators who do not want to carry the sizeable investment that owning their own plant would require. The Bell System, however, has expressed a willingness to continue to grant pole attachments to those CATV operators who want them. All CATV enterprises, therefore, will continue to have a free choice between channel transmission service as offered by Bell Companies or attaching their own distribution cables to telephone company poles under a pole attachment arrangement.

It has been necessary to place some limitations on pole attachment arrangements in order to maintain safety standards and to fully retain the use of such telephone facilities for both future and emergency requirements of basic telephone service. As most existing pole structures were not designed for more than two distribution systems, that is electric power and telephone, leased space for only one additional distribution system will be granted in any one area. Subsequent CATV operators proposing to distribute in the same area, will have to attach to poles other than those of the local Bell Company or obtain channel service from the telephone company.

To assist CATV operators who wish pole attachment privileges, the Bell System has recently standardized the application procedures so as to introduce uniformity and consistency on a System-wide basis.

In some communities, requests for pole attachments have been received at approximately the same time from more than one CATV operator. In an effort to be as fair as possible to everyone concerned, Bell Companies have declined to assume responsibility for selecting the one applicant to be granted pole attachment privileges. It has been felt that this selection is a matter that more appropriately belongs to the applicants involved or to the municipal government of the area to be served. If neither of these groups assumes responsibility for such a decision, the local Bell Company will provide channel service to all CATV operators who apply.

Privileges, similar to pole attachments, are not extended to CATV operators to use underground conduits of Bell Companies. The extremely high cost of providing such underground facilities and the need for keeping adequate duct space available for future telephone service needs, precludes the use of these facilities by others except for certain essential public safety services such as police, fire and traffic control. The security of certain essential communication facilities located in underground ducts, and the concern for the safety of personnel not trained in the special working conditions that exist in manholes and underground structures add further justification for this policy. Channel service will be available from the local Bell Operating Company where underground distribution is required.

At present there are over 1,000 pole attachment agreements in effect between CATV operators and Bell Companies. This represents about 63 per cent of the approximately 1,600 CATV systems currently in operation.

The Bell Companies have tariff offerings in effect in 38 states that are specifically designed to meet the channel service needs of CATV operators. Similar tariffs have been filed with regulatory commissions in several other states, but are not yet effective. All of these tariffs are subject to continual review and revision by the Bell Companies to incorporate cost savings and effciencies made possible by the continuing improvement in techniques and equipment used to provide such service. Since the first Bell Company tariff was filed in 1959, such reviews have brought about substantial savings. These savings have been reflected in current tariff rates which are considerably lower than those in effect several years ago. Specific tariff rates may vary from state to state, with each Bell Company making its own cost determination on a basis of the conditions peculiarly applicable in the area it serves and the varying complexities of plant construction that are involved.

Generally, these tariff offerings stipulate that channel service will be furnished to a CATV operator on a monthly charge basis for the primary purpose of distributing standard broadcast television signals. These signals are picked off-the-air by the CATV operator at his antenna site and distributed by telephone company channel facilities to the premises of the CATV patrons.

Considerable interest has been evidenced in these new tariff offerings. At the present time the Bell Companies are providing channel service for 17 CATV systems with construction either under way or due to begin in the very near future on an additional 75 systems.

It has often been stated that the Bell System is entering the CATV business. The provision of channel transmission service for use in connection with CATV distribution systems is considered to be a normal communications common carrier function. In furnishing such channel service the Bell Companies are in no way involved in the selection of the programing that will be made available by the

*A Bell Company puts up coaxial cable for channel service provided to CATV operator.*

CATV operator to his patrons. This is determined solely by the CATV operator, who picks all of the broadcast signals off-the-air which he wants the telephone company to transmit over the distribution system. No Bell Companies are rendering CATV service directly to the viewing public nor have they any plans to do so. Indeed, the tariff offerings available to CATV system operators specifically exclude the Bell Companies from any dealings with the CATV operator's patrons.

Some independent telephone companies are pursuing a very different course however, and are themselves becoming CATV operators by providing the complete service from program selection to installation and billing of each individual patron. Bell System channel service is offered only from the CATV operator's antenna location to his patrons' premises. Connection of individual TV receivers to the terminal of Bell-provided channel service is the responsibility of the CATV operator.

From the Bell System vantage point, it is apparent that the CATV industry is undergoing rapid and fundamental changes: for example, the move into the larger city markets from the smaller communities for which it was originally conceived; the increasing use of distant TV signals which are imported by means of microwave, and the intense struggle for franchises in non-CATV communities. Proposed regulation by Federal, state, or local authorities will impose still further changes. In this respect the Federal Communications Commission, on March 8, 1966, adopted rules establishing their regulatory jurisdiction over certain phases of the operation of all CATV systems. While designed to insure the continued orderly development of all types of television broadcasting service, the rules concern themselves primarily with the viability of UHF—particularly in the 100 largest population areas of the nation. In these areas, the newly adopted FCC regulations appear to place rather limiting restrictions upon the growth of CATV until such time as there is more conclusive evidence available indicating whether CATV will deter the development of UHF in such an area.

In summarizing the Bell System's position and involvement with respect to CATV, it is most important to stress the point that the Bell Companies do not seek to compete with CATV system operators. Rather their objective is to serve the CATV operators by providing them with the best, most reliable and most advanced communications service available for the transmission of television signals.

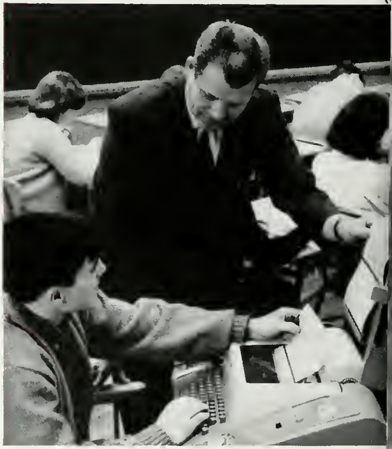
To better meet this objective, the Bell Companies have selected, on either a state or regional basis, specific individuals to act as CATV industry coordinators. Hopefully, through these individuals, a closer cooperation and understanding will be developed between the Bell Companies and the CATV industry regarding the day-to-day problems that are of mutual concern to both.

By this and other means which may suggest themselves as CATV continues to grow, the Bell System stands ready to serve this industry to the best of its ability and to provide and maintain the highest quality channel service for CATV system operators.

# Communications For Education

Mankind is amassing knowledge so rapidly that two major problems have been created. One is storing information in the most practical form; the other is providing a means of rapid referral to any desired part of the storage bank. Most educators agree that the promise for the future lies in augmenting conventional print by bulk storage, random-access devices such as magnetic tape and computers. Information stored in a central "memory file" can be retrieved by any student over any distance, by telephone or teletypewriter. Depending upon the nature of the information and the form in which he wants it, the student of tomorrow may obtain it as a voice response from a computer, print-out in a teletypewriter, slow-scan or regular TV image on a cathode ray tube or a facsimile reproduction on paper. Such techniques as those seen here and on the following pages can extend the horizons of knowledge, making it possible for students even in small, remotely located schools to have rapid access to centrally located reference material through the facilities of the telephone network.

(1)



(4)

(1) Dr. Henry Pollack, chairman, Mathematics Division, Bell Laboratories, uses Bell Laboratories-developed telewriting device during Tele-Lecture on Contemporary Mathematics to augment words with visible equations on "remote blackboards" for 500 students in ten colleges (2). (Left) High school students in Altoona, Pa., (3) concentrating in mathematics, science and social sciences, learn to use the computer as an academic tool. Over 1,000 students have access to remotely located computer (4) via teletypewriter links from classrooms.

(5)

A three-channel closed circuit television system serves 162 public schools with 105,000 pupils throughout the State of Delaware. Programs originating at a fully-equipped studio in Dover (5) are relayed over special Bell System lines to one central school in each district for re-transmission to local schools. (6) Schedules include series ranging from four programs of 15 minutes each to 30 half-hour programs, covering art, science, languages, social studies, health and physical education.

At the Carnegie Institute of Technology students use teletypewriters in the classroom (7) while learning advanced, sophisticated techniques of time-sharing for programing and retrieval of computer-stored information. They also work at the computer itself (8). Communications terminal equipment is supplied by the telephone company.

(7)

(8)

An experimental system under test in the Los Angeles Public School System was created especially to meet the needs of children — handicapped or ill — who cannot attend school. Special console with automatic dialer "convenes" class by telephone. As many as 20 children can be included in this school-by-telephone system.

Tele-Lecture (9) permits the simultaneous sharing of outstanding resources in the social science disciplines, under the Greater Cleveland Social Science Program, with other schools and school systems, both public and non-public, as far away as Michigan and Massachusetts. (10) Facilities and services of the nationwide telephone network enable teachers in primary and secondary schools to benefit from the Program and to receive college credit hours.

(9)

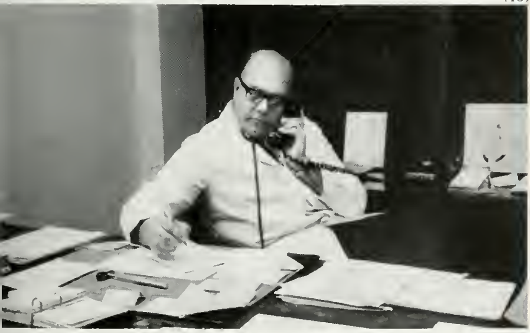
(10)

The use of an integrated data-processing system utilizing telephone facilities to link all scho
central processing facilities permits the rapid, accurate and automatic collection of data fo
entire Elementary School District in Tempe, Arizona. Instead of the familiar roll books, te
there report absent pupils by using pre-punched cards that have been individually co
each pupil. Each morning the school secretary feeds these cards into a card reader
automatically sends the pupil's register number, school and grade to the central data pro

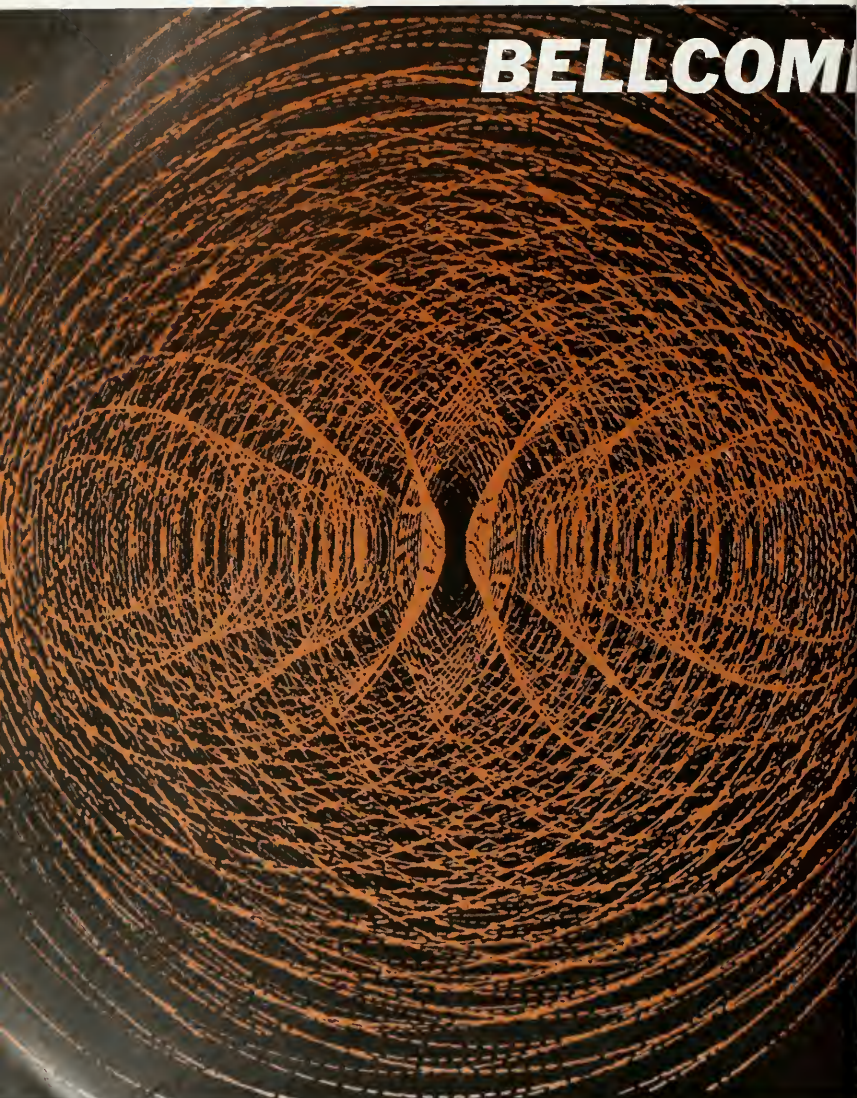
(11)

(12)

(13)



At the University of Wisconsin, a program in continuing education in medicine serves 250 doctors in 20 hospitals throughout the state. Lecture-discussions are heard live by participants (11) and are simultaneously taped. Taping is done at the studio (12) with compressed speech techniques; this enables individual doctors (13) who missed a live lecture to hear a speeded-up re-play by calling the studio. Compressed speech speeds up enunciation, or syllables-per-second, without changing pitch or character of speaker's voice.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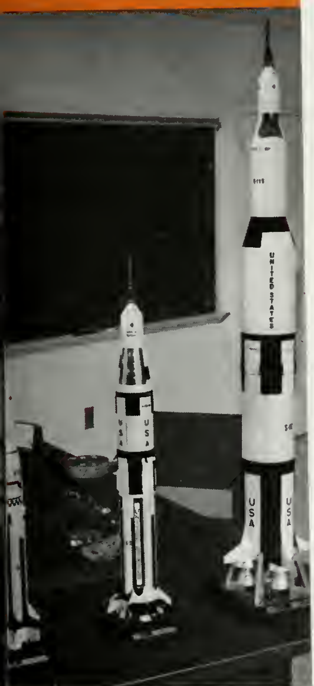
The author points out a possible Apollo landing site on a large scale map of the moon. Below, left to right, models of Saturn 1, Saturn 1B and the moon rocket, Saturn V.




John A. Hornbeck,
*President, Bellcomm, Inc.*

When Bellcomm first entered our nation's manned space flight program, just over four years ago, the concept of landing men on the moon and returning them safely to earth seemed daring at the very least and in some ways almost unbelievable. Many skeptics doubted that this feat could be accomplished at all.

Today, after tens of thousands of man-years of effort, the prospect of the United States accomplishing the Apollo lunar landing mission is good—most probably it will be done within the next three and one-half years.

Eight of the 12 Gemini flights have been concluded. Early next year, Project Gemini will be history, along with Project Mercury which sent the first Americans into orbit.

Already we have seen the first of the Apollo/Saturn flights which will culminate in the moon mission itself. In that first flight, which took place last February, an unmanned Apollo spacecraft riding a new Saturn 1B rocket left the earth on a successful suborbital mission. Next year we shall see the first Apollo/Saturn 1B manned flight as well as the first unmanned launch of the moon rocket—Saturn V.

This 282-foot (365-feet with spacecraft), three stage rocket, which generates 7.5 million pounds of thrust, is already in production as is every other major piece of equipment that will be needed in the expedition to the moon. All will be tested in a series of successively more complex flights culminating in the Apollo lunar landing mission.

In essence, the aim of the Apollo program is to give man a chance to explore the moon. To do this means that the

## BELLCOMM

Saturn V rocket must hurl a 95,000-pound payload to the vicinity of the moon. The payload is made up of two different spacecraft, the three-man Apollo command module and the two-man lunar excursion spacecraft, plus a service module. The service module is like a portable storehouse which supplies to the command module the electric power, potable water, oxygen and the rocket propulsion needed both to insert the two spacecraft into lunar orbit and to get the command module with the three astronaut-explorers out of lunar orbit and into a safe-return journey.

After the combined spacecraft and service module go into lunar orbit, two of the three astronauts will climb into the lunar excursion module and descend to the moon's surface. After exploration there they will re-enter the module and fly back into lunar orbit to rendezvous with the orbiting Apollo craft. This flight plan eliminates the need to expend the rocket fuel to lower the entire command module and service module to the surface of the moon. Also to conserve fuel, the landing gear and descent engine will be abandoned on the moon's surface just as the rest of the excursion module will be abandoned in lunar orbit for the return journey.

These elaborate flight plans result from the necessity to conserve weight. Additional weight requires more fuel, which in turn is more weight that the rocket engines have to boost. For example, adding one pound to the structure of the ascent stage of the lunar excursion vehicle would require the addition of about five pounds of fuel in the two spacecraft. Such factors as this have driven the size of the booster rocket to the immense proportions of the Saturn V.

### The Size of the Program

Not only the rocket, but all aspects of this National Aeronautics and Space Administration (NASA) program are impressive. The new facilities for manned space flight are valued at about $4 billion. These include the 52-story Vertical Assembly Building at Cape Kennedy,

Florida. Of this building, the largest in the world, it has been said with only slight exaggeration that the United Nations building would slip through its doors. It is a part of the John F. Kennedy Space Center (KSC). Two other field centers are the George C. Marshall Space Flight Center (MSFC) located at Huntsville, Alabama and the Manned Spacecraft Center (MSC) near Houston, Texas. More facilities are located in Mississippi, Louisiana, New Mexico and California. The 14 principal stations of the Manned Space Flight Network, for communications and tracking, stretch around the world.

The magnitude of the program is further illustrated by the size of the government-industry team which has been assembled. Besides the 15,000 government people charged with project management and procurement there are some 300,000 industrial people divided among 12 prime contractors, 17,000 subcontractors and uncounted sub-subcontractors and vendors.

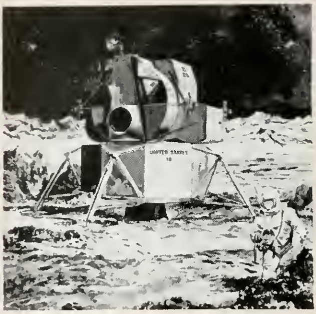
Assembling this team and molding it into an efficient operating structure, one that is directed and controlled, has comprised a monumental management problem. The technological feasibility of the Apollo mission is no longer in question although many technical challenges remain. At this stage, however, it is the competence of the technical management, and the excellence of their management tools, at almost every level in the program on which, in a very real sense, the success of the mission depends.

The management challenge derives from the very difficulty of the Apollo mission itself. In part this may be illustrated by the evolution of the booster design philosophy.

At the time the Apollo/Saturn program was undertaken, the experience in this country with the development of large rockets came exclusively from our ballistic missile programs. In the process of development of these missiles, scores of each were fired in tests before maturity of design was achieved.

The philosophy of the Saturn/Apollo program has to be different from the

*Important steps in the Apollo lunar landing mission are shown here and on the following pages. Left to right: The second stage of Saturn rocket burns out, and third stage ignites; spacecraft achieve orbit around earth; docking of Lunar Excursion Module takes place; Lunar Excursion Module ignites, while command module continues in moon orbit.*



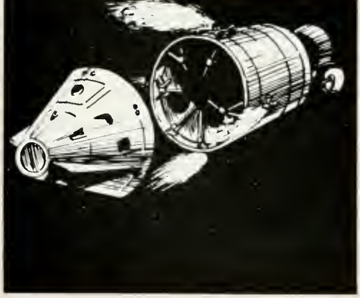
ballistic missile development philosophy for the simple reason that, given the size and cost of the tremendously large Saturn boosters, the nation could not afford to build and test scores of them before undertaking a manned space flight. We were therefore forced to adopt a concept of few flight tests and the accompanying objective of making each flight a successful one, especially so, of course, when it is manned. Thus the program places extremely severe demands on the industrial team. What is required is nothing less than the very best reliability that the nation's technology is capable of producing. NASA is asking this of all 17,000 prime and subcontractors, no one of which can be allowed to fail. In the last analysis, the matter of how successful industry is in this endeavor will determine when we can achieve the national goal of lunar landing.

### Bellcomm's Job

In describing Bellcomm's place in this exciting program the large numbers characteristic of the program do not apply, but the impressive technical challenge remains. The smallest full-fledged company in the Bell System, Bellcomm has about 350 people. Bellcomm has no laboratories. Its job is systems engineering, technical fact finding and consulting in technical support of the NASA Office of Manned Space Flight (OMSF) and its Director, Dr. George E. Mueller, NASA associate administrator for Manned Space Flight. The bulk of our effort is systems engineering for the Apollo Program Director, Maj. Gen. Samuel C. Phillips, an Air Force officer on active duty with NASA.

### Systems Engineering

Since systems engineering is a management tool used to help define, assess and control a major program, our work can best be identified and delineated within the framework of the Apollo Program management structure. The three NASA field centers previously mentioned are responsible to the Office of Manned Space Flight in Washington, D.C. These are MSFC, under Director Wernner von Braun, which has responsibility for development and procurement of the Sat-



*Steps in moon landing and return: Lunar Excursion Module descends to moon; LEM prepares for return to lunar orbit; LEM, command module are lined up for docking; service module is discarded, command module prepares for re-entry.*

urn launch vehicles; MSC, under Director Robert Gilruth, which has similar responsibility for the spacecraft; and KSC under Director Kurt Debus which is responsible for final assembly, checkout and launch of the total space vehicle. Each of these centers has a systems engineering function associated with its part of the program, as indeed does each of the prime contractors who are under contract to a center for hardware design and construction.

The systems engineering work in which Bellcomm is engaged is that associated with the level and functions of the overall Apollo Program Director. We work on a daily basis with the center systems engineering people as well as with Gen. Phillips and members of his staff. Because of this association with top program management officials, our technical work affects major program decisions. We, of course, do not make these decisions, but we are accountable for technical studies and judgments which form part of the basis for the decision-making. This is a very grave responsibility. Understandably, there is a high premium on our work being technically thorough and accurate.

Bellcomm's systems engineering role is to help ensure that the hardware being developed, including the space vehicle, ground communication and tracking system, and ground support equipment, is able to perform the designated Apollo mission and that the mission chosen is sufficiently well identified and described that everyone involved understands what it is. These objectives are achieved in part in the Apollo Program by the preparation and issuance of the following key systems engineering documents:

*Apollo Flight Mission Assignments.* This document designates the objectives, flight hardware configuration, flight profiles, payloads and on-board experiments on a flight-by-flight basis for each mission in the Apollo Program. It is approved by the associate administrator of NASA.

*Apollo Program Specification.* This is the top level technical specification and as such delineates the performance, design and test requirements for the Apollo Program. It is an inch-thick summary listing every major piece of hardware and what it is required to do. The specification is approved by the Apollo program director.

*Apollo Mission Sequence Plan*. This systems engineering working document is a step-by-step account of the lunar mission identifying what is happening at each step during the entire mission period.

*Quarterly Weight and Performance Report*. This summarizes the weight and performance capability of the Apollo/Saturn space vehicles.

*Natural Environment and Physical Standards for the Apollo Program*. This contains the approved set of values for the environmental conditions, both terrestrial and lunar, applicable to the Apollo mission. It also establishes a set of astrodynamic constants and geodetic and selenographic reference systems. The document is in effect an encyclopedia of definitions and numbers which all working on Apollo can use.

*Project Apollo Coordinate Systems Standards*. Here are recorded inertial, vehicle, geodetic, guidance and navigation coordinate system standards for the Apollo Program. It is a very thin, but very important manual which sets forth uniform standards for the many people working on the project.

*Remote terminal is used by Bellcomm people at NASA Headquarters to "converse" with digital computer at Bellcomm Headquarters.*

### The 'Top of a Tree'

Quite obviously, the information in these documents is not generated overnight. It is the product of years of effort by the entire program structure, technical studies by Bellcomm and other elements of the Apollo Program Office, the three field centers and their strong array of contractors. The majority of the information originates in the last two groups. The development of this information is also an evolutionary process in which the ultimate goal is to achieve completeness and accuracy. One recognizes, then, that in most cases these documents are simply the top of a series, or tree. For example, the *Apollo Program Specification* is enlarged upon in literally tens of thousands of specification documents in the program.

Work of the kind that generates useful systems information often requires sophisticated tools. In trying to understand how each part of the Apollo mission affects the whole, the systems engineer may be led to consider mission parameters that have a significant effect on the flight trajectory. Examples of these parameters are launch azimuth, flight times, lunar stay time and lunar landing site location. The mission trajectory is determined by roughly 20 of these major parameters. Problems with this many variables are not tractable unless handled with the help of a modern, general-purpose digital computer. And the computer is useless unless it has a program which has been especially designed to make trajectory calculations for the Apollo mission.

A major contribution to Bellcomm effort in this area was made by Bell Telephone Laboratories. Over a period of more than two years the Bell Laboratories constructed a sizable trajectory simulation program that would run on the Bellcomm computer. This program is a vital tool for work on trajectories, navigation, guidance and control.

### Contributing Programs

Another segment of OMSF and Bellcomm activity is introduced by describing one other document. It is, *Requirements for Environmental Data in Support of the Apollo Program,* which outlines the environmental data needed by the Apollo Program from other NASA offices. The data are principally in the fields of radiation (solar and Van Allen belt), meteoroids and lunar surface information.

Several of NASA's unmanned space programs have, in addition to important scientific and technological objectives, the specific objective of acquiring information needed by the manned lunar program. Most significant among these are Ranger, Surveyor, and Lunar Orbiter. Ranger, culminating in a spectacularly successful series of flights, has provided, through television pictures of the moon, early photographic samples of lunar surface roughness and the general character of the lunar surface. Surveyor is a spacecraft intended to land softly on the moon just as the USSR succeeded in doing with Luna 9. It is designed to provide direct measurements of small scale surface roughness, slopes and that all-important quantity for landing Apollo, surface strength. Lunar Orbiter is a spacecraft with photographic capability which when placed in orbit about the moon can photograph broad areas with very fine resolution and transmit the pictures back to earth. The strategy of employment of these spacecraft, which Bellcomm helps to formulate, is of special significance because of their use to survey and select good landing sites on the lunar surface for the actual manned Apollo mission.

A much smaller segment of Bellcomm's

*Dennis James of Bellcomm shows lunar lighting effects on relief map derived from Ranger photograph to Air Force Major General Samuel C. Phillips, the Apollo Program director.*

work is concerned with advanced planning, that is, planning studies for possible missions after the first successful Apollo mission. This work is in support of the OMSF Saturn/Apollo Applications Office and the Advanced Manned Missions Office. The studies include a mixture of earth orbital missions, extended lunar exploration and even considerations involved in that extraordinarily difficult venture, manned landing on our neighboring planet, Mars.

A few final remarks about Bellcomm as an organization and as a company may be appropriate. Bellcomm is a wholly-owned subsidiary, its stock being jointly owned in equal amounts by A.T.&T. and the Western Electric Company. It is a "regular" Bell System Company in the sense that Bellcomm has its own pension fund and the standard interchange of personnel agreement with A.T.&T. The chairman of its board of directors is R. R. Hough, vice president, Engineering, of A.T.&T. Its board is comprised of officers of A.T.&T., Western Electric, Bell Telephone Laboratories and Bellcomm, among whom is Bellcomm's chief administrative officer, R. E. Gradle, vice president and general manager.

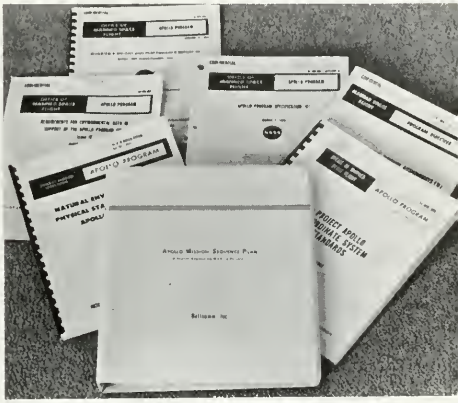
Bellcomm's technical management is divided into two areas—Systems Engineering under T. H. Thompson, and System Studies under Ian M. Ross. Both of these men joined Bellcomm from Bell

*T.H. Thompson, center, shows moon-earth geometry to I.M. Ross and R.E. Gradle. Plastic sheet illustrates orbital plane which will carry space capsule from earth to the moon.*

Telephone Laboratories. The titles of the divisions within these areas are illustrative of Bellcomm's work: Mission Assignments, System Requirements, System Configuration, Space Sciences and Technology, Advanced Systems, and Analysis and Computing Systems.

Members of Bellcomm's technical staff are highly trained and experienced. Their fields of specialization include physics, geology, chemistry, electrical and mechanical engineering, mathematics, computer programing, psychology, aeronautics, operations research and many others. Of the staff, 27 per cent have the PhD. degree, 48 per cent the Masters degree and 25 per cent the Bachelors degree. In the last group, none joined Bellcomm without some years of prior experience in related technical work.

While Bellcomm is a profit making company most of us in Bellcomm feel, as do many Bell System people, that we are firstly and most importantly performing a public service. I am sure that I speak for other Bellcomm people, too, when I say that our work in connection with NASA's historic venture in space exploration is not only demanding but exciting, and more than usually rewarding in terms of a personal feeling of accomplishment.




*These systems engineering documents are essential to success of Apollo Program.*


*Proximity of "in" and "out" boxes shows close working relationship of Bellcomm, NASA.*

# in this issue...

William S. Brown, Jr.

Hubert L. Kertz

■ In authoring "A Decade of New Products" starting on page 10, William S. Brown, Jr. is also reviewing much of the substance of his own career for the past ten years. He has been involved in the introduction of all new products and services offered by the Bell System during that time, and presently carries that responsibility as product marketing supervisor in the Marketing Department. This is Mr. Brown's second contribution to these pages. His article on Educational Television appeared in the Summer, 1961 issue.

After receiving his degree in Engineering from the University of Mississippi, Mr. Brown joined the Bell System, holding various management jobs with Long Lines in St. Louis, Kansas City, Atlanta and New York; with Southern Bell Telephone Company in Atlanta and then with A.T.&T. in New York.

■ In writing on "Annoyance Calls," (page 24), Hubert L. Kertz draws upon some 40 years of varied experience in the Bell System. As vice president, Operations of A.T.&T., Mr. Kertz is charged with implementing the Company's expressed policy that "the Bell System will use every available legitimate means to combat annoyance calling."

Mr. Kertz joined Pacific Telephone and Telegraph Company as a cable splicer's helper in 1926. There followed other assignments in Plant and Engineering until he entered the U. S. Navy in 1942. After the war he returned to Pacific Telephone, where he became assistant vice president of Engineering in 1953 and vice president, Operating Staff in 1958. He came to A.T.&T. in 1960 as assistant vice president in the rate division of the Planning Department, and took over his present position in June of 1964.

As vice president, Planning, for A.T.&T., Gordon N. Thayer has over-all responsibility for advice and assistance to the Bell Telephone Companies in working with the rapidly-growing new field of Community Antenna Television (CATV). His article, "The Bell System and CATV," beginning on page 30, covers some of the same ground as a talk he gave last winter before the Financial Seminar of the National Community Antenna Television Association in New York.

Mr. Thayer joined Bell Telephone Laboratories as a member of the technical staff in June, 1930. He later supervised various technical groups there and served as transmission development engineer, assistant director and director of transmission development and vice president before coming to A.T.&T. in 1955. Two years later he became vice president, Operations of Ohio Bell Telephone Company, then returned to A.T.&T., where he was vice president, Marketing and vice president, Operations before assuming his present post in the Planning Department in June, 1963.

Dr. John A. Hornbeck, president and a member of the board of directors of Bellcomm, Inc., since its founding in 1962, is eminently qualified to write of the new company's purposes and activities (page 44).

After receiving the Ph.D. in physics from Massachusetts Institute of Technology in 1946, Dr. Hornbeck joined Bell Telephone Laboratories in 1946 as a research physicist in the Physical Electronics Department. He later headed departments specializing in Semiconductor Physics and Solid State Device Development. He was named Director of Electron Device Development in 1955 and assumed the position of executive director, Semiconductor Device and Electron Tube Division in 1958.

Among many professional associations, Dr. Hornbeck is a Fellow of the American Physical Society and of the Institute of Electrical and Electronics Engineers and a member of the American Association for the Advancement of Science. He is the author of a number of technical articles which have been published in the *Physical Review* and elsewhere.


Gordon N. Thayer


Dr. John A. Hornbeck

# in the news...

W.E. Breaks Record

Medical Data Sets

Three New Phones

TD-3 Microwave

Telephone Tax Rise

Plastic Bonding Process

Caribbean Cables

## —Record-Breaking Year For Western Electric

The year 1965 was a record-breakin one for Western Electric, manufactu ing and supply arm of the Bell System, i its service to the Associated Companies With lower price levels, total sales exceede $3.3 billion, an 8 per cent increase over 1964

W.E. President Paul A. Gorman, in th company's annual report, noted that produc tion of Western's most familiar product— the telephone set—passed nine million fo the first time. W.E. more than doubled pro duction of the new electronic switching sys tems. Employment increased 11,200 to a all-time peak of 168,800.

Western Electric prices on products of it own manufacture sold to the Associate Companies were reduced $33 million annu ally. The latest reduction brought Wester prices to a point 16 per cent below the pric level at the start of 1950.

W.E. has also reported savings of mor than $49 million on work done under gov ernment contracts in 1965. Some 85 pe cent of the cost reductions were in connec tion with research and development worl done on Nike-X projects. Since 1963 whe its cost reduction efforts came under a formal cost reduction program inaugurate by the Department of Defense for all its con tractors, Western has listed savings totallin $85.8 million.

Sales to the Bell System were up 9.5 pe cent to $2.8 billion, almost 85 per cent o total sales. Sales to the Federal governmen amounted to $469 million, down from $490 million in 1964. W.E. earned $168.3 million or five cents per dollar of sales, compare with $152.8 million (4.9 cents) in 1964.

The most radical change in W.E.'s manu facturing operations during 1965, as for some years past, sprang from the Bell System's commitment to electronic switching. Produc tion of equipment for electronic central offi ces continued to climb.

Nearly a million Touch-Tone® telephones and more than 400,000 of the new Trim- line® telephones were among the 9,176,000 sets manufactured during the year. Produc-

*New Trimline telephone sets poured off Western Electric assembly lines during 1965 as telephone production crossed the nine million mark for the first time in W.E.'s history.*

tion of a limited quantity of special equipment for an industrial trial of PICTURE-PHONE "see-while-you-talk" service was also completed.

Western Electric bought goods and services from more than 400,000 other businesses in 1965, with these purchases amounting to $1.4 billion—a total surpassing any previous year. Ninety per cent of these suppliers were small businesses.

## Medical Data Transmission

The idea of a doctor entering his patient's home and within moments sending the patient's electronic characteristics to a central point for expert analysis may sound like science fiction, but it is now a reality. Three new DATA-PHONE data sets have been developed to permit medical personnel to send electrocardiographic signals and similar data over the public telephone network.

Two data transmitters are available: the 603A, which has a built-in telephone and connects electrically to the telephone line, and the 603D, which connects acoustically to almost any telephone handset when portability is necessary. The data receiver, the 603B, is electrically connected to the telephone line and is used with either transmitter. At the present time, there are no plans for an acoustically coupled data receiver.

Versions of these sets were on trial for some time in widely separted areas of the United States and Canada. The success of these trials and favorable reaction from doctors foretell a bright future for medical data transmission.

## Three New Phones

The growing array of Bell System telephones will soon have three new additions. Recently put into production at Western Electric's Indianapolis works are the newly-designed Hospital Set, the Automatic Reporting Telephone (ART) and the Call-a-Matic® automatic dialing telephone.

The Hospital Set, which has a Trimline® dial-in-handset phone and a base that resembles a transistor radio, will become part of a new communications system for hospitals, offering patients a convenient method of communication inside and outside the hospital. Instead of the usual buzzer system for paging nurses, the Hospital Set enables the patient, hands-free, not only to signal the nurse but also to speak with her. With the set, the patient no longer has to wait until the nurse sees his signal and walks to the room. The patient's set also provides

*Patients can have hands-free communication to nurses' station with new Hospital Set.*

telephone service to outside phones through the hospital switchboard. At the nurses's station, a small console provides terminations for lines to the patient's instrument and to the hospital PBX.

The Automatic Reporting Telephone is designed for use at unattended industrial locations to warn of abnormal or dangerous conditions, such as power failures or changing pressures in tanks filled with explosive gas. When the phone is triggered, it rings a pre-set local or long distance number. If no one answers within one minute, the ART will disconnect and then try again in 30 seconds. It will keep trying for a total of nine times in a 20-minute period. When someone does answer, a pre-recorded warning message is played.

The Call-a-Matic telephone combines Touch-Tone® dialing with an automatic telephone directory storing up to 500 frequently called numbers. The numbers are recorded on magnetic tape by simply lifting a "record" button on the set and then dialing the number. To place a call, the user turns an indexing wheel to the desired letter of the alphabet and a motorized scanner surveys the entire list of names within seven seconds, stopping at the proper letter. The caller then uses a manual wheel to center the name in the calling space and pushes a "call" button to automatically dial the number. No accessories such as cards or a separate dial for number recording are needed since the Call-a-Matic set houses all its features in a single unit. And, in addition to its capacious memory, the Call-a-Matic telephone features six buttons for additional lines and holding, as well as optional speakerphone service.

## TD-3

TD-3 Microwave, the latest Bell System microwave transmission system, is being manufactured by Western Electric for field trial this spring. The new system will double the message capacity of the present TD-2 Microwave—currently the backbone of the Bell System's long distance microwave communications. Employing transistors and other solid state devices, TD-3 will supplement, and in some cases replace, the older system throughout the United States. Each TD-3 system will provide ten working channels and two protection channels in both directions, with each broadband channel capable of transmitting 1,200 simultaneous telephone conversations—as

*Tower frames are placed on roof of station building for TD-3 microwave system trial.*

against 600 on TD-2—or a combination of phone calls, data and intercity television.

TD-2 has effectively handled this job since its introduction in 1949 and its present production is at an all time high. But with the unprecedented growth in traffic in the intervening years, the saturation point on available frequency band transmission space was fast approaching. Bell Laboratories engineers worked with Western Electric and A.T.&T. Long Lines people to develop the new larger capacity system.

TD-3's trial towers will rest on station buildings housing the power, amplifying and testing apparatus. This new roof-mounted construction will shorten and straighten the wave guides which conduct the microwave signals from the station transmitter to the antennas at the top of the towers.

Five watts of power—less than the amount needed by a typical Christmas tree bulb—is sufficient to send microwave signals on their way between stations. And the power consideration is of prime importance in a solid-state system. One 24-volt power supply is needed to operate TD-3's transmission equipment. At this low voltage, resistors and capacitors tend to last indefinitely. This helps lower maintenance costs and guarantees greater reliability—thus helping to keep costs of long distance communications services low.

For further reliability, sections of the two protection, or back-up, channels in each TD-3 system can be automatically substituted for sections of any working channel that become disabled. This changeover is made in millionths of a second.

## Telephone Tax Increase

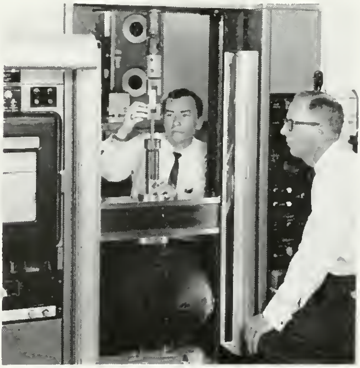
Starting April 1, telephone bills began to reflect an increase in the Federal excise tax on local and long distance telephone and teletypewriter services. The increase is a result of the Tax Adjustment Act of 1966, enacted to help meet the country's need for additional revenues during the Viet Nam emergency.

Since last January 1, most telephone customers have been paying a tax of three per cent, under provisions of a general excise tax reduction instituted by Congress last year. The new law reinstates the telephone tax at ten per cent until April 1, 1968, when it will be reduced to one per cent, and then eliminates it at the close of that year.

## New Process For Bonding Plastics

The Bell System is a large user of plastics of all kinds, and research in this field is constantly being done by Bell Telephone Laboratories. A new process for treating certain plastics so they can be joined strongly to other materials by adhesives has been invented at Bell Laboratories. The process also gives new insight into how materials stick together.

Many thermoplastics, including materials such as Teflon and polyethylene, can be treated by this new process. These plastics cannot be bonded strongly to other materials by adhesives unless their surfaces are treated. Previously, surface treatments changed certain characteristics of the plastics, including such things as tensile strength, color, and dielectric properties. The new



*Bell Labs scientists prepare a test of new process they invented for bonding plastics.*

process, however, does not alter the desirable chemical or physical properties of the plastics.

This process also makes it possible to print successfully on Teflon and polyethylene. Until now, Teflon could not be printed on successfully because its surface became badly discolored after exposure to surface treatment, thus obscuring the printing. (Printing is a form of adhering. Ink is the adhesive which "sticks" to the plastic.)

Two Bell Laboratories scientists found that by exposing a sample of thermoplastic to an electrically-activated inert gas, such as helium or neon, a tough outer "skin" forms on the surface of the plastic. (This is somewhat like the skin that forms on paint when it is exposed to air.) This layer of tough skin makes an ideal surface for adhesive bonding. The result is an adhesive joint ten or more times stronger than possible with an untreated sample of the same plastic.

Until now, many scientists believed that weak adhesive joints were due primarily to weak interfacial forces between the thermoplastics and other materials. The Bell Labs scientists have concluded that weak joints result primarily from a layer of weak material at the surface of these thermoplastics. The two scientists now say that two conditions—complete interfacial contact and strengthening of the weak boundary layer material—are necessary to achieve maximum adhesive joint strength.

## Caribbean Cables

A.T.&T. has asked the Federal Communications Commission for permission to construct a telephone cable between northeastern Florida, near Jacksonville, and St. Thomas, in the Virgin Islands, to meet the growing communications needs between the continental U.S. and Puerto Rico, the Virgin Islands and other points in the eastern Caribbean. Designed by Bell Laboratories, the single cable would be equipped with rigid two-way transistorized amplifiers and capable of handling 720 simultaneous conversations. Until now, the maximum capacity of submarine cables has been 138 conversations. A.T.&T.'s Long Lines Department would lay the cable, which will cost $33,000,000.

Work has been started abroad on an 80-voice overseas telephone cable to be placed between St. Thomas and Maiquetia, Venezuela, near Caracas. It is expected that the HMTS **Alert** will begin laying the cable, which is of British design, during the last week in June. When placed in service early in August, it will provide the first physical communications link between North and South America.

The cable ship **Mercury** finished laying the new British Commonwealth cable between Bermuda and Tortola, British Virgin Islands, in late March. A May service date is expected. This cable, which has a capacity of 80 channels, will be linked to St. Thomas by means of radio relay facilities. St. Thomas is also linked to San Juan, Puerto Rico; thus, with the opening of the cable to Venezuela, it will become an important hub of Caribbean and South American communications.

## Ultra-Clean Room

A room as clean as any place on earth had to be created by Western Electric for the production of the latest mini-

*Doors permit devices to pass to work areas in ultra-clean room without contamination.*

ature electronic wonders, including entire electrical circuits no larger than the head of a pin. The ultra-clean room is in Western's Allentown, Pa. plant, where tiny chips of silicon are transformed into microscopic units containing dozens of transistors and other solid-state devices. This Photo Resist Room—named for one of the photographic processes in making the miniature devices—is 1,000 times cleaner than most conventional clean rooms.

The "super interception" filter that makes the room super clean was developed for the Atomic Energy Commission and adapted for industrial and medical uses by scientists who specialize in contamination control at the Sandia Corporation, a Western Electric subsidiary. The filter, fashioned chiefly of asbestos and fiber glass, intercepts at least 99.97 per cent of all particles larger than 12 millionths of an inch in diameter—which includes most bacteria.

In addition the air in the room must be changed often to remove particles that are generated within any room—people, paper and even pencils emit particles continuously. Filtered air sweeps through the entire room in a uniform flow, straight down from ceiling to floor, carrying particles out of the room. The air is replaced completely at least once every ten seconds.

Each work position in the room also has its own filter and air-flow arrangement. These filters plus even faster air changes make the work areas some ten times cleaner than the main part of the room. The table-top work areas are almost completely enclosed and arranged so that the electronic devices can be passed from one position to the next without taking them into the room.

The chemical solvents used in the room are also super-clean; filters keep out everything larger than a 1,000th of an inch. And every night the room itself is swabbed from top to bottom with special cleansing agents.

Such stringent controls are a necessity. In fashioning a tiny electrical circuit, two electrical paths may be only a 500th of an inch apart. A dust particle that size drifting out of the air and landing between the paths would cause a short circuit.

Even moisture is controlled. Humidity is kept below ten per cent—fifteen per cent below that found in the central Sahara.

## Restoration Control

When natural or man-made disaster strikes—hurricane, flood or even sabotage—A.T.&T.'s Long Lines Department goes into action immediately to reroute communications to protection paths, channels kept free for emergencies. Sometimes rerouting around a trouble spot involves setting up channels hundreds of miles away.

Until recently, the time required to contact other offices and establish new routes has averaged 25 minutes or more. But this is expected to drop to less than ten minutes when the first Bell System semi-automatic Restoration Control Office is completed this spring. The Wayne (Pa.) Restoration Control will be the first of eight "master" offices to be established in the United States to help survey and coordinate restoration through

*In first Restoration Control Office lights trace outline of simulated circuit failure.*

subordinate offices in their territories.

Long Lines restoration men previously have had no way to determine instantly where a failure occured or what protection paths on other facilities were free for use. They needed a fast, fail-proof way of reaching at once all the telephone offices involved in rerouting. Now, with the new Western Electric-built equipment at Wayne, Long Lines technicians will be instantly alerted to a failure by both a bell and lighted wall displays.

One map display shows all the telephone offices through which the restoration center would coordinate operations in its territory. A second display identifies the channel that failed and lists the prearranged restoration plans. (The Wayne Restoration Control Office has more than 700 restoration plans, involving 19 subordinate offices, in a territory than includes parts of four states.) All information shown in the lighted displays is provided by a new Western Electric telemetry system that not only scans all communications channels in the territory continuously, but also allows the Restoration Control Office to activate the reroute switches in distant, unattended offices.

## Flood Forecasting System

The U.S. Weather Bureau has started tests of a new electronic detection system that may provide warning of flash floods to hundreds of river towns. The pilot project, called AHOS (Automatic Hydrologic Observation System), employs 20 remote stations in the Potomac River Valley. From four states, AHOS's sensing equipment transmits river and rainfall data continuously to Washington, D.C., furnishing Weather Bureau

*At Washington National Airport, left, data is relayed from Western Electric-designed equipment to meteorologist at map in Weather Bureau Control room. Information comes from 20 automatic reporting stations where recording devices, such as precipitation-sensing device being connected to system at right, provide constant data on possible flood conditions.*

hydrologists with the vital up-to-the-minute information they need for flood forecasting.

The whole process requires a fraction of the time it takes if the data is read from gauges by Weather Bureau observers, who often are farmers, housewives and merchants in flood-prone areas. Frequently they must hike several miles just to reach the semi-isolated measuring locations. Round-the-clock surveillance, which AHOS makes possible, maximizes the hydrologist's opportunity for early flood detection, a significant step toward eliminating the surprise element from floods.

Equipment for AHOS was designed and much of it manufactured by Western Electric to Weather Bureau specifications. A.T.&T.'s Long Lines Department is leasing the service to the Government.

A data "concentrator" and special teletypewriter housed in the Weather Bureau's office at Washington National Airport, plus the 20 measuring and transmitting stations, are the system's basic equipment. Electronic weather investigation begins at each remote station, where encoders are continually gathering data from two weather-sensing devices, which observe precipitation and river levels. This information is converted by the encoder into signals that can be used by the concentrator.

Signals are transmitted from the observation stations over Bell System and independent telephone company leased lines to the concentrator at Washington National Airport. Different frequencies are used by the various reporting stations so that the concentrator can accept the signals simultaneously, thus requiring fewer phone lines.

Equipped with a memory unit similar to the one used in Bell System electronic switching systems, the AHOS concentrator stores and updates the data, which is printed by the teletypewriter automatically, or whenever the hydrologist wants it. It takes two minutes for 20 stations to report.

When the information flashing into Washington National Airport indicates a potentially dangerous condition, warnings are telephoned to key agencies in areas likely to be flooded. Within minutes, alerts go to police, radio and television stations, radio hams, utilities and news services, giving communities along the course of the river time to protect lives and property.

## Data Communications Text

■ A new Bell System textbook, **Data Communications In Business: An Introduction,** has just been printed and is being mailed directly by the Associated Companies to about 19,000 educators and school libraries. Written by the Data Communications Planning section of the Marketing Department, the book is designed as a college-level text for use in business courses in the field of information handling and processing.

The book presents in non-technical language the fundamental ideas involved in developing effective uses of data communications. It provides insight into the ways in which business and industry may benefit from merging data processing and data communications techniques.

## Editing by Computer

■ In a demonstration of a new computer application that makes computerized copy-editing far more than a gleam in a dreamer's eye, a Bell Laboratories scientist recently received a fully-justified, perfectly spaced and paragraphed copy of a technical manuscript from a computer.

His secretary had typed the article, from a rough, hand-written manuscript, on a data terminal which transmitted the information, in the form of electrical impulses, to a multiple-access computer (Project MAC) located at the Massachusetts Institute of Technology. The data terminal was hooked up to the MIT computer via a DATA-PHONE data set. Upon completion of the typing, she "asked" the computer for a copy of the article and received 33 pages of neatly paragraphed, spaced and fully-justified copy.

Additions, deletions and corrections were then made by the author. His secretary recorded these changes, using special editing language programed into the computer, and asked for and received a fully-corrected and adjusted copy.

This exercise in computerized copy flow could also have been accomplished using Bell Laboratories' Graphic I Console instead of the MIT Project MAC. But the Bell Laboratories computer does not have the capability of recording copy in upper and lower case letters yet—only capital letters are reproduced. However, the Graphic I Console does have an important additional feature in entering and editing copy because its cathode ray tube allows the typist to view the script while making and editing corrections. Inputs and corrections are made directly on the cathode ray tube with a light-pen.

An interesting historical footnote to this exercise: it was over twenty-five years ago that George R. Stibitz of Bell Laboratories first demonstrated the remote control of a program-controlled computer—the harbinger of today's highly sophisticated time-sharing computer systems. On September 9, 1940, he sat down at a teletypewriter in Hanover, N.H., and—connected via a two-way telegraph circuit to a specially-constructed electrical calculating machine at Bell Labs in New York City—began transmitting problems to the machine 200 miles away. He immediately received typewritten answers. This historical demonstration was made possible by Stibitz's successful design of the first program-controlled computer two years earlier.

## Biomechanics Study

Assembly line workers find that soreness of hands, wrists and forearms is reduced when pliers are redesigned. A machine operator's back pains and muscle soreness are relieved by a padded posture chair and a newly designed bench, which she can raise or lower to the best height. A bench worker, who is very susceptible to forearm bruises and swelling, finds they occur less often when padded arm rests are installed on the edge of her work position. Operators who use microscopes discover neck and upper back stress is relieved when the instrument's eyepieces are relocated and a custom chair is used. Eye strain caused by glare on the work area is reduced when filters are installed on bench lamps.

These are but a few of the case histories which have resulted from a year-long Western Electric study of biomechanics—the science which deals with the man-machine relationship. It involves taking a new look at the physical capabilities and limitations of the human being on the other end of the tool or machine.

The study arose from complaints of plant workers about increasing muscular soreness and excessive fatigue, which often led to medical restrictions. A preliminary investigation disclosed that the ailments reported were not imaginary and that they affected the over-all operation of a plant because of deterioration in the individual's work performance. The company-wide program was then authorized.

Pliers, for instance, were one of the first tools to undergo scrutiny. Used thousands of times a day for intricate wiring operations, they were found to be totally inadequate when used by women for constant twisting action because of the smaller female hand. Swelling, restricted finger movement and acute soreness were some of the medical problems traced to use of the pliers. After studying these wiring operations, biomechanics engineers added a spring and plastic grips to the pliers, changed the shape of the handles, decreased the dimensions and added a flange as a thumb stop.

As part of the Western Electric program, similar changes and other new equipment have been designed to improve the machine-operator relationship, including screwdrivers, soldering irons, chairs, arm, back and foot rests. On a broader scale, entire work areas, taking into account space, positioning and lighting, are also being given careful study. Already W.E.'s work on biomechanics promises rewards beyond better conditions for the workers and improved performance for the plant: the attention to the individual's needs may also contribute to his personal sense of craftsmanship in the job—and his feeling of mastery of his machine.

*Western Electric biomechanics engineer studies bent wrist position caused by shape of conventional pliers. Contour handles and thumb stop of redesigned tool reduced strain.*

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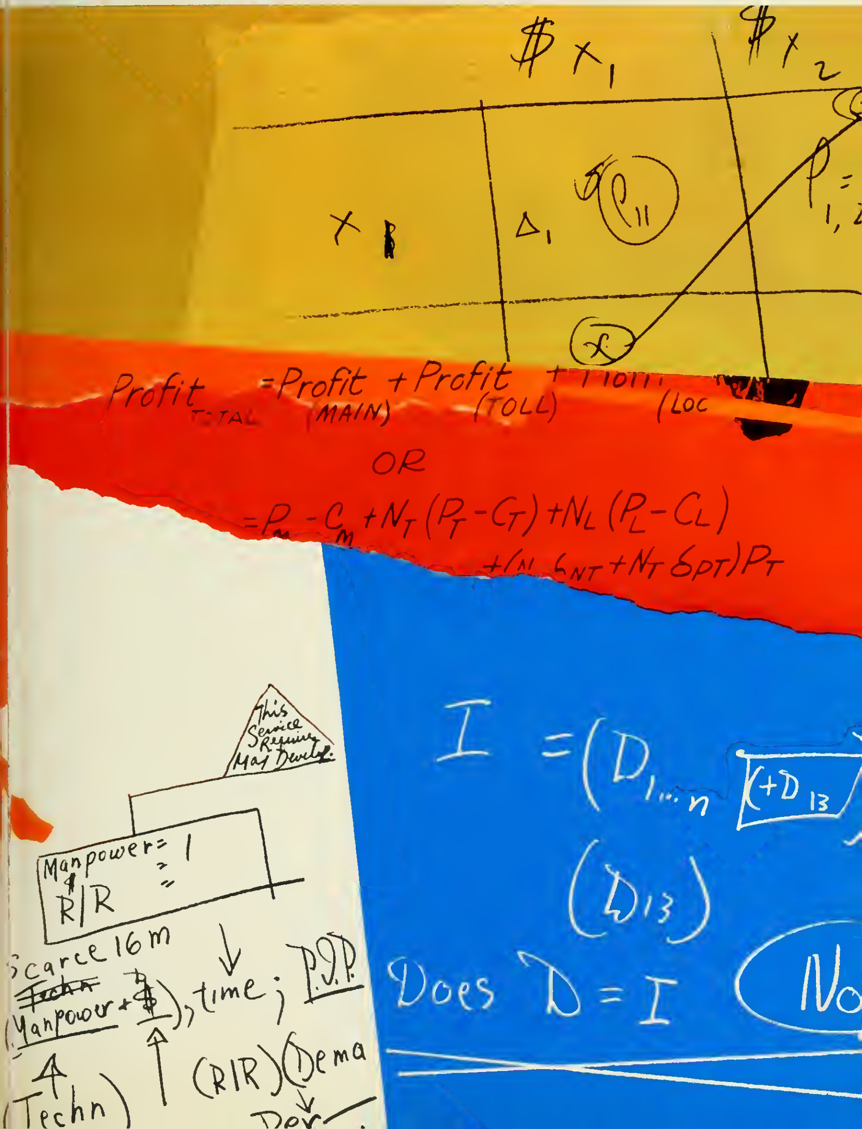
# BELL TELEPHONE MAGAZINE

SUMMER 1966



*Peering through a magnifying glass, a girl at Western Electric's Indianapolis Works inspects a newly manufactured Trimline® telephone for possible defects. The complete inspection process, which includes many inspection stations such as this one, insures the extremely high reliability of telephone station equipment before the equipment is delivered to Bell Telephone Companies. Last year Western's Indianapolis Works manufactured over 9,000,000 new telephone sets, of which more than 400,000 were the stylish new Trimlines®.*

# 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:**

"Collage," by Bernard D'Andrea, takes as its inspiration some of the pencilled thoughts found on scratch pads in the Analytical Support Center, subject of an article on page 22.

The following is the text of the keynote speech delivered by Mr. Romnes before the Internationa Data Conference, Chicago, Illinois, June 22, 1966

# Managing the Information Revolution

H. I. Romnes, *President, A.T.&T. Co.*

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To HAVE been chosen as the keynote speaker for this Fifteenth Annual Data Processing Conference is a very great honor and I am grateful for it. But it is a formidable assignment on a number of counts.

First of all, I don't suppose that anywhere, ever has there been gathered under one roof so many representatives of this new profession of yours—information management. Certainly I cannot hope to match your expertise or contribute substantially to it. However, I can perhaps provide some insights as to what business management expects of you—not only its hopes as to what you can do *for* business, but its apprehensions as to what you might do *to* it.

My assignment is formidable on another count. I hesitate to contemplate the number of keynote speeches in the last ten years or so that have been addressed to conferences on one aspect or another of the so-called "information revolution." Thus each succeeding speaker is confronted with mounting odds against his being able to discern new trends or rouse his audience to confront new challenges. Sooner or later program chairmen are going to have to cope with the law of diminishing returns.

Perhaps the computer can supply the answer. Computers have been programed to write sonnets and compose sonatas—and surely the keynote speech is an art form that should not be beyond its capabilities. But the computer would probably make its greatest contribution if it could take over the listening function as well.

I take some comfort, however, in the thought that there may be something new in your choice of a keynote speaker—in your having sought him, not from your own industry, but from the neighboring realm of communications.

# MANAGING THE INFORMATION REVOLUTION

*". . . our whole concept of what constitutes a telephone call has radically changed."*

COMMUNICATIONS and computation—my business and yours—have much in common.

The telephone system is itself a computer. Its components are dispersed across the continent but they work as one. Equipped with more than 90 million input-output stations, this enormous computer can be commanded to provide any one of the three million billion "answers" it takes to connect any one of its stations—telephones—with any other and do it in a matter of seconds. It is a "real time" operation by definition and design.

It should not be surprising, then, that our technologies should have much in common. Indeed our newest electronic switching systems, like your computers, are internally programed and are endowed with the same kind of quasi-human memory that you ascribe to your machines.

And your industry and ours have been mutually stimulating—yours deriving perhaps its greatest impetus from the invention of the transistor in our Laboratories and ours challenged to develop a new order of communications capability to meet the needs your industry has generated.

As a consequence of these new needs, our whole concept of what constitutes a telephone call has radically changed. Today, a telephone connection can carry a stream of data—or an engineering drawing—or a TV program—or the copy for a newspaper column—or it might even carry human speech. In short, it can be set up to transmit information in almost any form, oral or graphic, transitory or permanent.

In the short life span of this Association, we have introduced many new developments and services to match the new needs it represents. New higher-speed teletypewriter services are now widely used in moving data at speeds up to a 100 or 150 words a minute. At the other end of the scale, Telpak provides broadband channels which can be used for transmission at speeds up to 500,000 bits per second—on a point-to-point basis. DATA-PHONE sets translate the language of

*". . . we . . . are taking as a clear and present challenge what only a few years ago seemed a fantastic 21st century speculation . . ."*

your machines into the language of ours, permitting data transmission wherever telephone lines run. And our new Touch-Tone® telephone, in the areas where this service is available, can not only connect you to a remote computer but register information in it as well.

Your needs also continue to point new directions for our research and development. For example, we are working on a digital transmission system, which will provide precise and unerring regeneration of data signals at frequent intervals over long hauls. The capacities we contemplate range from 500 to 1000 megabits a second in our initial undertakings to the 15,000 megabits or so we think may eventually be needed.

In short, we in our business are taking as a clear and present challenge what only a few years ago seemed a fantastic 21st century speculation—the need to bring our switched network to the order of capability that will be required to give business and government, and the public at large, instant access to computer-stored information as conveniently as we telephone today.

Let me say in passing, that allied as our businesses may be, we are not in the data processing business and don't intend to be. We conceive it to be our job to be ready to provide the facilities for you and your machines to "say" whatever you want to say to each other, whenever and in whatever form you want to say it—and to provide the interface between your machine and ours that will make that possible. Ours is a common carrier communications undertaking and—from the prospects ahead of us—we shall have quite enough to do meeting our own responsibilities without getting into yours.

*". . . while data processing and data transmission are separate undertakings, each must take increasing account of the other . . ."*

But the principal reason I am here, I suspect, is your recognition that, while data processing and data transmission are separate undertakings, each must take increasing account of the other if the full potentialities of both are to be fulfilled. The "information revolution," if such it be, signifies not only our new-found capacities to generate, store and retrieve information but our growing ability to deliver it instantly where we please.

Today thousands of companies, large and small, are working to apply these twin potentialities to the improvement of their own operations. And so are we in the Bell System. If I have anything to contribute to your discussions of information management, it derives, not so much from our special competence in communications, but from our experience in working toward applying electronic information technology to our own job.

You will readily recognize, I think, that our end-product—nationwide communications service—depends on the activities of thousands of people all across the country—in factories, in warehouses and in operating units. Thus our stake in a system that will provide accurate and up-to-the-minute information to coordinate this process is very high indeed. While our final system is far from complete, I'd like to share with you some of the convictions we have developed in the process of designing it.

*". . . the information revolution must be managed."*

THE FIRST of these convictions is this: the information revolution must be managed.

Now before you dismiss that statement as the platitude of the month, I would ask you to think of the number of earnest but misconceived computer applications there were during the initial surge of enthusiasm for this powerful new business tool.

We are in a more sophisticated era now. We have learned from our mistakes. We have learned that the computer is not just another piece of hardware, a bigger and better desk top calculating machine. We have learned that its price tag is only the beginning of the full costs of applying it. And we have learned that a computer, however apt it may be—technically—for the application for which it was intended, just simply won't pay off if people won't accept it.

And what is true for the computer is doubly true for a comprehensive business information system. Technical matters are but a part—and probably the small part—of the considerations that need to be taken into account in the design of a business information system. Designing such a system calls for a fundamental thinking-through of organization structure and of lines of communication, formal and informal. And it calls for a careful appraisal of the potential human consequences, the effect of the system on the decision making power of managers and the job satisfactions of employees.

*“. . . we must apply to its development the same tough-minded standards of cost effectiveness, the same patient and comprehensive planning that we apply to the more traditional aspects of our operations.”*

For good results, a business information system can't "just happen." For all its glamor and novelty, we must apply to its development the same tough-minded standards of cost effectiveness, the same patient and comprehensive planning that we apply to the more traditional aspects of our operations.

In this connection, I can't help but wonder whether we do ourselves a disservice by our readiness to describe the change brought on by the computer and its associated mathematical techniques as a "revolution." Certainly, I am not ready to deny that the changes in business—and in society—that they portend warrant the use of the word. But we don't help matters much if its use conjures up a picture of an irresistible force with which mere mortals are powerless to cope.

We have had revolutions before—for example, the Bell System's conversion from operator switching to dial controlled switching. We managed to direct its introduction rationally, humanly.

We must do the same for this new revolution. For this revolution, like most others, holds equal promise of liberation on the one hand or, on the other, the imposition of a worse tyranny than the one it is designed to supplant. Computerized business information systems can extend and enhance human capabilities, providing new scope for initiative and imagination. Insensitively applied, however, they can depersonalize our undertakings, subordinating the organization and its people to the rigid requirements of an inflexible

*". . . it is not only punched cards but people that shouldn't be folded, spindled or mutilated."*

system. (As I have more than once reminded tele phone managers—it is not only punched cards bu people that shouldn't be folded, spindled or muti lated.) Instead of facilitating change, such a systen can become a barrier to progress. It can become, no a means, but an end in itself.

Which results we get will depend, not so much o our technical competence in linking computers an communications, but on the range and depth of th management judgment we bring to the job.

THIS MEANS to me that the responsibility fo managing the information revolution cannot be dele gated. Designing a business information system isn' the exclusive province of a specialized department. I the final analysis it is a general management respon sibility. And it needs to be a concerted undertaking reflecting a balanced consideration of the needs of th entire organization.

Letting the planning job go by default, fragmentin the responsibility in various little islands of develop ment, leads only to waste, duplication of effort and— eventually—to frustration.

But the principal hazard in leaving the planning jo to the disparate enthusiasms of this department o that, lies in the barriers to compatibility that inevit ably arise to confound subsequent efforts to develop a integrated system. If there is one lesson that the ex perience of building and operating a nationwide tele phone network qualifies us to pass on to the informa tion industry, it is the paramount importance of com patibility. Where this consideration has been neglected where planning has lacked direction from a "system' point of view, you can count on it that costly re engineering and re-arrangement will follow.

*". . . a business information system, if it is to be successful cannot be imposed—appliqued—on an organization."*

For a business information system, if it is to be successful cannot be imposed—appliqued—on an or ganization. Indeed, were you to attempt to do so—anc however elegant your design— its purported beneficiaries would most certainly resist it. And they would be right in doing so. To the technologist, their resistance might seem like sheer human cussedness, mankind's traditional response to any threat to his accustomed ways. But, more fundamentally, any system that does not grow out of an organization's own experience and that does not match its own definition of its needs and the results it seeks, just can't be a very good system. Participation isn't just a necessary precondition of acceptance; it is a prerequisite of effective design.

*". . . we sit the expert in information technology down with the operating man and the engineer, the doer with the dreamer, the pragmatist . . . with the planner . . ."*

All of which is just another way of saying that the information revolution—on the scale of one department, one company or society as a whole—is too important a matter to be left to the experts. It calls for the fullest possible range of management skills. In our experience, the best results are achieved by assigning information systems development to "mixed teams," each member of which brings to the job a different departmental interest, a different set of experiences. On these project teams, we sit the expert in information technology down with the operating man and the engineer, the doer next to the dreamer, the pragmatist who thinks in terms of today's results with the planner who is looking ahead to tomorrow's. It's our feeling that only by such a team approach can our business assure itself that a "system view" is being applied to the development of its information system and that their design will accommodate not only today's needs but the future's as well.

It may be that some information specialists will object to so many strangers getting into *their* act. But most, I'm sure, will take it as a sign of the critical importance of their new profession to the effectiveness of modern management. And most, I think, will welcome the team approach as an opportunity—and a challenging one—to bring their special competence to bear on the organization's basic goals.

Data processing people, it seems to me, would do

*". . . managing the information revolution is going to take more than competence in technology . . ."*

their profession a disservice—and risk aborting the success of their own undertakings—should they provide occasion for their colleagues in management to view them as a breed apart, an aloof priesthood inhabiting a cool world of their own. For, managing the information revolution is going to take more than competence in technology, demanding as that may be. It's going to require, not only that you know the computer and what it can do, but that you know your business in all its aspects—its operations, its markets, its people, its philosophy. Only as the information technologist applies his skills, not merely as a technical expert but as a manager who understands his company's goals and is committed to them, can he make his maximum contribution to the job and the progress of his own profession.

Now, there is an equal and corollary obligation on the part of general management. No manager can be a manager in this day and age, it seems to me, without at least a general grasp of the potentialities of the new tools your profession has developed and the risks and opportunities of applying them. That's why we in the Bell System are sending our managers back to school. Not only has each of our operating companies set up training curricula in data processing and data communications for their people, but we have also established at Cooperstown, New York a special school where selected engineers and management people from all across the System are subjected to an intensive 12-week course in the combined technologies of computers and their communications requirements. Already we have some 1,700 graduates of this school. Also at Cooperstown—and more recently at other regional schools—we have been running courses designed to acquaint our entire top and middle management—not excepting presidents—with the rudiments of information technology. In these courses it is not our purpose to create instant experts but rather to provide a basic grounding which will help our managers to participate knowledgeably and responsibly in the application of information systems to their own operations.

"We are training our own revolutionaries."

It should be apparent by now that we in the Bell System are pretty well committed to the information revolution. We are training our own revolutionaries.

But what specifically are the goals we want to accomplish? To say it in one sentence—we are seeking advances in service, improvements in management and economies in operation.

And what are we doing about it? How are we applying the new information technology to our own operations?

There are, I'm told, some 220 different computer installations in the Bell System. Some are scientific machines, available on a time-shared basis to researchers at various laboratory locations. Some work in our factories, programed for process and inventory control and some are in our warehouses, taking orders for supplies over telephone lines directly from field locations. Still others are assigned to the—by now—conventional accounting chores.

All of these are internal applications, not different in kind from those you would find in many large businesses. More distinctive—and more critical—are those which have a direct bearing on the quality of our only product—service to the public.

Let me give you two examples:

At Bell Telephone Laboratories we are conducting a test of a new computerized system which will help information operators come up with the right telephone number even though the inquiring customer may not be sure of the spelling of a name or the accuracy of the street address. In response to such fragmentary information as the operator keys into the computer, a cathode ray screen displays the names, addresses and telephone numbers of the half-dozen or so people who match the customer's prescription. In

*". . . no matter how mechanized our operations become, the customer will always have a real, live human being to talk to . . ."*

our trials so far, the operator's performance was somewhat faster than our traditional manual methods. But more important to us than this increased productivity is the fact that—with the computer's help—the percentage of customers who got the information they were looking for was much, much higher. In short, this system promises to produce, not only better service for our customers, but more satisfying jobs for the employees involved. These results are reason enough to go ahead with this development.

Another example: We have 25,000 business office representatives in the Bell System and, all together, they answer some half a million calls a day from customers, ranging from orders for new service to helping people with questions about their phone bills. Each of these young ladies is our ambassador to the public. She is the one we're thinking about when we say that, no matter how mechanized our operations become, the customer will always have a real, live human being to talk to should he encounter difficulties. Today we are readying a computerized Business Information System to help the service representative do her job. With this system, she will sit in front of an on-line terminal device with a cathode ray tube display. By keying information into the computer as the customer talks, she will be able to retrieve all the information she needs to complete the transaction. In fact, when the system we contemplate is fully developed, she will be able—as she talks to a customer ordering new service, for example—to set up a complete computer file on the customer, assign a number, complete installation arrangements, at the same time providing other departments all the information they need to fulfill our commitments.

I have recounted these examples in some detail because they embody our best hopes for the information revolution. We look to information technology, not to supplant people but to enhance their capabilities and enlarge their opportunities to exercise initiative.

Oddly enough it appears to us that the information revolution—instead of draining work of its significance, as some of our dismal prophets would have it—offers unique opportunities to enlarge the individual's contribution and the satisfaction he derives from it. I hope we can make the most of these opportunities.

And, while we're planning our new business information systems, I hope we can make the most of our opportunities to extend rather than limit the exercise of real responsibility on the part of our managers. In the popular conception, computerized information systems inevitably have the effect of drawing the authority for decision-making closer to the top. Certainly the sheer cost of computers and their attendant programers and analysts argues for a centralization of *effort*. But that it argues for a centralization of *authority*, I would deny. Indeed, such an approach would in my mind represent a serious misinterpretation of the really great opportunities computers can afford us.

To my mind the first criterion in charting the flow of information from a computer is the simple question "Who needs it?" And the only right answer to that question, it seems to me, is the man who can act on it most effectively. There may be some executives who take a perverse satisfaction in being the first to know when anything gets out of line anywhere in their domain. But there are greater satisfactions surely in getting the job done right in the first place and that can only be accomplished, not in the executive suite, but where the action is.

*". . . the first criterion . . . is the simple question, 'Who needs it?'"*

That's why we in the Bell System have made it a prime requirement of our evolving business information systems that they provide our local manager with the data he needs—in the form in which he needs it—so that he can make his own decisions as to how best to serve his customers. The computer can tempt us in the direction of centralization and consolidation. But if the efficiencies of centralization can only be achieved at the cost of moving the authority for decisions affecting our customers further away from the communities we serve, I would reckon that cost too great.

One final thought on business information systems as a management tool. The technologies represented here in this room offer a tremendous potential for enhancing the performance of American business. But there are limits to what information technology can do. When the information revolution has been won and its accomplishments consolidated, it may well be that your greatest contribution will prove to be the new freedom you provide management to direct its energies to the elusive, unstructured problems—the human, social and political problems—which will shape the future of American business.

*". . . it may well be that your greatest contribution will prove to be the new freedom you provide management to direct its energies to the elusive, unstructured problems . . ."*

LOOKING BACK over what I have been saying, I find four or five observations that might bear repeating—not because they are original perceptions on my part—they aren't—but because they arise out of the hard-won experience of an outfit that is trying—as earnestly as any I know of—to apply the fruits of the information revolution to doing its own job better.

*First,* the information revolution must be managed. Its costs are too high, the consequences of misapplications too grave, simply to let it happen.

*Second,* that the job of developing a business information system bears so directly on an organization's structure, its adaptability to change and its capacity for decision that it can't be delegated to a corps of specialists. It is a general management responsibility.

*Third,* such a system—for compatibility's sake, for optimum efficiency—must be planned comprehensively—systematically—rather than in bits and pieces.

*Fourth,* that the planning job is best done by teams whose members bring to the job a wide diversity of interests, skills and perceptions, reflecting the range of interest of the entire organization.

*". . . the ultimate criterion . . . is . . . the scope and freedom . . . to serve people better."*

And *fifth,* the ultimate criterion of the business information systems we devise is not so much the kind and quantity of information they produce, or the efficiencies they provide, but the scope and freedom they afford for people to use their own initiatives to serve people better.

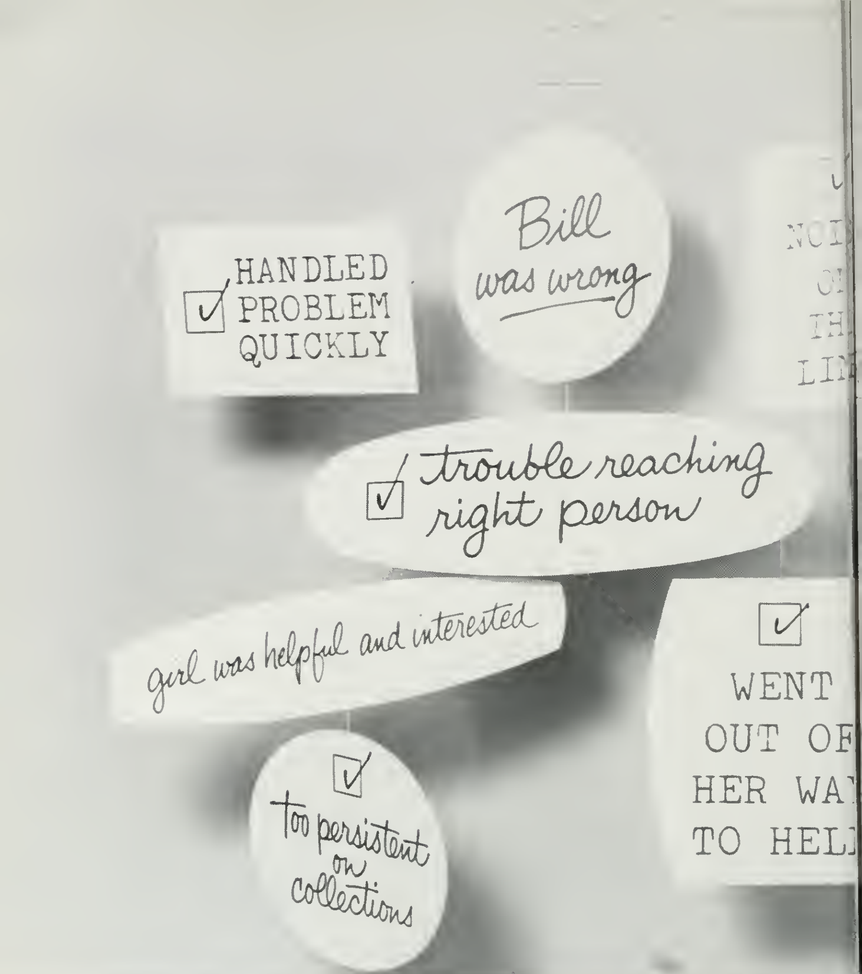
*". . . how well we in business manage the information revolution . . . may well be the proving ground for its broader application . . ."*

Finally on this point, it appears to me that how well we in business manage the information revolution —for better of for worse—may well be the proving ground for its broader application to our society as a whole. There, I suspect, the criterion of success or failure will be the same. Surely it must not restrict the role of the individual but rather enlarge and enhance it. And surely, too, it must provide new scope for attention to the problems that computers cannot and only man can solve.

In giving this talk on "Managing the information Revolution," Mr. Romnes draws upon his experience in managing Bell System operations and his understanding of the people who perform those operations. His abiding concern in the development of a business information system in the Bell System is that the business and the men and women who comprise it cannot be simply re-built to fit the needs of the machine. He stresses a thinking-through of organization structure and the necessity for a team approach, a mixture of telephone skills and experience with technical expertise, in developing a BIS.

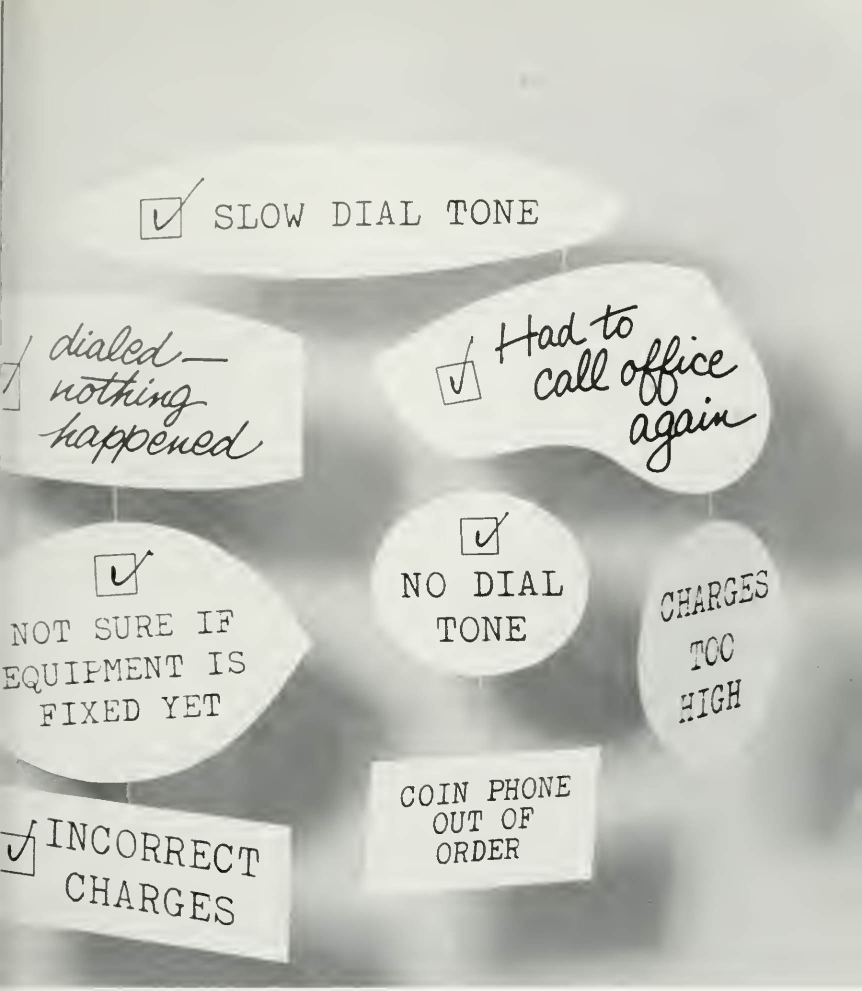
Mr. Romnes' Bell System career started in the summer of 1928, when he joined the technical staff of Bell Telephone Laboratries. He subsequently held many positions in engineering and operating. He became general manager of of the Long Lines Department in 1950, chief engineer of A.T.&T. in 1952 and vice president, Operations in 1955. Four years later he was made president of Western Electric Co., and in 1964 was elected vice chairman of the board of A.T.&T. At the beginning of 1965 he assumed his present position as president of A.T.&T.

H. I. Romnes




SAM

SERVICE ATTITUDE MEASUREMENT




C. K. Collins, *Assistant Vice President, Operations-Traffic, A.T.&T. Co.*

When Robert Burns expressed the ancient human wish to see ourselves as others see us, he was also recognizing the equally ancient truth that fulfilling the wish, even partly, is always difficult and often impossible.

If it is difficult for an individual to know truly how others see him, how much more difficult it is for a large organization which must be concerned with how many people see it. The Bell System exists by public franchise, by consent of the millions of people it serves. That consent is conditioned by the quality of service as the public sees it.

About five years ago a well-known research firm was retained to conduct depth interviews of Bell System employees and management. The object: to find barriers to giving service from the customer's point of view. The survey showed that many telephone employees felt some internal measurements of service did not fully reflect the customer's viewpoint on the service he receives. Something more, something different, was needed. Subsequently a Bell System measurement committee was formed to examine and recommend improvements in measurement procedures. Among other things, the examination generated a new concept, a new customer-oriented technique for measuring service named the Service Attitude Measurement Plan —SAM for short.

SAM provides a practical means of measuring telephone service as the customer actually sees it and has experienced it *in specific situations*. It affords a new view—from the outside looking in, on specific details of service performance, pinpointed by specific customers in specific places at specific times, reported by districts within the companies—and a new basis for meaningful action.

### "We Would Like Your Opinion . . ."

If you try to give a man advice, he may or may not listen. But ask his opinion of something, and you had better be prepared to draw up a chair and listen. Customer response to the SAM Plan illustrates this point. The Plan is predicated on questionnaires sent to customers who have had recent contact (usually within a week) with business office, installation or repair service. In addition to these questionnaires, there is a general service questionnaire mailed to a representative cross-section of residence and non-PBX customers covering aspects of service with which they have fairly frequent contact, such as local, long distance calls and information, quality of transmission, directory, helpfulness of employees, billing etc. Response to the questionnaires clearly shows that customers are willing to express their views freely and that they welcome this opportunity to be heard. Mailing of questionnaires is done on a random sampling basis under direct supervision of business research people in the companies.

Customers to whom questionnaires are sent are selected from basic records: service orders for the installation questionnaire, trouble reports for the repair service questionnaire, contact memoranda for the business office and billing records for the general service questionnaires. About ten days after the initial mailing, there is one follow-up on any questionnaires not returned by then. Built into the processing procedure are safeguards against surveying the same customers too frequently. First, a complete record of all mailings is maintained. Second, all new selections based upon service contacts are checked against this record. All customers who receive a business office, installation or repair questionnaire are excluded from further samples for six months, as are all those who received a general service questionnaire within 12 months.

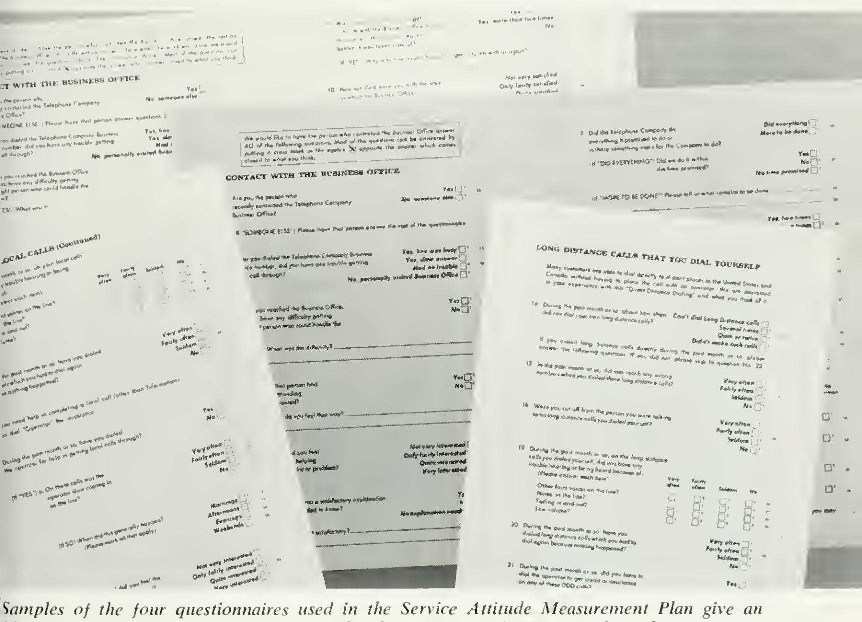
The study procedures have been tried and essentially proven in two districts in each of four Bell Operating Companies: New England, Chesapeake and Potomac of Maryland, Illinois Bell and Michigan Bell. The districts were selected for the trial to give the widest possible variety of service environment; they included metropolitan and suburban districts, districts which encompassed two large towns and a district with a small-town, rural flavor. The trial, which continued over a period of two years, was designed to obtain 200 responses to each of the four questionnaires in each of the eight districts surveyed. Return of the filled-in questionnaires averaged from 60 to 70 per cent.

The percentage of returns indicates more than just the fact that customers are willing to answer questions about specific aspects of their service; it also is clear evidence that the SAM method of soliciting opinion is quite acceptable in itself.

## Name of the Game is ACTION

So far about half of the customers surveyed have tallied one or more criticisms of service. The pay dirt in the Plan is being found in the fact that such specific criticisms have uncovered trouble spots, some previously unknown, and have led to effective corrective action.

In the phrase, "effective corrective action," *effective* is the key word. It has been manifested in concrete service improvements many of which were achieved through interdepartmental team effort. Force schedules have been adjusted, equipment has been modified,




*Samples of the four questionnaires used in the Service Attitude Measurement Plan give an idea of the variety of situations covered by the survey—and commented on by customers.*

new approaches have been found to solve the problems revealed. And where effective action has been taken, subsequent SAM measurements have consistently indicated a downward trend of those criticisms.

One instance of the kind of trouble SAM can uncover, and the action being taken, is the case of an information office where, despite the fact that internal measurement was at a fully acceptable level, response to a SAM General Service questionnaire showed 29 per cent of the customers complaining of slow answers. Investigation revealed that performance for the total day as measured internally looked good because poor answering performance during the day was being offset by exceptionally good performance in the evening.

By concentrating on more accurate estimating of traffic volume and better force adjustment, management obtained a balanced performance over the whole day. Improved customer reaction was evident when complaints dropped nine percentage points in less than two months after the change.

Again: one question in the Business Office questionnaire asked customers, "After you dialed the telephone company business office number did you have any trouble getting your call through?" Unfavorable answers ran toward 20 per cent. Remedial action was taken in three main steps: an accessability study was made of business office trunks and people; meetings were held for service representatives to create awareness of the situation; an adjustment was made in the force requirements in the office. As a result of the action, the unfavorable customer comments dropped from 20 per cent to 8 per cent in about three months.

Similar examples of trouble uncovered and of effective corrective action are found in the Plant Department. One trial district found that they received more favorable responses to questions about repair service when they followed these simple rules which apparently were meaningful to the customers:

- Advise of any necessary delay.
- Advise, whenever possible, that repair work is in progress.
- Notify, in all cases, when the trouble is cleared.

These are fundamental steps, sometimes forgotten, but particularly important to the customer when, as often happens, he can't see the repair work going on. This is one of the salutary effects of SAM: it seems to send us back to the fundamentals of operating the business—service to the customer.

There are other examples of troubles uncovered and corrected which stress the importance of interdepartmental action in working effectively with SAM.

### To Supplement, Not Replace

During the earlier days of the Service Attitude Measurement Plan trial, its ultimate objective was sometimes misunderstood as being intended to replace existing internal measurements. While some technical measurements might eventually be eliminated or altered, it is certain that many will continue to be needed. Actually, internal technical measurements are administrative tools designed to provide detailed information regarding specific operations—to help operating people locate and correct weak spots in specific aspects of service before customers bring them to our attention.

The two types of measurement—external, such as SAM, and internal—are complementary, not mutually exclusive. External surveys of customer opinion indicate whether or not the company is meeting its real objective: that customers be satisfied and pleased with the quality of service received. Internal technical measurements give detailed information about operations to help telephone people analyze performance and direct action to correct any weakness found; this also might affect customers' attitudes toward service. Time and experience will enable Bell System people to achieve a useful, working meld of the two kinds of measurement.

This will be a period of adjustment for many telephone people who see established methods of judging quality of service changing—but they will find SAM very helpful in their efforts to truly improve service from the customer's viewpoint. With the help of A.T.&T.'s interdepartmental steering and working committees, the new Plan is in the process of expansion throughout the Bell System. Evidence gathered to date shows clearly that SAM methods are sound and acceptable, that the Plan is sensitive to specific corrective action, and that it can make a positive contribution to improved service through concrete action on the part of the people who use the Plan.

SAM will require new skills for its effective use and a new outlook in applying those skills. It is a new method in a world alive with new methods. And it promises to be one of the best means the Bell System has to help achieve its objective: customers who are satisfied with the service the Bell Telephone Companies provide.

As chairman of A.T.&T.'s interdepartmental SAM committee, C. K. Collins is well qualified to write about the successful introduction of the Service Attitude Measurement Plan in the Bell System.

A large part of Mr. Collins's 42-year telephone career has been in the Traffic Department, where he has lived and worked with the various types of internal measurements designed to insure effective operation. This broad background of experience serves well now as he contributes A.T.&T. staff guidance to the new SAM Plan.

Mr. Collins joined the Bell System in 1924 after graduating from Amherst College, and worked in the Traffic Departments of both New York Telephone and New Jersey Bell Telephone. He came to A.T.&T. in 1941, became Traffic results engineer in 1945, worked in the Commercial Department as sales and servicing engineer and served on the staff that organized the Bell System Executive Conference at Asbury Park. In 1955 he assumed his present position as assistant vice president, Operations—Traffic.

C. K. Collins

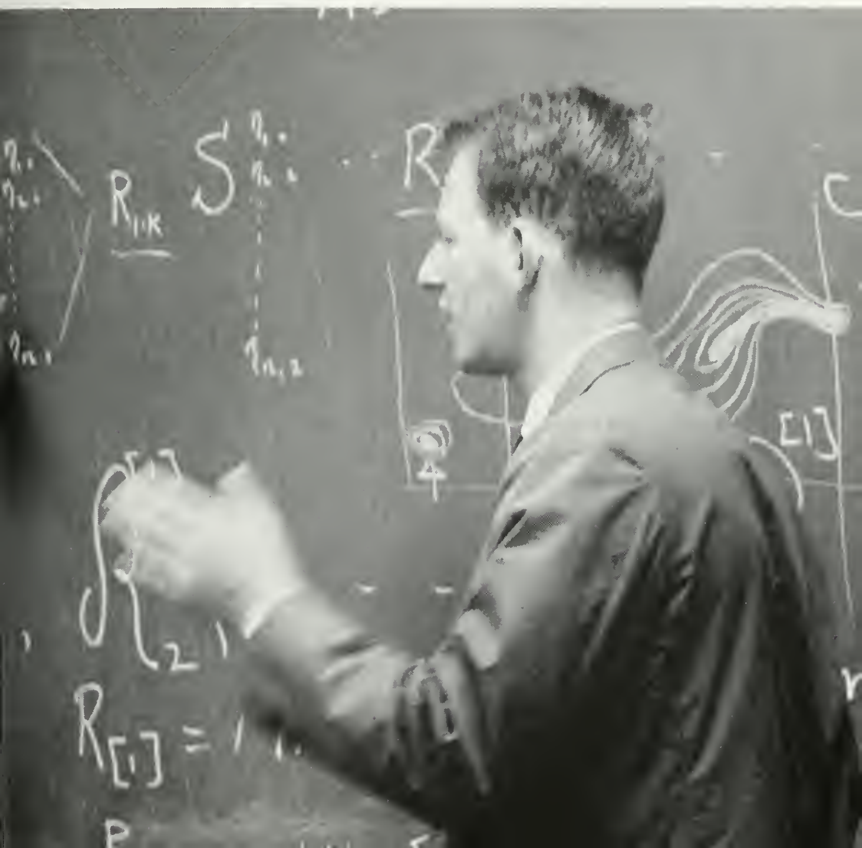
"Top management should have models available of important activity areas which are organized so that assumptions, key factors and constraints can be changed and various capabilities, strategies or consequences can be explored in a way that gives the manager the best chance of arriving at a successful and fully-informed decision. This can be accomplished. . . ."

# ANALYTICAL SUPPORT CENTER

*Dr. Edward Zajac and Peter Rosoff discuss a mathematical model: "As a result of rate changes in Service B, you'll have reciprocal revenue effects in Service A; all these are interdependent so far as revenue effect is concerned, and are interactive. . ."*

The statement quoted on the facing page is from a description of a basic management analytical support center, which was presented to the officers of A.T.&T. The theory of such a center is postulated on its functioning as an aid to, but not a substitute for, management judgment. This function is a relatively new means of generating information to help support management decision-making.

More specifically, it is a relatively new application of existing means to an old problem. To create a corporate organism equipped to evaluate the maximum amount of useful information and pre-



sent it in a viable form for a given situation, it is necessary to integrate appropriate professional skills in a cohesive but flexible organization. This requires a group of individuals whose skills are a blend of the experience and competence of operating management with the techniques and disciplines of professionals such as engineers, marketing strategists, computer programers, mathematicians, statisticians, economists and others. These people apply the instruments of modern synthesis and analysis and are fed by a well-organized management information source. To put it another way, the analytical support function applies the principles of systems engineering (the existing means mentioned above) to the organization of management information (the old problem).

*Dr. Milton Terry in downtown New York City programs a computer in Valley Forge, Pa. "The average holding time on these is two hours; we're going to need more access circuits . . ."*

The individuals comprising the analytical support center at A.T.&T. form a combination of skills unique in the Bell System, a mixture of sophisticated professional disciplines and advanced academic achievement. While the center itself is a permanent operating entity, its structure is extremely flexible, and the people who work in it may move in and out as their special contributions are needed. A brief summary of the backgrounds of those who have shared in the work of the analytical center in the past or are presently engaged in it, may help illuminate its structure.

Harvey J. McMains, who heads the group, is a registered professional engineer, holds degrees in mathematics and physics, has also studied law, and was new services coordinator before assuming his present position. R. M. Gryb, electrical engineer, has been a member of the technical staff at Bell Laboratories and now handles statistical analysis and market research. Merle C. Conley, registered professional electrical engineer, was new product analysis supervisor at A.T.&T. before joining the support center. Edward E. Zajac, Ph.D., is a member of the Mathematical Physics Department at Bell Laboratories, and specializes, among several things, in advanced computer programing, including computer solutions of partial differential equations and computer-made graphics and movies. H. S. McDonald, Dr. of Engineering, has taught electrical engineering, has worked in communications theory and computer science and is head of the Information Processing Research Department of Bell Laboratories' Computing Science Center. Peter Rosoff, economic analyst, has the S.M. in industrial management and has the responsibility, among other things, for working with outside consultants in preparing testimony for the FCC Interstate Rate Inquiry. Milton Terry, Ph.D., statistician working in statistical data analysis, was associate professor of engineering statistics at Virginia Polytechnic Institute and now is director of Computer Projects Research at Bell Laboratories. S. M. Fulda, engineering economist, holds the M.S. in applied mathematics, is now studying toward the Ph.D. in mathematical economics and is a member of the Transmission Systems and Switching Systems Engineering Divisions at Bell Laboratories. Neil Bernstein, with degrees in political science and law, has been a contributor to many legal publications and is now an attorney at A.T.&T. and a special consultant in law for the analytical support center. R. R. Auray has the M.A. in economics and statistics and now is working toward the Ph.D. in economics; he is a general business research manager at Long Lines. W. T. Esrey, economic analyst, has the Master of Business Administration degree and worked in the economic studies group of A.T.&T.'s Business Research Division before being loaned to the analytical support function; he is now in New York Telephone's Comptroller's Department.

This abbreviated sketch cannot convey the essence of the operation as it takes place day to day—the constant interplay of ideas, opinions, approaches generated by these skilled, highly trained people, each an expert in his field.

### Means to the End

Much has been said, and is being said, about the importance of *current* information in the decision-making function of management. The Bell System's emerging business information system, for example, (see *BTM*, Summer, '65) is at least partly dedicated to providing management with up-to-the-minute data on any part of the operating system. *Real time* is the operative term in this concept. While present intelligence derived from computerized information sources may well be grist for the mill of future action, providing the real-time status of any area of corporate activity is not the mission of an analytical support center. It is, rather, the structuring of models with which management can "play," as military strategists do with war games. It behooves the man of business, as it does the man of military strategy, to examine and manipulate, so far as he can, the variables in a given problem to the end that his informed judgment may guide him at the moment of truth when he commits his forces.

Lest the reference above to playing with models be misconstrued as frivolous through a simple accident of language, let it be understood that the models in this context are immensely complicated, often require thousands of man-hours of the most sophisticated analysis to construct, and that "playing" with them for useful results demands a high order of cerebration.

The word "model" suggests a three-dimensional object, and indeed, some of the models constructed by the analytical support center take a three-dimensional form. Some can be manipulated to show an almost infinite number of relationships between variables and the consequences of these relationships. Other models may take the form of print-outs from a computer; some are actually computer-made movies—*dynamic* models—produced by extremely sophisticated programing of the machine, which projects the moving lines of a chart or graph upon a cathode display tube, which in turn is photographed. One of these, for example, shows the relative costs per mile of Long Lines circuits, with and without microwave radio relay, by dates, over a 20-year period.

There are still other models in which the parameters, assumptions and constraints of a given problem are defined and manipulated with the esoteric language of higher mathematics, usually on large two-by-three-foot pads of paper and in several colors.

These generalizations give some idea of the physical properties of analytical models. But more important than this is the underlying purpose of their development and the techniques of their employment.

The management support function entails developing the "realizations" of verbal management models; supporting special management studies; supporting engineering costing; supporting market research; supporting the rates and regulatory staff; developing better methods for preserving data; providing field trial facilities in real-time computing for A.T.&T.'s Treasury Department and Bell Telephone Laboratories for the implementation of BIS, etc.; providing computation support for Marketing (Long Lines Department large customers, etc.); providing a computation support for combined Laboratories-Engineering-developed programs; and providing training facilities, as required, in the techniques of analysis.

### Background For Testimony

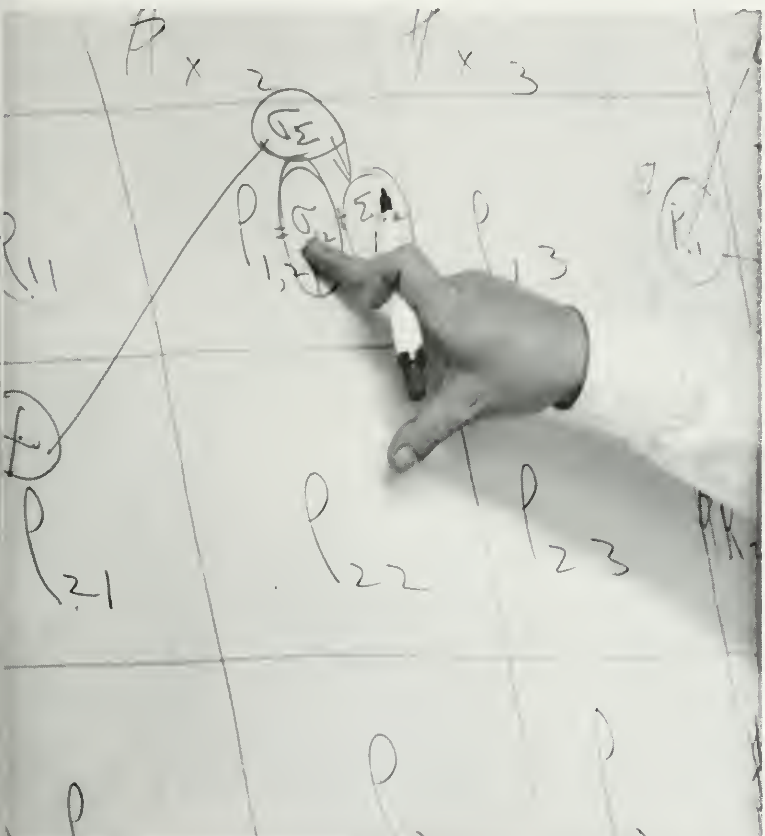
The primary mission of the analytical support center, since its organization in October, 1965, has been that of providing material in support of testimony given by A.T.&T. people and outside consultants before the FCC during the opening of phase one of the Interstate Rate Inquiry. One task, for example, has been an examination of the overall demand and market for Bell System services. As described in a presentation prepared for A.T.&T. management, the task would be approached in these logical steps:

- Search and assemble for review relevant statistical sources to be used in developing demands and growth analysis of communications.
- Request all elasticity and demand studies made in the past by the Associated Companies.
- Examine study of customer opinion of flat rate and measured service made by the Business Research Division.
- Examine specific factors to formulate mathematical models to explain customer behavior.
- Assemble entry and exit tests for

types of services and equipment offerings; this relates to interconnection and interface problems.

- Study existing and potential competition.
- Analyze the effects of removing distance factor rates.
- Analyze the effects of providing fully-measured service.

This example is given simply to indicate the kind of fundamental thinking which is typical of the analytical support function. Details of the analysis and structuring of models to fulfill the assignment are technically beyond the scope of this article; some visible evidence of the



*An arithmetic econometrics model used in a meeting to plan a program for computer analysis, which in turn will be used to support figures on rate structures in testimony before FCC.*

techniques involved may be gained from the accompanying illustrations.

### Spectrum of Purposes

Although much of the initial effort of the analytical support center has been committed to material for the FCC Inquiry, the ultimate purpose of the center is broader and far more general than that. An interrelated set of economic models is being developed which can describe the major sections of the Bell System and all of the relevant interactions between them, and which, when used with a sound data base, can serve as a major support for corporate decision-makers and for other purposes. The basic model units in such a project would include these:

*Engineering:* Plant facilities, including capitalization; construction program; operating expenses; research and development and current engineering; and competitors' facilities.

*Service offerings:* Government services; standard offerings by categories, i.e., business, residence, horizontal, vertical, etc.; new existing services and proposed and possible services; and competitive non-Bell services.

*Rates:* Structures; levels; rate element unit charges; and competitors' rate policies.

*Economics:* Demand determinants; money supply; utility of service; and market characteristics.

*External forces:* Time pressures; economic climate; and regulatory, social and political environment.

Spelled out, even in capsule form, that is a mission of staggering size. But it is under way, and the organization exists to acquire, process and use an adequate statistical data base to define and exploit these economic models for management decision-makers.

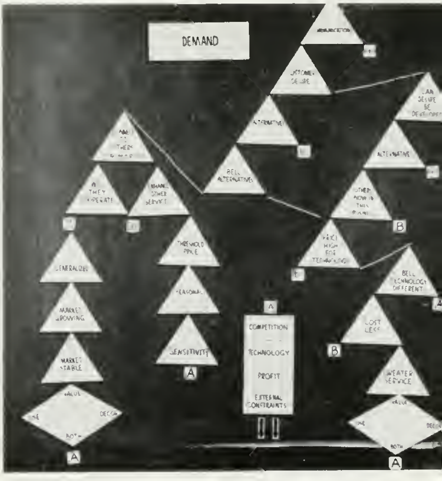
One graphic tool in frequent use in the analytical support function is the *decision tree.* This extremely flexible device consists of triangles, rectangles and diamonds equipped with magnetic tabs and labeled with questions and assumptions. Construction of a tree starts at the top and proceeds in logical order downward. It makes explicit all major factors contributing to a decision and forces appropriate consideration of them by requiring a connected chain of "yes" and "no" answers. Specifically, the advantages of a decision tree can be summarized as follows:

- It forces a clear problem statement and shows where information is missing or whether studies are needed.

- It forces a complete logical description of the problem.

- It completely defines, at an overall level, decisions to be implemented.

- It permits development and orderly




*(Left) Dr. Zajac, foreground, uses computer program he wrote to help Merle Conley reconstruct decision tree as Peter Rosoff listens. At right is completed decision tree.*

presentation of systems too complex for effective discussion by ordinary means.

- It is a superior form of documentation for communication among—for example—economists, technologists, marketers and rate people.

- It is easy to update and revise and shows clearly the effects changes will make upon the decision logic.

- It permits problem definition and description without imposing a premature sequence of problem-solving operations.

- It is a technique that is easily learned.

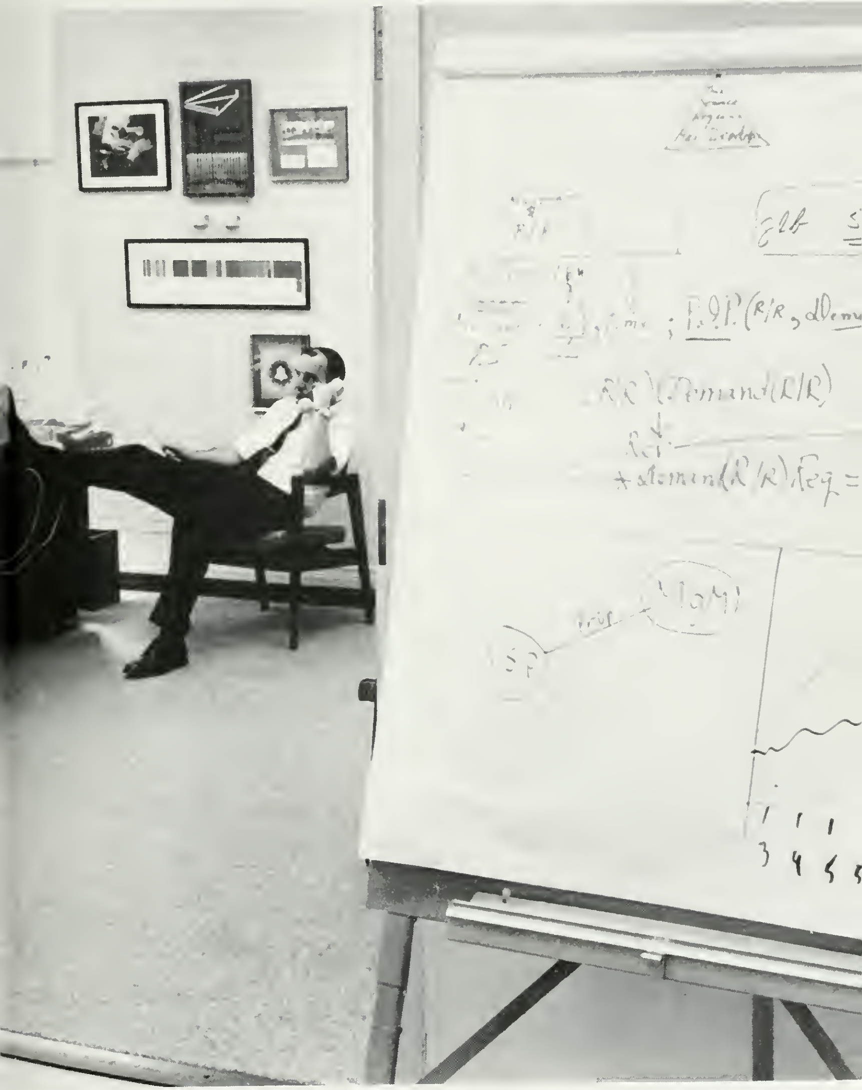
- Because of its chain of "yes-no" answers, it is suitable for direct translation into machine language where mechanization is desired by administrators.

### We Are Not Alone

From what has been said, it is clear that application of such sophisticated techniques as those described is relatively new in the Bell System. We are by no means alone, however, in using these techniques. The analytical support concept is becoming fairly widespread throughout private industry in this country. General Electric, for example, has a successful corporate-level analytical studies activity. Xerox is actively building what they call a "computerized corporate model." Most auto manufacturers have analytical study groups dispersed throughout their operational divisions; Ford is currently enlarging its analysis staff. Some of the major airlines have analysis groups studying such things as the interaction between air travel and rates. Certain food, chemical and petroleum companies have successfully used analytic techniques to solve corporate problems. And the considerable increase in the recruiting of skilled people to work in these areas indicates an upsurge of interest generally in corporate analytical studies.

In Government, too, there is currently a large, across-the-board trend toward analytical studies. The Bureau of the Budget has been asked to allocate "funds as required" for this purpose. The Department of Defense has been very successful with its major cost analysis and reduction program, which is based on several analytical models. As an indirect result, the Brooks Bill, passed in 1965, assigned to the National Bureau of Standards the technical "overview" responsibility for quantative analysis, computation, data processing and systems engineering in all government agencies. A Federal Data Center is being organized. And many Federal agencies are setting up analytical studies, including an interesting one in which the Interstate Commerce Commission is attempting to apply the techniques of automation to rate-making functions.

Obviously, the amalgam of sophisticated technical skills with management experience and competence is neither entirely new nor exclusively the property of the Bell System. Wherever it is found, however, it is symptomatic of new needs in management decision-making and of new means to meet these needs. That it has concrete, useful applications is clearly beyond question. Its usefulness, however, must always be qualified by one of the vital intangibles in any business enterprise: the judgment of management based on experience, which is a human faculty partaking of elements which cannot be precisely expressed in figures of any kind. A decision rests where it must: with administrative heads of the enterprise. The analytical support center gives management one means of estimating what would be the consequences of a certain course of action before committing men, money and time to its execution. It helps the manager to see what would happen—*if*.



*One of many large pads covered with mathematical shorthand stands outside the office of Harvey J. McMains, who heads A.T.&T.'s analytical support center at 150 William St.*

*With the help of ISC, the Bell System salesman can offer a customer one-order service on a controlled-installation-date basis.*

**A new, more efficient way to give business customers complete, coordinated service**

# ISC

ISC—just one more set of initials? Perhaps. But one with the promise of much better service to telephone customers. The letters stand for "Intercompany Services Coordination"—a plan that provides another step in improved service for business customers who need out of state or out of town service.

And what does ISC do to provide that step? It makes it possible for the Bell System to give its customers one-order service—uniform, dependable and on a controlled-installation-date basis, whether it be between two points or involve a complex multi-point network.

Progress itself—especially in communications—has made this kind of service increasingly difficult in the last ten years. In the past, telephone services were relatively simple. Today, the services we can provide are tremendously expanded—data and private line services, WATS—and they have grown in their complexity and requirements. We are being asked to look ahead, to provide and coordinate services and equipment which were in the realm of dreams just a few years ago. Furthermore, in this day of geographically dispersed markets, we face an increasing demand by businesses, both large and small, for greatly expanded nationwide services involving highly sophisticated equipment needs—both for communications and customer-owned equipment. Indeed, not only are we facing an increase in demand for the number of such services, but the rate of increase is growing as well.

Meeting this demand requires a new and better plan for coordinating Bell System inter-company and inter-area services; it necessitates complete coordination and uniform understanding in all company and departmental procedures. The crux of the problem is not capability: it is coordination. Clearly we need to operate as a perfectly integrated team.

## All Speak The Same Language

Developing a plan to meet this goal was, in this increasingly complex business, not easy; it took almost four years of planning and development. It is designed so that all parts of the Bell System—and independent telephone companies—are speaking the same language, so that there is uniform policy and practice. Essentially, ISC defines what everybody affected should be doing at all times; it provides a clearing house of authority which can direct and control orders and assign specific accountability. It coordinates the implementation of all inter-company or inter-area Private Line

Services (including Long Lines) and Special Exchange Services (those which use the Direct Distance Dialing network, such as TWX, WATS and DATA-PHONE service). It gives the customer complete, coordinated service to any place outside his own local area—within or across state borders, across the United States, even to Canada and Hawaii.

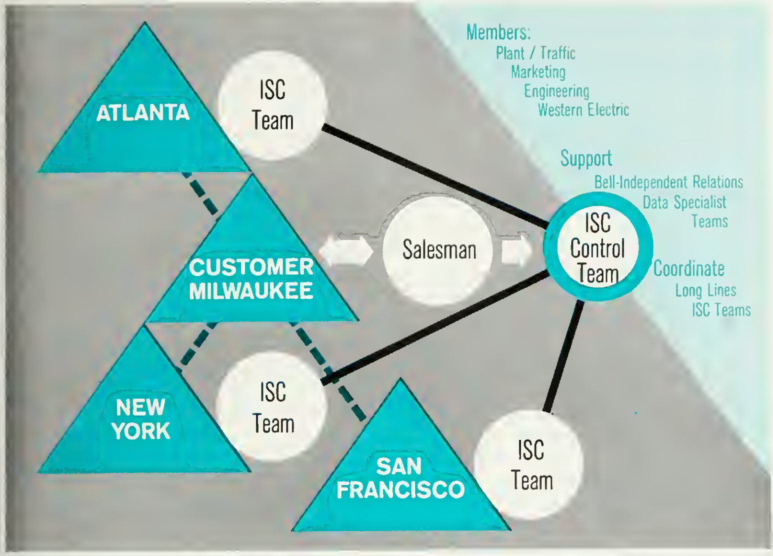
ISC is flexible enough to be adaptable to all manner of different services and projects, to all departments in all companies and areas and, with minimum modifications, to electronic data processing methods. It makes it possible to meet customer service dates and schedules by means of the fast exchange of standard instructions and specifications on any job. In sum, ISC makes it possible for 22 Bell Operating Companies, Western Electric, Long Lines and the independent telephone companies to give the unified, coordinated total communications service that a customer wants and needs.

And just how does ISC do this? Basically it is a team plan, with interacting layers of interdepartmental teams, each with specific responsibilities. The key operational teams are the Area ISC Teams, assigned to each Operating Area of each Associated Company and to each Long Lines Department Sales Office. The Area ISC Teams are composed of representatives of the Marketing, Engineering, Plant and Traffic Departments and Western Electric; they function as professional coordinators—the designated contacts for the interexchange of information regarding intercompany services —and are responsible for all intercompany services in their area. The Area Teams are backed up by interdepartmental Data Specialist Teams which stand ready to furnish advice and assistance on specific requirements and problems. Behind these teams are the interdepartmental Administrative Teams which act in a staff capacity to maintain and administer the plan on a uniform basis; these teams review problems monthly and act as coordinators with the "Working Committee" at AT&T. Finally, there is an AT&T Steering Committee which monitors the ISC plan, measures its effectiveness and recommends any modifications that might be desirable.

### How It Works

Although this might sound complicated, the plan is essentially quite simple. It is all summed up in one word—coordination. For example, a telephone company salesman in Milwaukee sells one of his customers a data system with terminals in Milwaukee, Atlanta, New York and San Francisco. This salesman then prepares a work sheet listing the details of the customer's requirements. The work sheet goes to the Wisconsin ISC team which then becomes the control team for this particular project.

This team, as noted before, is made up of representatives of Western Electric and of the Plant, Traffic, Enginering and Marketing Departments—and each has a definite function. For instance, the ISC Engineering representative is responsible for the overall design and equipment; the W.E. member provides information on equipment availability and delivery; the Plant representative needs to furnish information on installation, testing and maintenance and then schedule plant test dates; the Traffic member must help develop and design such information as when and how the customer's employees will be trained to handle the new service and determine how long this will take. The ISC Marketing representative, as liaison for the salesman and the customer, is chairman of the team and is responsible for preparing, distributing and maintaining status information on the System Service Order—a uniform and controlled document which furnishes all the information the teams need to establish a service. At this point, a service due date is set. This




*Milwaukee customer wanting data system with terminals in Milwaukee, Atlanta, New York and San Francisco is assured of coordinated action on his order through ISC plan. Wisconsin ISC team controls the order and coordinates the work of ISC teams in other areas involved.*

coordinated information is also available to the salesman and, through him, to the customer.

The Wisconsin ISC team, the control team, now sends a copy of this System Service Order to the ISC teams in the other companies or areas involved; in this case Atlanta, New York and San Francisco. These other teams become the non-control teams in the project and must send an acknowledgement of the order to the control team, an additional check for control and accountability. When they receive the order, they check it, adapt it to their own internal service order procedures and proceed with the project. If necessary, their Data Specialist Teams are on tap to provide them with any special information and assistance they might need.

This plan also provides for such contingencies as a due date in jeopardy or one part of the project going off schedule. For instance, if a problem develops for one of the non-control teams (a delay in equipment delivery, for example), they must send a report to the ISC control team. The control team notifies the salesman who can then relay this knowledge to the customer, with up-to-date information as to the problems and the new date the entire system will be operational.

The end result: coordinated one-order, controlled-installation-date service, with accountability for all aspects of the project. This is as it should be. The customer wants uniform service for all his locations, and we must provide the complete package. We must coordinate—for the sake of our customers and to achieve our own high standards of performance.

And that is just what ISC is designed to do.

# CHRONOLOGY

APRIL 1

## A.T.&T. filed written testimony on operating results and rate base

Bell Exhibit 1—Knut Sandbeck, general accountant, A.T.&T., points out that earnings ratio based on net operating earnings and average net investment as recorded for interstate and foreign operations for the year 1965 was 7.78%. However, when adjustments are made for all known changes (as required by the Commission's order of December 2)—such as the new Denver Plan for separations, the $100,000,000 rate reduction, bargained-for wage increases and others—a figure of 6.90% results. That is what the earnings ratio would have been had all such changes been in effect throughout 1965. He qualifies this, noting that it is not intended to imply that this represents actual conditions for any given period or that it should be regarded as a "going basis" for the future.

Bell Exhibit 2—A. Max Walker, general accountant, A.T.&T., presents an analysis, with adjustments, of investment statement of Bell System Interstate and Foreign services.

Bell Exhibit 3—Robert F. Wentworth, special accountant, A.T.&T., describes the computation of Cash Working Capital needed in the provision of interstate communications services. In measuring the Cash Working Capital element of the rate base, he presents the interstate portion of actual Cash, Working Funds and Temporary Cash Investments. In addition he describes lag studies made as a second component in the measurement of Cash Working Capital, the purpose of such studies being to measure operating costs, including taxes, paid in advance or in arrears of the receipt of revenues from customers. The combination of the actual cash amounts and the results of the lag studies determines the amount of Cash Working Capital.

Bell Exhibit 4—Donald A. Dobbie, general accountant, A.T.&T., describes allocation to Interstate of the cost to the General Departments of furnishing services to the Bell System operating telephone companies and to the Long Lines Department, the investment required and the incidental revenues from such investment.

Bell Exhibit 5—Dr. G. L. Bach (then) Maurice Faulk professor of Economics and Social Science, Carnegie Institute of Technology, (now) Frank E. Buck professor of Economics and Public Policy, Stanford University, presents evidence that inflation has been a persistent problem over the last quarter century or more and is likely to continue. He examines impact of inflation on different sectors of the economy, especially business corporations. He points up how the non-regulated business corporations have managed to protect themselves against inflation and concludes that inflation should be taken into account in designing an effective and equitable regulatory policy for public utilities.

**Bell Exhibit 6**—Dr. George Terborgh, research director, Machinery and Allied Products Institute, deals with the effect of changing price levels on the reckoning of depreciation expense and presents the broad theoretical or philosophical aspects of underdepreciation. He observes that current-dollar depreciation is valid for regulated industry where the problem is greater due to generally longer lives of its fixed assets and higher depreciation expense per dollar of revenue.

**Bell Exhibit 7**—Richard W. Walker, partner, Arthur Anderson & Co., presents a statement on interpretation and application of accounting records of cost in a regulatory proceeding in the light of the steady erosion of purchasing power of the dollar over the last 30 years, addressed solely to cost principles of utility ratemaking. He concludes "indexes as to purchasing power of the dollar are now well proven and objective and should be incorporated into the process of rate regulation on a cost basis. Rate regulation using original cost expressed in current dollars and related depreciation amounts provides an equitable, efficient basis for balancing consumer and investor interest; historical original cost no longer serves this function because of long-term changes in the purchasing power of the dollar."

**Bell Exhibit 8**—Dr. Arthur R. Tebbutt, professor of Statistics, Northwestern University, gives specific evidence of upward price movement as seen in an examination of price indexes; all price indexes indicate a sharp upward movement from the end of World War II. He examines three in particular—Implicit Price Index, Consumer Price Index, Telephone Price Index—which can be used to translate historical original cost of plant investment into 1965 dollars. He then examines the process of statistical deflation by which this is done.

**Bell Exhibit 9**—John I. Boggs, cost engineer, A.T.&T., presents and explains calculations made to translate original cost of telephone plant into current dollars which may be related to current revenues and expenses to obtain a more consistant measurement of the ratio of net operating earnings to net investment. He notes that this ratio is significantly higher when calculated on historical dollars than when calculated from an economic point of view adjusting for changes in the dollar's purchasing power.

MAY 2

## A.T.&T. direct written testimony filed on general economic principles and rate of return; final notification to F.C.C. by A.T.&T. of names and topics of all its phase one witnesses

**Bell Exhibit 10**—Dr. Paul W. McCracken, Edmund Erza Day University Professorship of Business Administration, Graduate School of Business Administration, University of Michigan and former member of the President's Council of Economic Advisors, emphasizes that our nation now has a statutory declaration on national economic policy that commits us to use all our programs to attain maximum employment, production and purchasing power. He points out that our economy must grow at an exceptionally rapid rate in the coming years if jobs are to be created to absorb our fast-growing labor force and if living standards are to continue their rapid rise. He emphasizes that the dynamic processes through which our economy achieves progress are to hold out the lure of high rewards to those who lead and impose profit penalties on those who lag behind. He sums up that a careful appraisal of the emerging economic environment leads to the inescapable conclusion that the zone of reasonable profits for the Bell System will need to be somewhat higher than during the last decade, and the rate of growth which the nation will need suggests earnings in the upper end of this zone.

**Bell Exhibit 11**—F. J. McDiarmid, manager, Securities Department, Lincoln National Life Insurance Company, reflects the professional investor's opinion in pointing out that A.T.&T. needs earnings on equity comparable to those of other companies with heavy capital requirements and similar growth characteristics. He emphasizes that A.T.&T. must compete for capital against all other well-regarded companies and that its earnings must be comparable to attract funds over the long run and thus provide service. He also notes the growing elements of competition and risk and the non-essential A.T.&T. services which indicate that A.T.&T. should not be forced into higher debt levels.

Bell Exhibit 12—Charles W. Buek, president, United States Trust Company of New York, discusses factors a professional investment manager considers in deciding whether to buy and hold A.T.&T. common stock in investment portfolios he supervises. He makes the point that earnings growth has become a much more important factor in investor's evaluation of stock in recent years than dividends and that the best way to maximize dividend yield over the long run is to invest in companies with growing earning power. He notes that the risks on A.T.&T. stock are broadly comparable to those of other common stocks and that A.T.&T. competes with all other possible investments in its quest for capital. He points out that if A.T.&T.'s rate of return is lowered in the future, earnings growth will be retarded and the common stock cannot be expected to do well; professional investment managers would be deeply concerned if this were to happen, because of their clients' interests in the stock and because of the important role A.T.&T. plays in the well-being of the economy.

Bell Exhibit 13—Gustave Lehman Levy, general partner, Goldman, Sachs, & Co., reviews A.T.&T.'s efforts to raise capital in the face of inadequate earnings during the early postwar period and points out that A.T.&T. would encounter similar or greater problems in today's market should current earnings decline. He notes that unless A.T.&T. promises expectation of continuing growth comparable to that of other businesses, investors' money will go elsewhere and that if the rate of return were to retreat to uncompetitive levels the supply of capital would be shut off.

MAY 23

## Filing of further A.T.&T. direct testimony on general economic conditions and rate of return

Bell Exhibit 14—John H. Moller, senior vice president and member of Executive Committee and Board of Directors, Merrill, Lynch, Pierce, Fenner & Smith, presents the small investor's viewpoint on common stocks in general and A.T.&T. in particular. He points out that the individual investors generally expect to obtain from an investment in A.T.&T. stock a measure of dividend return and price appreciation reasonably close to those they obtain from other investments. He thus concludes that A.T.&T. must have earnings on its equity reasonably like those of other corporations if it is to maintain a competitive position for financing the future growth of its service to the public.

**Bell Exhibit 15**—Adrian M. Massie, former executive vice president and chairman of the board, New York Trust Company and former chairman and now a member of the Trust Committee of Chemical Bank New York Trust Company, reviews the impact of postwar changes in the national economy on the capital and investment markets and particularly on A.T.&T. stock and its earnings requirements. He emphasizes that institutional investors, a growing factor in the investment market, concentrate more and more on earnings trends and price performance of stocks, that A.T.&T. earnings through much of the postwar period have not kept pace with those of competing investments (a fact that is becoming more obvious because of the concentrated studies of earnings and price performance of various stocks), and that if A.T.&T. is to attract equity capital from institutional sources in the future somewhat better earnings on equity will be essential.

**Bell Exhibit 16**—Robert R. Nathan, president, Robert R. Nathan Associates, documents the view that the nation and its requirements for communications services will be growing at a much more rapid pace during the next decade. He says it is the unique nature of public utility industries that their growth and development not only are linked to the economy—but must precede it. In today's growth economy they must lead in extension and technological intensification; they must anticipate demands and there are substantial risks associated with this lead position, including heavy advance capital outlays. He stresses that the F.C.C. has the responsibility to carry out its regulatory mandate, but simultaneously to permit a framework of incentives and rewards for the Bell System so that regulation does not dull the motivation for performance. He analyzes how in the perspective of public policy for a full employment economy, the problem of regulation is a matter of arriving at a "full employment rate structure" and a "full employment rate of return." He also emphasizes that the Bell System has made outstanding contributions to the national economy and in terms of innovation and quality of service. He concludes that the needed rate of return cannot likely be less than that of the recent past and may have to be higher.

**MAY 26**

## A.T.&T. filed additional written testimony on rate of return

**Bell Exhibit 17**—Dr. Walter A. Morton, professor of Economics, University of Wisconsin, analyzes A.T.&T. earnings requirements in detail in determining a fair rate of return. He also analyzes the standards of a fair return from both an economic and a legal standpoint, finding a "compelling similarity." He says that, in economic terms, the fair return to any company is what its assets could earn if employed in other enterprises of corresponding risk and hazards. The cost of capital to A.T.&T. is therefore an "opportunity cost;" it is measured by returns in other uses. He also points out that in a period of inflation a stable nominal dividend is a declining real dividend; he attributes A.T.&T.'s failure to move with the market largely to regulatory lag, a hazard of regulation in an increasing cost industry during a period of inflation. On the composition of a fair rate of return he says it is composed of pure interest (time value of money) plus compensation for risk and uncertainty. Based on his detailed analysis, he concludes that the fair rate of return on A.T.&T. equity is 10% on an original cost net investment rate base, with fluctuations in the return of about one-half a percentage point up or down as the zone of reasonableness. He further concludes that the overall fair rate of return to A.T.&T. is 8%, which he conceives to be a target rate around which the actual rate may fluctuate about a half a point in either direction. This figure is derived by using a cost of 3.95% for the debt component of total capitalization of one-third totaling 1.3% and a rate of 10% for the equity component of two-thirds of total capitalization, totaling 6.7%. The two combined equal 8%.

**Bell Exhibit 18**—Dr. I. Friend, professor of Economics and Finance, University of Pennsylvania, presents evidence to determine the expected return on the market price of A.T.&T. stock required to induce investors to purchase it. He estimates this "cost of equity capital" to be between 8.0% and 9.0%. However, he points out that although the cost of capital is obviously a relevant consideration in arriving at a fair return, it cannot be applied directly to book investment. He also points out that in his opinion "a comparable earnings standard is more relevant than the cost of capital to the determination of a fair rate of return for regulated industries . . . ."

**Bell Exhibit 19**—Albert J. Bergfeld, president, Case and Company, discusses operating risks of the Bell System, electric utilities and the non-regulated manufacturing industry. It would appear, he concludes, that electric utilities generally show lower operating risks than the Bell System. Manufacturing, on the other hand, shows mixed tendencies, with high and low risk indications, so that no clear-cut conclusion is possible that manufacturing faces higher or lower operating risks than the Bell System. Both manufacturing and the Bell System face very sizable, though different, operating risks.

**Bell Exhibit 20**—John J. Scanlon, vice president and treasurer, A.T.&T., stresses several points: in the interests of customers, employees and shareowners, Bell System earnings should be reasonably comparable with those available on alternative investment opportunities; the Bell System is not seeking a general increase in its rates to improve earnings; it aims to improve earnings through increased operating efficiencies. He emphasizes that the comparable earnings approach recognizes the realities of the capital market and the variety of investment opportunities offered there, and that the fair rate of return for a regulated business should be a range, "a zone of reasonable earnings," within which it might be allowed to operate without regulatory intervention. He concludes that the Bell System under today's conditions should be allowed to earn in a range of 7½% to 8½% on its total capital. However, he notes, this has been conservatively determined and, in the light of forces prospectively operative, a somewhat higher range may well be required to assure the continued investor support required to finance the substantial growth which appears likely in the years ahead. He also provides statistics to show that the range of 7½% to 8½% is just sufficient to restore the Bell System's long term earnings relationships with unregulated industries and that 8½% would be required to restore a relationship to the 50 largest manufacturing companies generally similar to that obtaining in prewar years.

MAY 31

## Filing of A.T.&T. direct testimony on overall Bell System policy, economic changes and ratemaking principles, and supplemental testimony on operating results

Bell Exhibit 1A—Knut Sandbeck, general accountant, A.T.&T., gives supplemental testimony, furnished at the request of the F.C.C., showing that the earnings ratio, based on net operating earnings and average net investment as recorded for interstate and foreign operations for the period November, 1965 through April, 1966 was 7.74% on an annualized basis, and that when the results for this period are adjusted for known changes in wage levels, taxes and other factors affecting the period, the earnings ratio on an annualized basis becomes 7.78%—a figure believed to be reasonably representative of the Bell System "going level" of earnings.

Bell Exhibit 21—W. O. Baker, vice president for research, Bell Telephone Laboratories, emphasizes that the long-run benefits to the public of Bell System research and development can be realized only through the dedication of substantial resources. The necessarily quick and decisive commitment of funds entails unavoidable risk, which regulation must take into account. He makes the point that the Bell System's constant research and development efforts have provided a reliable and sophisticated communications network and have benefitted other industries. He stresses that, in order to meet future communications needs, the Bell System must maintain its business vitality and make the latest technology available to its customers. He says that to bring the benefits of new technology to meet the customers' needs requires the commitments of large amounts of capital, and that "the benefits which new technology promises to society are great enough to justify devoting sufficient resources to the task."

**Bell Exhibit 22**—Alexander Sachs, economic consultant to a number of industrial, insurance and investment companies and formerly consultant to the Roosevelt administration, underscores fundamental economic and political changes: the national concern with economic growth and welfare in the postwar period; the support for our advanced industrial economy coming from technological progress; and the great growth and increased professionalism in the community of investors. He points out that these changes require new attitudes by regulatory bodies to permit regulated industries to fulfill their mission in our growth economy and society, that the Bell System has made outstanding contributions to economic growth and must make further progress, and that flexibility in outlook and a broader viewpoint are needed in regulation.

**Bell Exhibit 23**—Gordon N. Thayer, vice president-planning, A.T.&T., emphasizes several points, among them that the objectives of the Bell System's rate structure are to achieve its overall revenue requirement, to meet customer needs, to promote greater use of its service and to encourage more efficient use of its plant. He stresses that there are a number of significant ratemaking principles and factors, of which cost is only one, which must be considered in setting or evaluating rates. He points out that the Bell System intends that the revenues from each service cover the full additional costs incurred in furnishing that service, including return on the related investment, and in addition make a contribution to coverage of common costs. By designing rates so that each category of service, other than message toll telephone service (and WATS), makes as large a contribution as feasible to the overall interstate earnings requirement of the business, it is possible to have lower rates for the basic message toll service. He emphasizes that, in considering costs as one of the appropriate factors in determining rates for particular services, the relevant costs are the "additional" costs for which that service is responsible. And he stresses that experience and judgement play a major part in the development and design of rates; the ratemaking function cannot possibly be reduced to the use of some mathematical formula —flexibility is required. (He also presents proposals for revised rates for private line telegraph service, to be effective at the close of phase one and subject to intervening events.)

**Bell Exhibit 24**—Albert M. Froggatt, vice president, A.T.&T., reviews various problems involved in the determination of costs for the several categories of interstate service and describes the general principles and concepts being followed in analyzing the costs for the purposes of the F.C.C. investigation. He stresses two points in particular: a full allocation of embedded costs such as was made in the seven-way cost study does not provide the proper basis on which to appraise the interstate rate structure; the cost information needed to appraise or determine rates for a particular service category should be based primarily on costs currently and prospectively attributable to the furnishing of the particular service category.

**Bell Exhibit 25**—Dr. James C. Bonbright, professor emeritus of Finance in the Graduate Business School, Columbia University, discusses the role of costs in the determination of reasonable public utility rates. He stresses that the costs of greatest significance in the determination of rates for specific services are incremental costs—not fully distributed total costs. He says total cost distributions are arbitrary, in that they assign to specific classes of services common or joint costs that cannot be allocated on a cost responsibility basis. He concludes that "it would be little short of a catastrophe for the cause of the sound development of telecommunications in this country if a persistent and unyielding attempt were made to impose upon the Bell System an obligation to bring the revenues from each of its major classes of service into alignment with costs imputed to each class by any kind of a total-cost allocation."

**Bell Exhibit 26**—Dr. William J. Baumol, professor of Economics, Princeton University, directs his testimony to the fundamental principles involved in determining appropriate rate levels for the major classes of Bell System services. He stresses that market demand must be considered along with costs in setting rates, that it is the costs directly incurred in the provision of a service which are pertinent for the determination of its price, and that there is general agreement among economists concerning this role of cost in pricing. He points out that, while total costs must be recovered by a business, any attempt to divide all the costs among the different services must necessarily be arbitrary and can lead to pricing decisions harmful to the firm and to consumers. He also points out that arbitrary measures are implicit in the seven-way cost study. He concludes that no cost criterion, particularly fully allocated cost, can indicate by itself whether a given pricing proposal is in the public interest, and above all there is the danger, as with any price support device, that fully allocated cost pricing will prove inimical to the interests of consumers.

**Bell Exhibit 27**—Charles H. Frazier, independent public utility consultant associated with National Economic Research Associates, Inc., deals with ratemaking developments in the regulated gas and electric industries. These firms attempt to set rates for different customers and service classes that will enable them to meet competition, tap their markets to the maximum degree and reduce the portion of their fixed common costs which would otherwise be borne by core or base load customers. He illustrates how the ratemaking philosophy developed in the gas and electric industries over several decades has been largely responsible for the growth and success of those industries and has enabled them to provide improved service at lower real cost to the user.

Bell Exhibit 28—Dr. Merrill J. Roberts, professor of Transportation and director of the Business Research Center, Graduate School of Business and professor of Economics in the Division of the Social Sciences, University of Pittsburgh, analyzes the role of costs in the regulation of pricing in the surface transportation industry. He shows that the Interstate Commerce Commission has not rigidly adhered to the use of any particular type of cost formula in ratemaking but has been flexible in its sanction of both incremental and fully distributed costs, depending on the situation. He notes that, as an economist, he believes that it is a mistake to rely on fully distributed measures to identify the low cost carrier and to establish rate floors, and he quotes from The Economic Report of the President, January 1966, to show that his view is shared by the President's Council of Economic Advisors in their evaluation of surface transportation regulatory policy.

Bell Exhibit 29—Dr. Franz B. Wolf, vice president, Robert R. Nathan Associates, Inc., deals with air transport pricing practices and rate regulation principles as well as with the general economic structure and dynamics of the air transport industry. After pointing out the specific characteristics which make the air transport industry different from many regulated industries, he proceeds to show how the Civil Aeronautics Board has, nevertheless, acknowledged the public interest and the interest of the carriers in attaining fuller employment of available capacity and more rapid expansion of the market by offering service at rates above added cost though below fully allocated cost. He also points out that the Board has frequently expressed a view closely similar to that prevailing among economists: that sale of an additional output of a product or service at value-of-service price above incremental cost is desirable, regardless of fully allocated cost.

Bell Exhibit 30—Albert J. Bergfeld, president, Case and Company, notes that in his experience in the consulting profession he has observed a clearly discernable trend among industrial business enterprises toward placing greater reliance upon the use of incremental cost principles in analyzing the profit consequences of management decisions including pricing. He says that the management of such firms has generally concluded that historical costs are irrelevant in decisions such as pricing that involve future events, and that they have recognized a need for a system of costs that is predictive and that truly reflects the behavior of cost, revenue and profit as demand and price vary. He reports on a survey of leading businesses made by his firm which documents this trend and adds that the experience of his firm's practice since this survey also confirms this view.

**Bell Exhibit 31**—Ben S. Gilmer, executive vice president, A.T.&T., provides the backdrop for all Bell System testimony by dealing with the System's fundamental objective of service to the public. He stresses that the System's responsibilities to employees and shareowners, basic organizational structure, and policies of research and development, marketing and pricing all support the fundamental service objective. This service objective is also the basis for the position the Bell System takes on the issues in the investigation, he emphasizes. He states: "We do not look to regulation to protect us from risk or assure our earnings for us. We have worked to improve our earnings level and intend to keep on doing so. All we ask is the continued incentive that derives from the opportunity to share in the benefits of our own initiatives." He underscores that innovation depends on the aims of people and organizations and on the freedom and incentive to pursue those aims, and that good earnings are essential if Bell System innovation is to continue to serve the public interest in the demanding period ahead: "Earnings prospects that encourage a commitment to the future will help assure continued leadership in the technology of common carrier communications."

## JUNE 7

Oral testimony by Bell System witnesses. F. Mark Garlinghouse, vice president, A.T.&T., and attorney for Bell System respondents introduced witnesses after presenting an opening statement outlining the issues as the Bell System sees them in phase one and briefly stating the System's position on them. Witnesses were Ben S. Gilmer, W. O. Baker, Dr. Paul W. McCracken, Charles W. Buek, Robert R. Nathan.

## JUNE 8

Further oral testimony by Bell System witnesses: F. J. McDiarmid, Gustave Lehman Levy, Adrian M. Massie, Dr. I. Friend, Alexander Sachs, Dr. Walter A. Morton.

## JUNE 9

Final oral testimony on overall policy and rate of return; witnesses were John J. Scanlon and John H. Moller.

## JULY 18

Start of cross-examination of Bell System rate of return witnesses; the Commission has stated that it expects it to be completed by mid-August.

*(The following schedule is subject to change.)*

## JULY 29

Bell System to file additional testimony on ratemaking principles and factors.

## SEPT. 15

Testimony of witnesses of all other parties on rate of return to be filed. (Written summaries of any testimony to be presented orally must be filed by this date.)

Bell System to file testimony justifying inclusion in rate base of plant under construction, cash working capital, and materials and supplies.

## SEPT. 23

All other parties to give notification of the names of their witnesses and subject matter of their testimony with respect to any Bell System testimony filed since May 31 (except as to ratemaking principles and factors).

## SEPT. 26

Cross-examination to begin of Bell System witnesses on plant under construction, cash working capital, and materials and supplies, and any other Bell System witnesses who may not have been reached for cross-examination at the hearing beginning July 18 (other than witnesses on ratemaking principles and factors).

## OCT. 10

Cross-examination to begin of witnesses of other parties on rate of return.

## OCT. 17

All other parties to file their testimony on net investment, operating results, and any other issue (except ratemaking principles and factors) in phase one not theretofore dealt with.

## NOV. 7

Cross-examination to begin of witnesses of other parties on evidence submitted as provided above.

(No schedule has yet been set for cross-examination of Bell System witnesses on ratemaking principles and factors or for the filing of testimony of other parties on this subject.)

*Note: Expanded summaries of Bell Exhibits 10 through 31 are available.*

Photographed by weather satellites and sped to meteorologists via specially engineered Bell System facilities, these pictures of world-wide cloud formations are . . .

# taking the 'whether' out of WEATHER

Camera-carrying weather watching satellites are giving the Environmental Science Services Administration (ESSA) an invaluable new tool for weather analysis and forecasting. Since last February, two satellites have made it possible for forecasters to have a complete photographic look once every 24 hours at cloud formations surrounding the earth. The satellites transmit the cloud photographs to tracking stations in Alaska and Virginia. The cloud pictures give weather experts a much faster and much more complete view of the world's weather than they have ever had before.

From the tracking stations, the picture and control signals are sent to ESSA's National Environmental Satellite Center (NESC) in Suitland, Md. for processing and analysis. From Alaska to Suitland, signals are sent over one of the longest microwave systems in the world. To assure clear transmission of the pictures over this great distance, the Bell System completed an overall systems engineering job for ESSA and set up specially engineered terminals at Gilmore Creek, Alaska; Suitland, Maryland and other locations where the signals are transmitted or received. In the continental U.S. the Bell System provides a wideband channel which simultaneously handles Teletype, voice, data and picture signals.

Weather satellite is readied for launching. At Cape Kennedy rockets are controlled by guidance system developed by Bell Laboratories.

750 miles above the earth, a rotating weather satellite photographs cloud formations the world in segments 1,700 miles square using TV-type camera as shown in artist's tion (left); signals representing each picture are later sent to ground tracking in Virginia (center) or Alaska, then fed over the ground communications to meteorologists at the National Environmental Satellite Center in Maryland. ality of transmission is being checked in a Long Lines test room (upper right).

photomosaic was assembled from 450 individual pictures taken by Tiros weather satellite 24-hour period in February, 1965. Brightest features on photographs are clouds which are d at National Environmental Satellite Center to provide world-wide information on weather.

Transmission of weather pictures from space is triggered by technician at Gilmore Creek, Alaska. Signals from the ground turn on tape recorder in weather satellite, which will send signals representing cloud photographs taken during one orbit of earth by satellite.

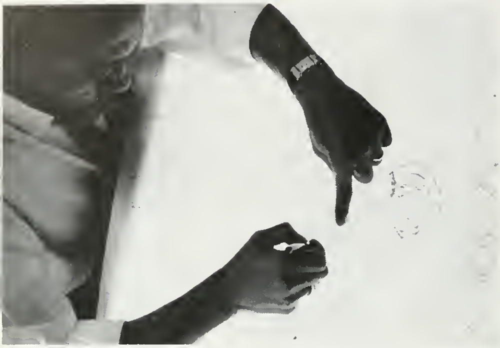
Data received from weather satellites at the tracking station in Alaska is transmitted via one of world's longest microwave systems extending from Gilmore Creek across Canada and continental U. S. to National Environmental Satellite Center, Suitland, Md. Signals are also received at Goddard Space Flight Center, Greenbelt, Md. and at Strategic Air Command Headquarters in Omaha, Neb.

Distribution panel represents demarcation between Bell System transmission facilities and equipment of National Environmental Satellite Center.

At NESC Headquarters in Suitland, Md., microwave signals transmitted over Bell System equipment are reconverted into television-type pictures and photographed. Prints then are pieced together into a mosaic of the world's weather.

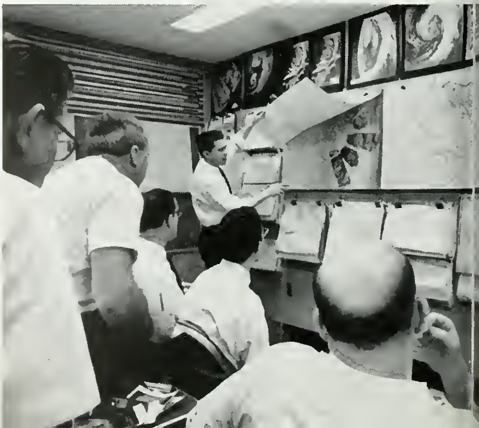

Individual cloud photos are analyzed by weather experts at NESC. From these prints, a cloud map is prepared. The cloud pictures and map are turned over to the Weather Bureau for use by meteorologists in preparing weather maps and forecasts to be sent all over the U. S. by facsimile via Bell System ground lines.

## taking the 'whether' out of WEATHER



A master cloud-map—Nephanalysis—is prepared by weather chartist from information taken from photographs made by weather satellite less than hour earlier. High speed Bell System communications facilitate up-to-the-minute forecasting.

Weather data prepared by interpreting cloud photos snapped by orbiting satellite is distributed on Weather Bureau's facsimile transmission network to all map users.

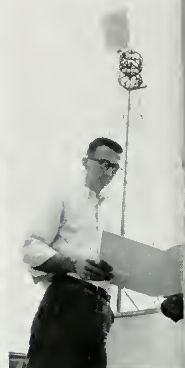


Meteorologists at National Environmental Satellite Center hold daily critique of information on weather maps prepared from cloud photographs taken by the ESSA satellite.

Alfonso Butera of NESC checks out teletypewriter equipment at Suitland, Md., with Donald Posey of Chesapeake and Potomac Tel. Co. Plant. The Bell System's teletypewriter network ties together the various stations of ESSA, ranging from points in Virginia to Alaska.

Enlarged photo of an Indian Ocean storm was made from print on film strip held by Laura Walters of NESC. The film strip was received from satellite of Environmental Science Services Administration. Such film strips are archived for use in future research.

## taking the 'whether' out of WEATHER



Microwave tower located in Suitland is at the eastern terminus of circuits to the satellite tracking stations in Alaska and Virginia.


Paul McGrath, Chesapeake & Potomac Tel. Co. Marketing, discusses the communications system for the Tiros Operational System (TOS) with NESC employee so that he will be able to anticipate future communications requirements.

Henry Kahl, left, Bell Telephone Laboratories' systems engineer for the weather satellite project, and Douglas Pew, Long Lines engineer, make facility tests at Suitland. Both have key roles in the project. Heart of the communications system at TOS Operations Center is the switching system consolette (right). All voice communication is controlled by attendant using pushbutton cordless set tailored to customer's needs.

ırd Hach, A. T. & T. Long Lines sales representative, discusses ce with Robert Laudrille, NESC ground communications rvisor, to be sure facilities meet NESC present and future rements. In foreground is a half-size scale model of the ESSA ıer satellite, which permits working parts to he viewed.

In this central office at Suitland, C. & P. Tel. Co. Plant men are on 24-hour duty to insure continuous quality performance of NESC communications system.


BRAZIL
AT&T
32
COMSAT
USA
GT&E


17
JAMAICA
18
19
NORWAY

**As guests of AT&T, delegates from 24 countries weighed worldwide telecommunications problems amid all the trappings of an international conference**

# CCITT conference

The headquarters of A.T.&T.'s Long Lines Department—which, among other things, handles overseas telephone service—normally has a somewhat international flavor. From April 14 to May 6, however, the main floor took on a greatly heightened global aura as 100 delegates from 24 countries met to discuss international telecommunications problems. They were members of three Study Groups of the International Telegraph and Telephone Consultative Committee (CCITT), one of the permanent organizations of the International Telecommunications Union which, in turn, is the UN specialized agency dealing with telecommunications. The Study Groups to which A.T.&T. was acting as host were considering, successively, the characteristics of signaling and switching systems for communications throughout the world using either cable or satellite circuits; quality of service, signaling requirements and worldwide numbering and routing plans; and coordination of the work of other study groups on questions affecting the worldwide operator dialing and customer dialing networks. The chairman of the last group was Edwin C. Laird, of the Long Lines Department; delegations comprised of representatives from A.T.&T., Long Lines and Bell Telephone Laboratories attended all of the sessions.

The auditorium of the Long Lines building, at left center, was transformed into a meeting room that rather looked as though it belonged in the UN or Geneva, replete with translation booths (providing simultaneous translation into English, French and Russian) and crowded with busy delegates clustered around signs identifying their countries, upper right. A number of U.S. firms, upper left, were also represented. The working documents of the meetings lined the back of the room, lower right, and were frequently changed as different topics came up for discussion. And finally, lower left, as with most such conferences, the delegates took many opportunities to get together for informal and often intent discussion of their problems and questions.

# in the news...

Overseas By Dial

BTL and DNA

NORAD/ADC System

Continuous Copper Rod

Laser Surgery

Transistorized Undersea Cable

Standard Tones

## Direct Dialed Overseas Call

A telephone call between Philadelphia and Geneva on June 15 marked the first time in telecommunications history that a telephone in Europe was dialed directly from a telephone in the United States.

Lowell F. Wingert, vice president of A.T.&T.'s Long Lines Department placed the call to Jean Rouviere, director of the International Telegraph and Telephone Consultative Committee (CCITT) in Switzerland. The call highlighted a talk Mr. Wingert gave before an international conference of the Institute of Electrical and Electronics Engineers (IEEE).

While U.S. telephone subscribers may now dial directly to telephones in Canada, they must go through either an overseas or long distance operator to call other points outside the country.

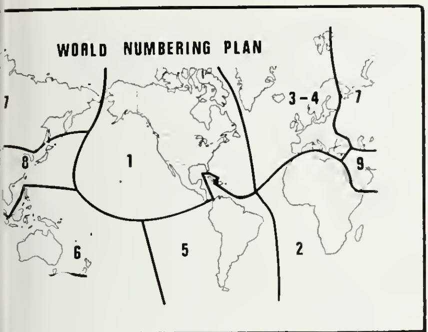
In his remarks at the conference, Mr. Wingert said that the Bell System is planning to talk with overseas telephone administrations regarding the possibility of a limited trial of overseas customer dialing next year between selected central offices in New York and several European cities. He said the timetable calls for introducing the service "on a gradual basis" beginning in 1970.

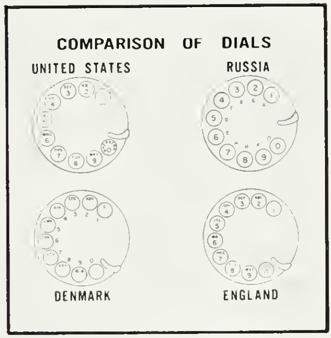
However, Mr. Wingert stressed that its extension to all U.S. telephones will require several years. Modifications requiring "a substantial investment of money" will have to be made in switching and automatic accounting equipment in the country's long distance telephone offices.

Mr. Wingert told how international cooperation—as reflected in the work of the CCITT (see p. 56)—is paving the way for global telephone dialing. He said agreement has been reached on international switching arrangements, techniques for language assistance and a worldwide routing and telephone numbering plan.

The numbering plan divides the world into nine numbering zones and assigns code numbers to countries within each zone. The plan envisions a maximum of 12 digits for a world telephone number plus a special overseas access code.

Conversion of the world's telephone sys-




*To facilitate worldwide dialing, areas of globe have been given numerical designations, as shown at left. At right, a quick look at differences in some telephone dials reveals one compelling reason for conversion of the world's telephone systems to all-number calling.*

tems to all-number calling will be a major step toward global customer dialing, Mr. Wingert said. "One compelling reason for this in the United States is growth because the use of numerals provides far more possible number combinations. But another basic reason is to achieve uniformity among the telephone systems of the world."

Citing differences in equipment, Mr. Wingert said: "In the United States, we use a dial with 24 Roman letters. We would have trouble in calling from Philadelphia to Moscow and dialing an exchange prefix with Cyrillic letters . . . and vice versa. And how would the Danes, who have no 'W' on their dials, manage to call a WAlnut exchange number here?"

Nonetheless, Mr. Wingert said, telephone people of many nations are striving to solve these and other problems. Their efforts are being made against a backdrop of continuing growth in the number of telephones in the world and in the volume of overseas calling.

The world's telephones are expected to increase from 195 million today to 500 million by 1980. Overseas calls to and from the U.S. are expected to grow from eight million in 1965 to 90 million by 1980.

"Looking to the future, we see a constantly expanding need for more and better (com munications) satellites as well as more and better cables and other facilities," Mr. Wingert said.

The demonstration call to Geneva was made—coincidentally—almost 90 years from the day Alexander Graham Bell came to Philadelphia to show his new invention, the telephone, at the 1876 Centennial Exposition.

## Bell Labs Studies DNA Molecule

The molecule which carries genetic information needed to reproduce living creatures—from bacteria to human beings—is the polymer deoxyribonucleic acid (DNA). The efficiency and accuracy with which vast amounts of information are stored in, read out of, and copied by DNA molecules are unmatched and make the most sophisticated computers appear like the crudest toys.

Scientists at Bell Laboratories are engaged in detailed physical and chemical studies of these amazing molecules. They are seeking to learn all they can about how the biological molecules store and transmit information;

*R. G. Shulman (left) and J. Eisinger of Bell Laboratories discuss experiment designed to investigate excited electronic states of DNA. Model of DNA molecule appears at far left.*

such knowledge may one day be useful to engineers trying to improve our man-made communications system.

The DNA molecule uses a "language" made up of a sequential arrangement of four different base compounds. A single "word" in the DNA language consists of three consecutive bases. When one of these base compounds in the molecule is altered or eliminated or inserted, the genetic message is changed and a biological mutation results. This mutation may be inconsequental, beneficial, harmful or lethal to the living cell. It may occur spontaneously, by chemical interaction involving the DNA or by radiation damage to the DNA.

Bell Laboratories scientists have concentrated their studies on the detailed properties of DNA molecules as they exist in the moment after DNA has absorbed radiation and before permanent damage has occurred. As a result of these specialized studies, a new understanding of the electronic properties has been obtained. This research provides a molecular model for early stages of radiation damage in DNA and may contribute to a better understanding of these molecules as they exist under normal conditions in the cell.

## NORAD/ADC Communications

The North American Air Defense Command has over the past few months begun operations in its new hardened Combat Operations Center deep inside Cheyenne Mountain near Colorado Springs, Colorado, culminating in the cutover of a new 4-wire #1 Electronic Switching System on July 1, 1966. The Bell System worked closely with NORAD/ADC for several years in planning and installing a survivable communications system both internal and external to the Cheyenne Mountain Complex (CMC) (see **BTM,** Summer 1965).

The internal communications package, provided by the Mountain States Telephone and Telegraph Company, includes the new 1,000 line 4-wire #1 ESS programed for NORAD/ADC's special operational requirements. In this capacity it will serve as a large dial PBX with full capability of accomplishing a wide variety of switching functions. The ESS automatically recognizes certain (ultimately all) priority NORAD/ADC calls and puts them through regardless of lines in use. It offers preset (hot line) and abbreviated dialing, conference arrangements, Touch-Tone® calling, transfer of calls, and message recording and playback service. Early reports indicate that NORAD/ADC is well pleased with the system and its special features.

The external communications for the complex, provided by the Long Lines Department of A.T.&T., consist of six routes or "spokes" (four hardened cable and two microwave) radiating out from the CMC and connecting to a crescent-shaped communications ring which surrounds three sides of the mountain. The ring, in turn, connects to all the major Bell System communications routes, including the transcontinental hardened cable. Any one "spoke" has the capacity to carry the entire communications requirements.

Bell Telephone Laboratories engineers designed a special matrix switch for automatic switching between spokes if a working spoke fails. They also designed a hardened microwave antenna, with a foundation embedded in the mountain, for each of the two microwave routes. Buildings housing the equipment in the CMC are shock mounted, and the communications systems are designed to survive electromagnetic radiation from a nuclear blast.

## Short Cut Copper Rod

Copper rod—basic to the production of telephone wire—is being formed directly from scrap copper for the first time, in a new continuous process now being used by the Bell System.

The casting and rolling operation eliminates the need to convert molten copper into ingots and to reheat them for subsequent rolling. It will substantially reduce the cost of producing rod.

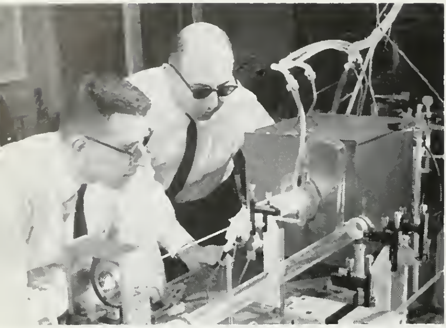
The process is under way at the Nassau Smelting and Refining Company—a subsidiary of Western Electric—which specializes in reclaiming metals from worn-out telephone equipment. When the new process is in full operation it will produce about one-fifth of the Bell System's current requirements for copper rod.

Until now continuous casting and rolling of rod was possible only with metals of relatively low melting temperatures. For more than a year Western Electric engineers have worked to adapt to copper a process developed in Italy that has been successfully used for making aluminum rod.

The process starts in a large gas furnace, where up to 75 tons of copper scrap are melted and refined. When ready, the molten copper is poured in a continuous stream into an electrically heated holding furnace. Then, at a carefully regulated rate, it flows into a grooved molding wheel and is retained by a rotating steel belt. While in the groove, the moving metal is water-cooled until solidified into a continuous red-hot bar about two inches thick.

Leaving the wheel, the copper is carried along a short conveyor and passed through 14 closely-aligned steel rollers. In this rolling mill, the bar is further cooled and drawn into rod about one-quarter inch thick. It runs off the machine and is coiled into large, circular collecting bins. The casting and rolling process is controlled from a console by a single operator.

*Hot copper rod moves around wheel in new continuous casting and rolling operation.*



*Argon laser used in bloodless surgery was developed, above, at Bell Laboratories.*

## Bloodless Surgery By Argon Laser

Doctors at the Laser Laboratory of the University of Cincinnati Medical Center and The Children's Hospital Research Foundation have successfully used a continuously operating argon laser as a "light" knife in performing bloodless surgery on cancerous tumors, and on a tattoo. The type of laser used was developed in the Optical Device Department at Bell Telephone Laboratories.

One of the most promising aspects of laser surgery is the fact that the argon laser cauterizes the wound as it cuts. This prevents loss of blood which can be of serious concern when an operation is performed near vital organs and when there is fear of contamination from diseased growth to surrounding tissue. The argon laser is especially well suited to this new application because of its relatively high continuous power output (up to 4 watts), and because its bluish-green beam is readily absorbed by body tissue.

The director and surgeons from The Children's Hospital Research Foundation Laser Laboratory expressed a need for a technique of positioning the laser beam. The problem was solved by Bell Laboratories scientists who devised a positioning scheme using a gimbal-mounted spherical mirror that allows the focused beam to be moved through a large angular field.

## Transistorized Undersea Cable

Details of a new transistorized undersea telephone cable system that can carry nearly six times as many two-way conversations as any existing submarine cable system have been revealed by Bell Telephone Laboratories. For the first time, transistor amplifiers are used in the repeaters, the devices inserted in the cable at specific intervals to boost the strength of telephone signals. The system has 720 two-way voice channels in a single cable, compared to 128 such circuits in the last previous system.

Existing submarine cable systems use vacuum tube amplifiers to boost signals as they pass through the repeaters. The transistors used in the new system's repeaters offer a number of advantages, including broader frequency bandwidth which permits greater voice-channel capacity and reduced power requirements. They are also expected to enhance an already excellent record of reliability and long life for submarine telephone cable systems. (There have never been any component failures on any of the existing four transatlantic cables.) The special, extremely high reliability transistors used in the new repeaters were developed by Bell Laboratories and manufactured by Western Electric. The repeaters on the new system must be spaced every ten nautical miles instead of every 20 nautical miles as on present systems.

The new cable system can operate over distances up to 4,000 nautical miles and in depths of four nautical miles. Like other recent systems, it will use a coaxial cable. Cable diameter is one-half inch greater than previous systems.

## Single Quartz Wafer Does Eight Components' Work

A single wafer of quartz—a crystalline material used widely in making electronic components for communications systems—is now performing a complex function of frequency selection which previously required eight electronic components.

Developed at Bell Telephone Laboratories, ne new device—a four-tenths of an inch cir- ular wafer of quartz with gold electrodes— an be fabricated for use in many phases of adio, narrow-band FM and voice frequency ransmission. The device is mounted in a eremetically sealed cylinder.

A variety of applications may exist for the ew filter in telephone carrier systems. These pplications would include tone selection, hannel, pilot and carrier supply filters. The rst use of this filter will be as a single requency selector in the Bell System's new 4 Coaxial Cable System, now undergoing eld trials.

## Standard Telephone Tones

Telephone signals for ringing, busy and dial differ slightly in various parts of he Bell System, but standardized signals ave now been devised so that, in the future, elephone users will feel at home with the ounds regardless of where they are located.

Already, a vanguard of these sounds—the oft hum of the Touch-Tone® calling dial one—is being introduced in various parts f the System. All of the new signals will be reated from four pure tones with frequencies etween 350 and 620 cycles per second. Vhen generated in pairs they become the hree basic signals of the telephone central ffice: ringing, busy and dial tone.

Except for dial tone, which is easily dis- inguished from the old one, the paired tones roduce a signal similar to the single modu- ated tone signals now in general use. In ome areas, however, tone differences will be erceptibly greater, depending upon the ex- ent the new tones deviate from the old.

The complete range of new tones was first ntroduced in the electronic central offices t Succasunna, N.J. and Chase, Md.

The new tones make up what is called the 'Precise Tone Plan," the Bell System's blue- rint for standardizing audible telephone ignals. Still in its infancy, the program will e made availabe to the Associated Com- anies over a period of years.

The ringing and tone equipment producing the precision signals were originally designed for electronic systems, but Bell Laboratories and Western Electric are now working on ways to adapt it for electro-mechanical central offices.

## Tenth Anniversary For Visit Program

The Bell System's Share Owner-Management Visit program marked its tenth year of operation this year. Over the last decade it has grown to the point where there are now about 10,000 employees participating, and, across the nation, over half a million share owners have been visited.

The program came into being in order to make A.T.&T. share owners feel more a part of the business.

Although they can go to annual meetings, correspond with A.T.&T., read annual reports and quarterly dividend statements, or attend open houses, the information obtained through these sources is sometimes limited. What is lacking, of course, is the opportunity for full two-way communications. It was to overcome this limitation that the Share Owner-Management Visit program was inaugurated.

Last year about 100,000 share owners were visited by management people in their homes and offices. During the discussions questions about earnings, growth, construction, regulation and the long-term prospects of the business were brought up—and answered as completely as possible.

To help them answer the questions, participants in the program first attend a three to four-day workshop during which they get background about the business and advice on handling share owner visits.

The share owner is not the only one to benefit from the program. The visits help the Bell System learn more about the kind of information share owners want. And the men and women who make the visits benefit because they broaden their own knowledge of the basic issues of the business.

## Electronic Expressway

The highway of tomorrow is just a few minute's drive outside downtown Chicago, where traffic on a six-mile stretch of the heavily traveled Eisenhower Expressway is being electronically controlled.

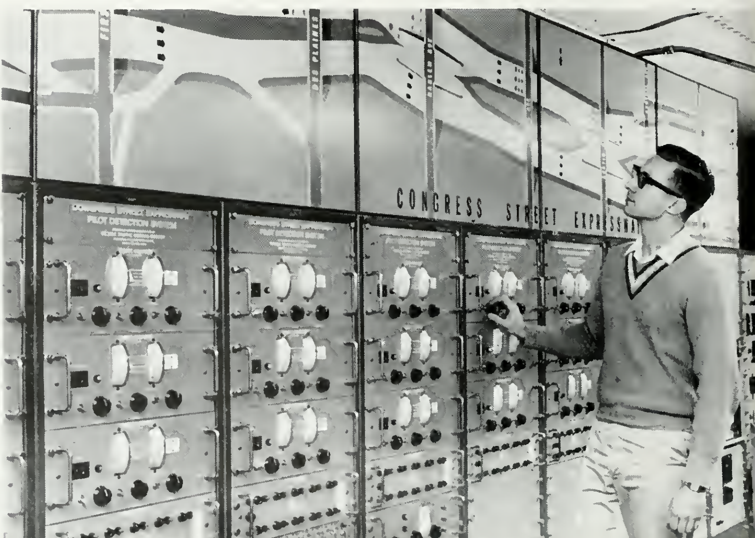
Until recently bumper-to-bumper traffic jams formed on this particular stretch of expressway during the evening rush hour. Now, as a result of electronic controls linked to computers by telephone circuits, rush-hour drivers can drive at a comfortable speed.

This boon to commuters has been created as a "live traffic laboratory" by engineers who are studying the causes of traffic congestion and investigating ways to improve traffic flow. The project is being financed jointly by Federal, State, Cook County and Chicago funds.

The effect of this experimental system on expressway and surface street traffic will hel determine the extent to which traffic conges tion problems can be lessened by electroni controls. By locating critical points and de termining the causes of congestion, the sys tem is also providing valuable informatio for highway planners. In addition, this sys tem may be contributing to a reduced acci dent rate in the experimental section.

The control system consists of traffic de tectors on the expressway and its ramps connected by 35 telephone circuits to analog computers and various recording devices a a central office. The computers process dat from the detectors into traffic volumes speeds and densities for a comprehensive analysis of expressway operations.

The actual control of traffic is accomplished by adjusting entry to the expressway by means of signal lights on the ramps. The signal lights can feed vehicles onto the ex-




*Lights on visual display map and meters on computers, linked by telephone circuits to detectors at different locations along the expressway, indicate current traffic conditions.*

ʼessway at rates varying from four to 12 ehicles per minute. As congestion increases, ıe number of vehicles allowed to enter the ‹pressway each minute is decreased, helpg to maintain free-flowing conditions.

In an additional test, an experimental motorist aid" phone for the reporting of ɔllisions and stalled vehicles was recently ıstalled on one of the expressway's exit amps. By installing the phone on the exit amp, instead of on the expressway itself, roject planners hope to learn whether motor-;ts will stop as they leave the expressway ɔ report someone else's trouble.

## ⁼irst North-South American Jndersea Cable Link

Work has been completed on the first underseas telephone cable link between ɬorth and South America. The cable, capable ıf handling 80 simultaneous telephone con-ʼersations, was put in service in August. It ·xtends 50 nautical miles from St. Thomas in ʼhe Virgin Islands to Maiquetia, Venezuela. At ʒt. Thomas, it is joined to an underseas :able from Florida, completing the North ⁄merican-South American link. Communica-ions between the two continents were for-nerly handled via high frequency radio only. The first call over the new cable was made ɔy President Lyndon B. Johnson who spoke o Venezuelan President Raul Leoni.

When announcing the scheduled start of :he project, Lowell F. Wingert, vice president ɔf A.T.&T.'s Long Lines Department and Jorge Armand, president of the Compania ⁄nonima Nacional Telefonos de Venezuela, ʒaid:

"The cable to Venezuela will mark a sig-ıificant step forward in meeting the ever-in-:reasing need for communications facilities ɔetween the two continents. Its installation ɟramatizes the growing community of interest and rapidly expanding commerce between the Jnited States and Venezuela.

"Whereas 67,000 telephone calls were ɔlaced between the two countries in 1965, :he figure is expected to double this year and increase to more than 225,000 calls annually by 1970."

The $6.4 million cable system is a joint undertaking of A.T.&T. and the Venezuelan telephone company.

## English for Computers

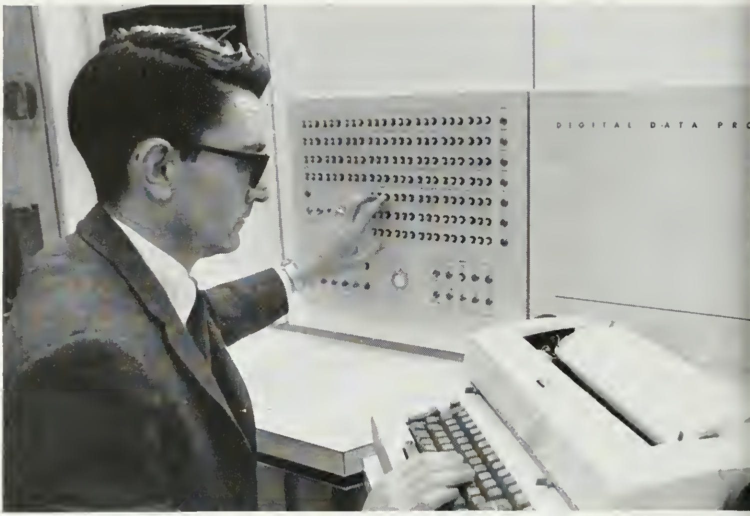
A new form of English will eliminate computer confusion about the relation of words in a sentence. The language, which was developed at Bell Telephone Laboratories, is called FASE for "Fundamentally Analyzable Simplified English."

Sentences in FASE can be easily parsed (resolved into parts of speech) by a computer. For this reason, FASE may eventually be the basis for information retrieval by machines in libraries and institutions which handle large numbers of written documents. For readers, FASE is indistinguishable from ordinary English. For example, this story is written entirely in FASE.

FASE was devised by Dr. Lee E. McMahon, who is a psychologist studying ways of improving communications between computers and people. His work at Bell Labs is part of research in communications sciences—an area which includes the study of future communications networks which will handle messages between computers or between man and computer.

Dr. McMahon has reduced the English language to a strict form in which syntax (the orderly arrangement of a sentence) is clear and sentences are easily broken into component grammatical parts to avoid ambiguity. A sentence in FASE strictly maintains the sequence of subject, verb and object; modifiers like adjectives and adverbs, and other parts of speech must fall into line. A complicated set of rules has been devised to ensure unambiguous syntax.

Dr. McMahon believes that FASE is an adequate tool for communicating a broad range of ideas and that FASE can say anything which needs saying. Since long passages of FASE may produce a somewhat flat prose, the language is most useful for applications



*Bell Laboratories' Dr. Lee E. McMahon, who devised FASE, is shown at computer console*

in which clarity of expression is preferable to an elegant style. For this reason, its immediate application would lie in the mechanical indexing of scientific abstracts or documents.

FASE also may provide a more accurate computer translation of foreign languages. Automatic translation of foreign scientific papers is growing into a big business; but the results are not always reliable. Although present mechanical translation is based on grammar to an extent, it involves complicated series of computer decision-making. To some degree, those necessary complications compensate for inherent ambiguities in the language being used. FASE, which removes the syntactic ambiguities in English, would simplify the task of the computer and lessen the chance of error.

## CNA Bureaus

Procedures for establishing Customer Name and Address (CNA) bureaus in the Commercial Department have recently been recommended as an economical way of enabling service representatives to answer inquiries about long distance charges on their bills by providing name and address information of distant numbers. In most cases, the information can be obtained with minimum delay during the initial customer contact with the business office.

The plan offers a number of benefits: improved handling of customer contacts, increased customer and service representative confidence in the accuracy of toll billing through immediate verification of the billed call, reduction of uncollectible toll adjustments and a decrease in the volume of in-Company calls made to business offices.

## Telephone Hour Documentaries

It will be a new Bell Telephone Hour, starting this fall. Beginning with the premiere show on September 25, the Telephone Hour will present on alternate Sundays a series of musical documentaries featuring utstanding events, personalities, movements nd ideas in the field of music.

One of the programs planned for the current season is the "Festival of Two Worlds" t Spoleto, Italy. Filmed on location, it will resent the festival's creator-director Gian arlo Menotti, its participants and musical resentations.

Also planned are an on-the-scene report of n American city as seen through its music nd other arts, a television portrait of the ife of a renowned concert artist and special hristmas and Easter programs. Additional ubjects will be announced later.

It is hoped that the Bell Telephone Hour's ew format will bring an increased awareness f the many significant events and movements in music and the other arts to television viewers. For many people, the programs will present aspects of the arts not ften seen on commercial television.

Henry Jaffe Enterprises, Inc. will produce he Telephone Hour while Donald Voorhees, who has conducted the Bell Telephone rchestra since its radio debut 26 years ago, vill continue as musical director of the series. The programs will be shown in color.

## Clarified Helium Speech

Engineers at Bell Telephone Laboratories have devised a technique for restoring naturalness to speech distorted by a helium atmosphere. Divers and aquanauts usually work in a predominantly helium atmosphere to prevent nitrogen narcosis, an uninhibited condition often referred to as "rapture of the deep." A peculiar "Donald Duck"-like voice quality results because the resonant frequencies of the vocal tract are changed and the velocity of sound is higher in helium than in normal air.

A careful spectographic analysis by a Bell Laboratories engineer verified that helium changed the resonant frequencies but also showed that fundamental voice pitch is relatively unaffected. Based on these analyses, the new method was devised: the helium speech was processed through a special vocoder (voice coder)—a device first demonstrated by Bell Laboratories in 1936—to restore the natural voice quality.

A vocoder separates and codes fundamental vocal cord pitch and resonant frequencies produced in the vocal tract. Once coded, the information can be transmitted to a receiver and synthesized into a replica of the original speech. Naturalness was restored to the helium speech by modifying the vocoder so that it returned the resonant frequencies to where they would have been in normal air. Fundamental voice pitch was preserved by the vocoder because it had not been affected by the helium atmosphere.

The effectiveness of the vocoder in increasing the intelligibility of helium speech was tested without constructing an operating model. A computer was programmed to simulate components in the proposed vocoder system. Recorded samples of helium speech were converted into electronic signals and fed into an analog-to-digital computer. The data were then fed into the simulated vocoder system. The output from the computer was reconverted to electrical signals which then produced the improved helium speech. This simulation showed that such a vocoder could be constructed for live communications with divers and aquanauts.

## Improved TD-2

The first TD-2 microwave radio system was placed in service in 1950 with a designed load carrying capacity of either 480 high quality message channels or one television channel in each direction per pair of radio channels. In more recent years, TD-2 radio systems have been more heavily loaded with message channels to meet service demands with some degradation in performance even though improvements over the original design were applied.

Improvements to the TD-2 system have recently been developed that will permit increasing the message capacity to 900 channels with transmission performance about equal to the original design objectives. These improvements are now feasible due to advances in technology such as solid state circuitry, more efficient electron tubes and increased knowledge in the field of antenna and waveguide propagation.

A considerable portion of next year's long haul message channel facility relief will be provided by means of increasing the capacity of existing TD-2 radio routes. These additional message facilities can be constructed at a lower cost per circuit mile than would be possible by new route construction.

## Origin of Hearing —A New Theory

Studies by a Bell Telephone Laboratories scientist suggest that the origins of man's hearing mechanism, particularly the middle ear, may have been found in a fish that lived 350 million years ago. Previous theories of hearing assumed that the eardrum and stirrup bone, major components of the middle ear, first appeared some 300 million years ago in primitive amphibians.

Calculations by Dr. Willem A. van Bergeijk of Bell Laboratories indicate that the Eusthenopteron, or other members of the Rhipidistia family of prehistoric fish, would have been able to hear sounds not only through the water but also sounds carried through the air, with practically no loss of hearing acuity. His studies show that this fish had an air-filled sac, similar to man's middle ear, and also probably had an outer eardrum.

Biological research at Bell Laboratories is one means of obtaining a better knowledge of hearing, and thus, of communications. The hearing mechanism of mammals is complicated, inaccessible and difficult to study. Bell Labs researchers therefore also study simple primitive hearing organs, including those in fish. Calculations of the hearing capability of primitive fish, for example, provide insight into the hearing capabilities of higher animals, including man.

## 3-D Movies of Inner Ear Made By Computer

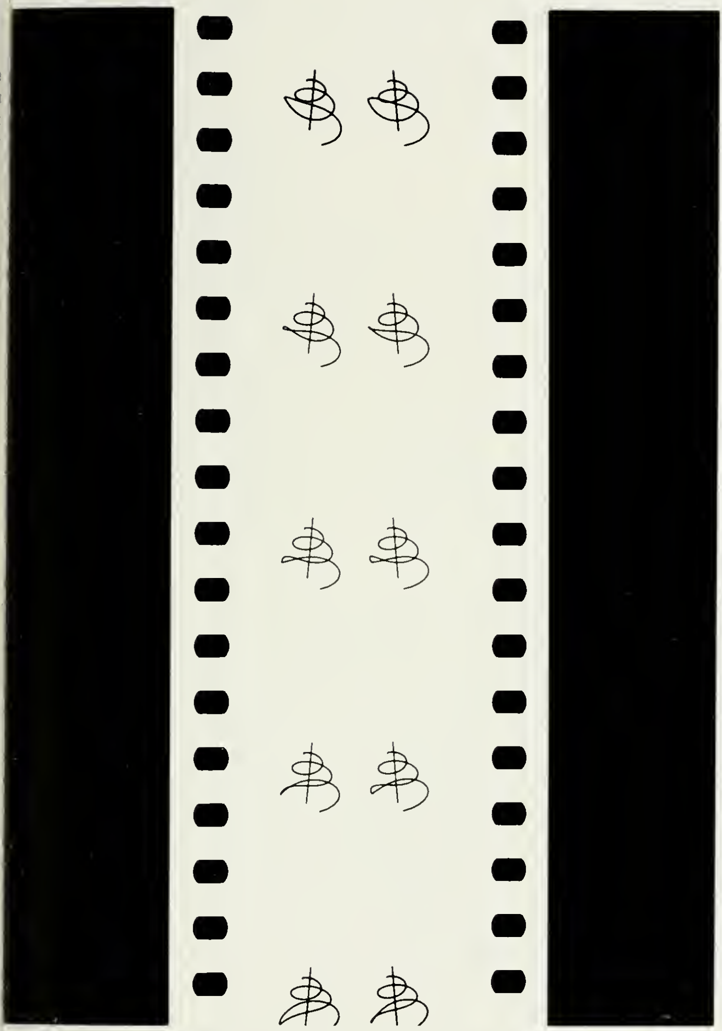
A computer has been used to mal three-dimensional animated movies d picting the basilar membrane, the part of th inner ear that translates sound waves in audible sensations. The movies may he scientists understand how we hear.

The movies, produced at Bell Laboratorie were made by a computer which was pr gramed with a mathematical model or de cription of how the basilar membrane move under certain conditions. Using this program the computer calculated the movements c the membrane in general. Then the comput produced a stereo-optical view of what ha pens when a sound wave stimulates the mem brane to perform the complicated moveme that might be called "the dance of hearing.

The film depicts the basilar membrane a a conical spring tilted at about 45 degree A sound wave entering the ear travels fro the base of the membrane to its summi causing its various parts to vibrate in diffe ent ways.

One of the most significant advantages c this computer-generated motion picture i that the complicated motions of the basila membrane can be seen clearly and studie in detail. This is because small, rapi changes can be slowed down and movement greatly exaggerated. For example, even th loudest sounds move the basilar membran by an amount measured in microscopic d mensions; yet there may be thousands c movements in the basilar membrane eac second. Without a computer, it would be im possible to calculate, let alone plot, th movements of the basilar membrane in re sponse to even ordinary speech sounds. Th movements are so fast that to show clearl what happens when the spoken word "to" i heard takes two minutes of film time.

Using these movies, movements of th membrane can be related to frequencies an intensities of sound. By studying these move ments, scientists are able to understand th correspondence of physical motions to psy chological phenomena.



*Shown above are several frames from a computer-made 3-D animated movie produced at Bell Laboratories which depicts the basilar membrane, a spiral structure in the inner ear that converts acoustic vibrations into audible sensations. To view these pictures in 3-D, place a piece of paper on edge between images in any frame. Look at images with nose touching edge of paper; images will move toward each other, converge and appear in 3-D.*

# What you can do about obscene, harassing or threatening phone calls

It's our policy—indeed, it's our business—to make sure that customers receive the best possible phone service.

That's why, when the telephone becomes an instrument of annoyance, unpleasantness or harassment, it's a matter of the most serious concern to us.

There are three things that you and members of your family can do about such calls, if you receive any.

**1. Don't talk to a caller you're doubtful of. Don't give him the audience he wants.**

**2. Hang up at the first obscene word, or if the caller doesn't say anything, or doesn't identify himself to your satisfaction.**

**3. Call your Bell Telephone Business Office *if* the annoyance persists. We have employees who are trained to assist and advise you and who can frequently help in identifying the origin of unwelcome and troublesome calls.**

In communities across the nation, we are working with police officials and other authorities to curb abusive calling.

In most circumstances we can reveal the origin of abusive calls to law enforcement authorities with the consent of the called party. We want to do all we can to protect your right to privacy.

The more everyone cooperates, the fewer such calls there will be.

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# BELL TELEPHONE MAGAZINE

AUTUMN 1966

# BELL TELEPHONE MAGAZINE



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VOLUME XLV ■ NUMBER THREE ■ AUTUMN 1966



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.


**On the cover:** The painting is one of several made by Bernard D'Andrea at Bell Laboratories and Western Electric. This artist's-eye-view of research in computer technology symbolizes a segment of the innovation process, which is examined in depth on pages 2 through 15.

# The Innovation Process


Jack A. Morton
*Vice President*
*Bell Telephone Laboratories*


More today than in the past—and more in the future than today—industrial survival depends upon technological innovation. Innovation means improving the old or developing new industrial techniques, products or services. This implies growth, but not just in size. Innovation must lead to growth in technology's ability to meet the more challenging needs and opportunities of our changing world.

MATHEMATICAL RESEARCH
BELL LABS.

## The Innovation Process

Innovation is not a simple action, but a *total process* of interrelated parts. It is not just the discovery of new phenomena, nor the development of a new product or manufacturing technique, nor the creation of a new market. Rather, the process is *all these things* acting together in an integrated way toward a common industrial goal.

In earlier times, these specialized acts took place at widely separated times and places. Ofttimes the acts and their couplings were random-like and it was difficult to see them as related parts of a total process. In the past, only a small amount of our technology was science based. Even today, not all of our technology comes from research nor is all research directly relevant to industrial goals.

We are learning that technological innovation is a process for better coupling of industrial goals to relevant research. As a process it is complex but clearly structured from basic specializations coupled together through a common purpose. By paying attention to the purpose, to the parts and to the couplings of the process, we can accelerate and improve the effectiveness of industrial innovation. All the parts and their couplings of the process must stem from the individually creative, yet cooperative actions of people—it is a *people process with a purpose*.

We can not order people to create what we need—for creativity can not be programmed. Creative people can be broadly motivated if they are given scope for imaginative contributions toward a known goal. Even better is *self-motivation*—the only kind that brings out total commitment. It springs from goals that challenge and rewards that satisfy.

Management and creative people can be in basic agreement, through their common interest in *relevant* innovation—one needs to get it, the other needs to give it. How can we make innovation to a purpose self-motivating for creative individuals? Can we build a *people-system* in which relevant innovation "com[...] naturally?"

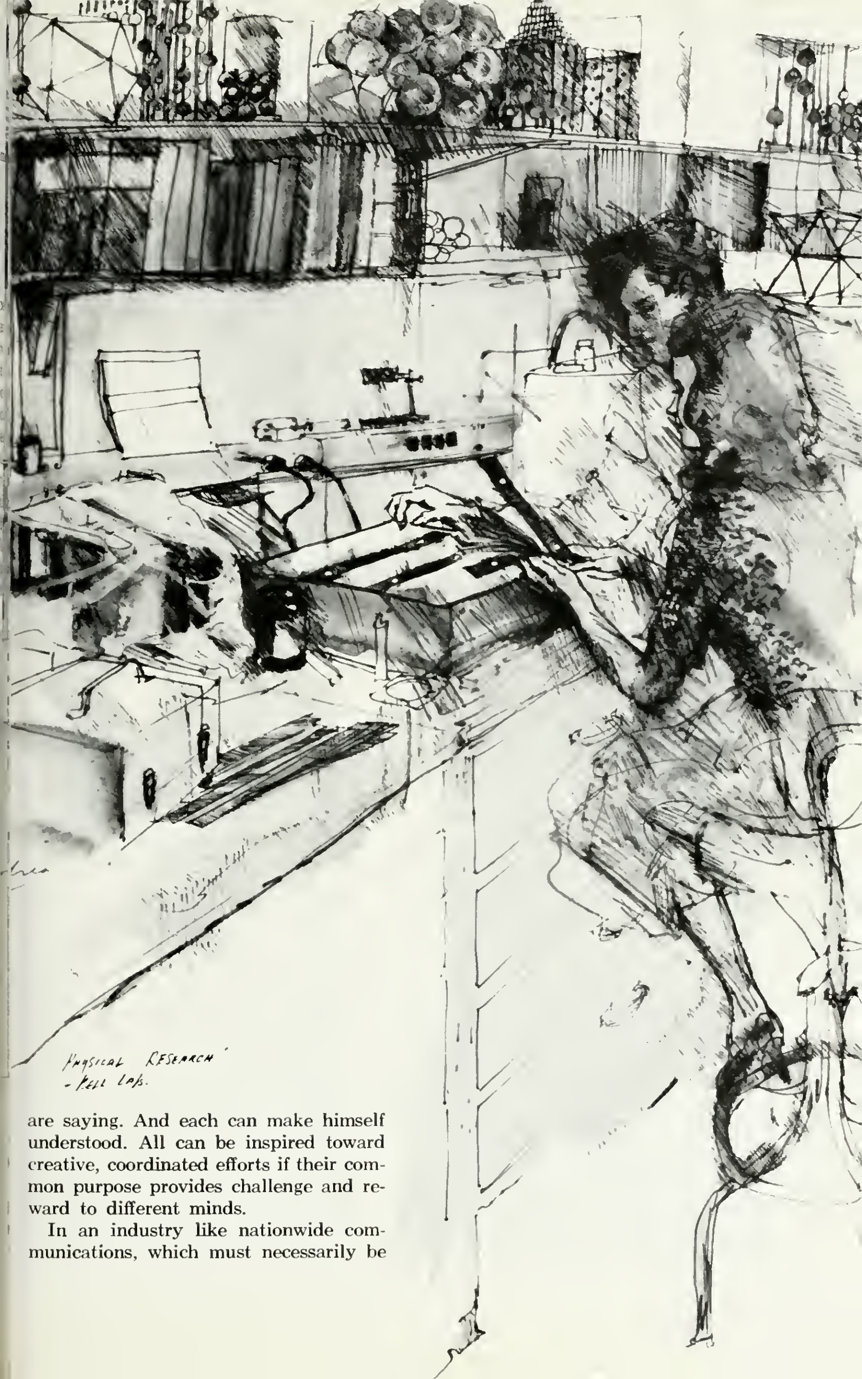
### A Systems Approach to the Innovation Process

Management's role in the people-proce[ss] of innovation is like that of a system[s] engineer for a complex information-pr[oc]essing machine. As always, analogi[es] must be used with caution. The compo[n]ents of a human "innovation processo[r]" are creative people, each with differe[nt] capabilities and needs. Its manager m[ay] design a creative, adaptive system, b[ut] he must not try to "program" it in th[e] computer sense. It will be a living, d[y]namic organism—not one that just fo[l]lows a prearranged schedule but one th[at] can learn, adapt, and grow in a changin[g] world.

To work together toward a comm[on] goal, specialists need a common philos[o]phy and language at each interface b[e]tween their respective specialties. Ca[n] systems engineering, which was deve[l]oped originally for studying technic[al] systems, provide this? We need onl[y] restate some of the things that system[s] engineering does:

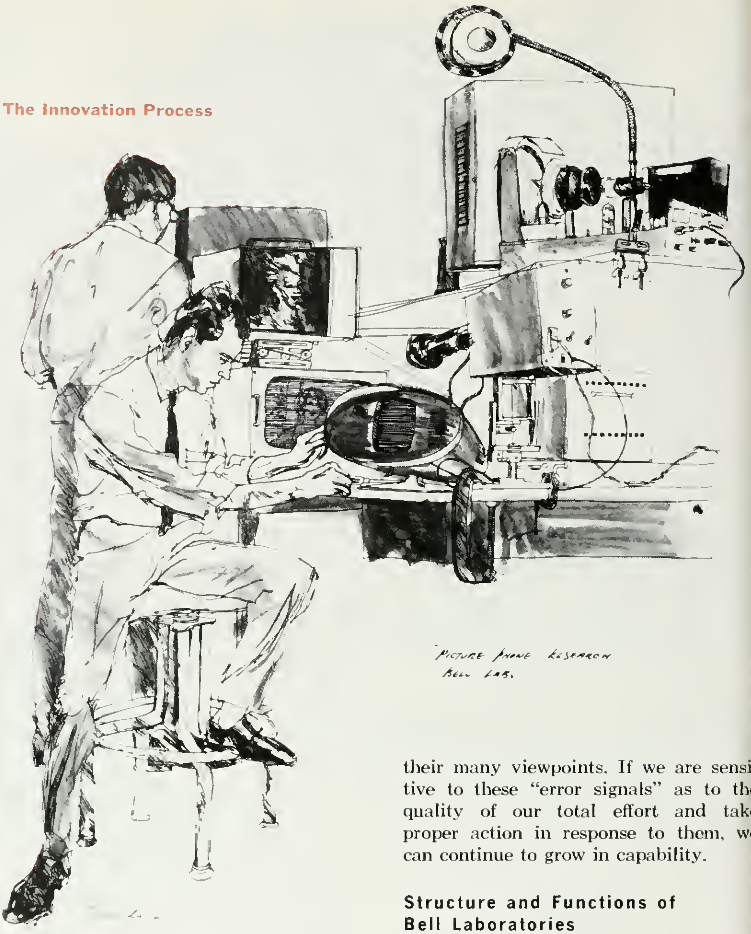
- it identifies limitations, needs, an[d] opportunities, so as to state over-a[ll] goals and give them priorities;
- it determines alternative potential so[]lutions and develops measures of thei[r] relative cost-effectiveness;
- it distinguishes between what i[s] known and what needs to be know[n] about problems and alternative solutions and
- it selects and develops the mos[t] promising combinations of problems an[d] solutions.

Stated this way, systems principles ar[e] not technically narrow; they can b[e] meaningful to all the kinds of peopl[e] who must work together. In these terms marketer, manager, engineer, and scien[]tist can all understand what the others




are saying. And each can make himself understood. All can be inspired toward creative, coordinated efforts if their common purpose provides challenge and reward to different minds.

In an industry like nationwide communications, which must necessarily be




technically integrated, it has been natural that the systems engineering should find application in the people-part of the process as well as in its technical parts. The Bell System is an organization of many diverse people who discover and transform relevant knowledge into new and improved technology for communications. They use this technology to provide improved services, salaries, and dividends to an even larger group of diverse people. These people, in turn, supply essential feedbacks to the system from their many viewpoints. If we are sensitive to these "error signals" as to the quality of our total effort and take proper action in response to them, we can continue to grow in capability.

### Structure and Functions of Bell Laboratories

The essential ingredients in the research and development part of the innovation process—as in the total process—are people, organized into a process with a purpose.

*People come first.* Scientists and engineers of the highest possible professional competence and motivation are essential. The appropriate mixture of the best possible technical people must be carefully selected, recruited, and continuously educated. It means that management must recognize the role of technology in industrial innovation, with science as its source. Most importantly, it means providing challenge and reward for the individual as the creator of the new science and technology.

*Purpose is second.* People working in a laboratory that is part of a total innovation process must understand clearly why it exists—what business it is in and what business it wants to be in. Without such a clear purpose, people cannot see the professional challenge of serving the over-all system, nor can the system reward them when they achieve relevant innovations.

On the one hand, the system's purpose should be as broadly stated as possible, to take advantage of the widest range of research and to provide the maximum challenge for diversified people. On the other hand, it must be specific enough to focus the efforts of all specialists. Aimless searching for diversification can result in unfocused, uncoupled behavior. No enterprise can be in every business throughout the total innovation process. Research and development, no matter how brilliant, will not contribute to the total process if it is not coupled to the world of manufacturing, operations and marketing. Finally, corporate goals must provide opportunities for individual goals and growth. A person does not see himself only as a part of his own laboratory or company. He also sees himself as a member of his family, community, profession—and of his country and humanity as well. If business goals are not compatible with the goals of these groups, people in an industrial laboratory will be incapable of complete commitment.

*Process is third* and the structure which matches people to its functions. At Bell Laboratories, to best match goals to people with different motivations and talents, we recognize clearly the separate but coupled specializations of *basic research, applied research* and *development-design* as shown on page 9. What kind of information is generated by the specialists in each part, and what kind of coupling is necessary to combine their different talents into a connected process?

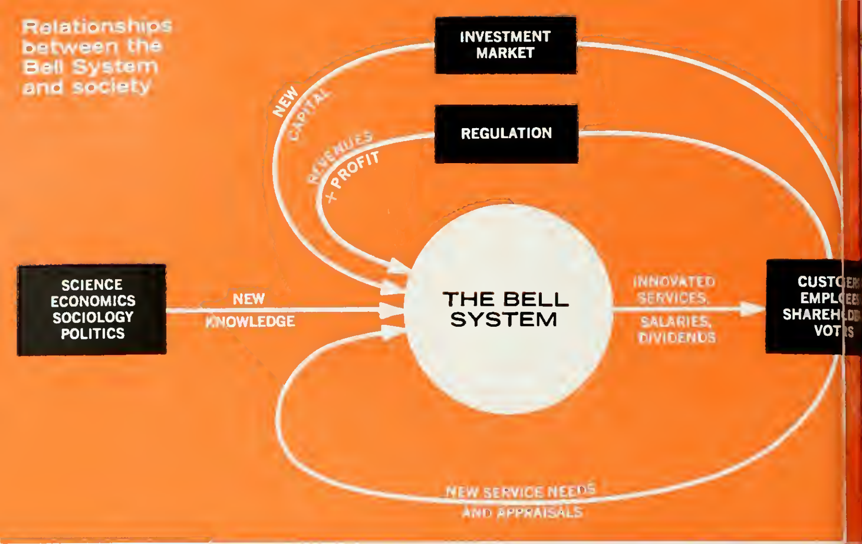
## Functions of Basic Research

We depend on basic research people to perceive and generate new scientific knowledge of long-term relevance to the company. It is essential that they know both the basic limitations of old technology and new scientific possibilities. Some examples of such relevant research have been the discovery and application of the transistor effect, the synthesis of new materials such as superconducting niobium-tin, and new system concepts such as modulation, feedback, and information theory.

Such advances are not lucky accidents—not randomly discovered "solutions looking for problems." Rather, they are answers to known problems and anticipated opportunities. They cannot be specifically scheduled, but are definitely stimulated if the research man is aware of the relation between communications goals and *relevant* fields of science.

Such breakthroughs are not all. The research that produces them provides the opportunities for new technology; the payoff comes only when applied research and development follow. From the raw material of basic research, applied research and development meet specific technological needs or create new service opportunities.

A close personal interaction between research workers and development people is essential to both groups. The researchers provide the knowledge and stimulus that reduce empiricism and increase the effectiveness of development. In turn, this interaction provides the research man with a feedback of needs for further understanding while the subject is still hot. It also provides new and better tools and materials for research to use. Development success or failure gives research people a measure of corporate relevance for their work, which goes be-




yond its appraisal as new science by their professional peers. Quite frequently, this close coupling provides the research man with the opportunity and challenge to move into development.

### Functions of Applied Research

The functions of applied research are to identify the most pressing technological needs and opportunities and to apply new research knowledge to demonstrate the *technical feasibility* of new materials, devices, and systems. It must also develop complete understanding and expansion of the new technology to its basic limits, so as to maximize its range of performance and applicability.

To be effective, applied researchers must use the same tools and procedures as basic research does. The modern engineer must be able to understand and apply scientifically the output of basic research. In addition, he must understand and practice the systems method—not only because of its problem-solving power but also because of its aid in selecting and evaluating the most needed innovations in the overall system. It is most important that applied researchers be aware of the relative economic potential of new technologies in choosing between alternative potential solutions.

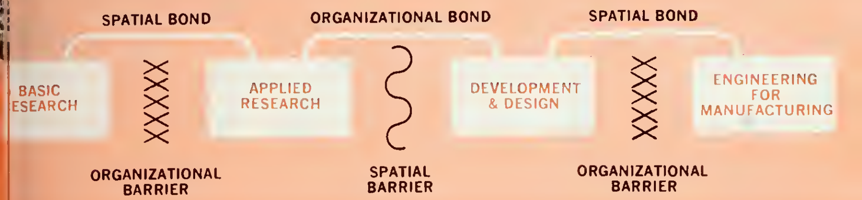
### Functions of Development and Design

From the reservoir of basic and applied research, the development-design engineer can select the best technology for the design of a specific function. At this stage in the process, the design engineer must carry the development much farther in quantitative detail. Not only do performance requirements become more precise and numerous, but reliability, cost, and timing now become major measures of effectiveness. This widening set of requirements and measures increases the range of solutions and the importance of cost-effectiveness judgments. It provides a new set of challenges to the engineer, and a new set of viewpoints and knowledge is required. The final output of this phase is a design that meets the service objective of maximum performance at minimum annual expense.

Unless such objectives can be met at the right time, the original basic and applied research have not contributed to the total innovative process. The final

EPARATE BUT COUPLED SPECIALIZATIONS


ALANCED ARRANGEMENT OF BARRIERS AND BONDS

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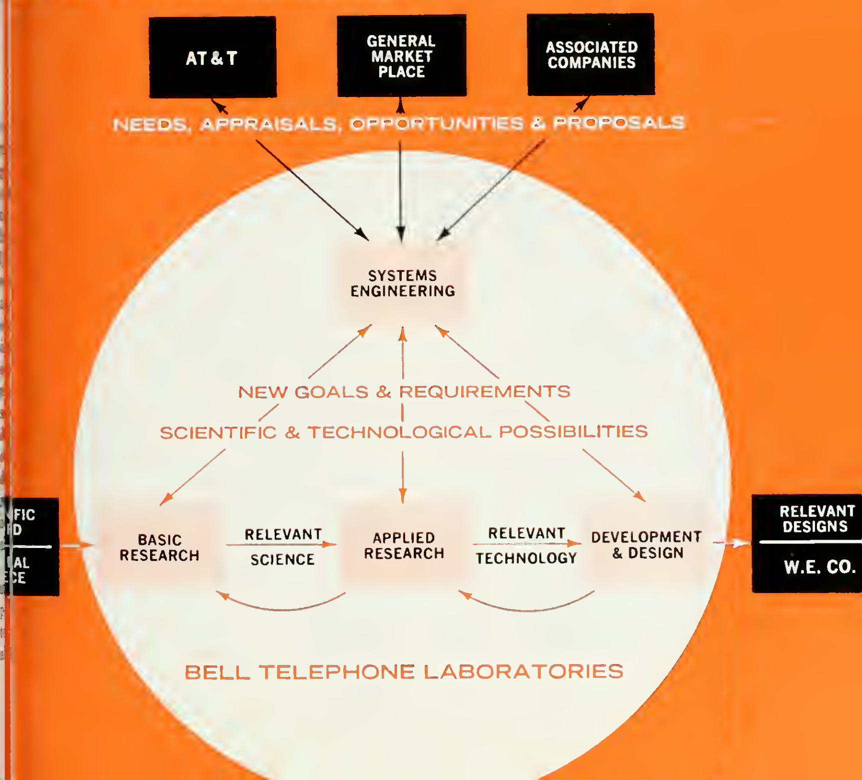



CERAMICS LAB.

yardstick of a new design is its ability to produce old services at less annual cost than the old technology permitted—or new services not possible before.

### Importance of Communications

In all these major functions of the laboratory phase of innovation, we are dealing with the generation and transformation of information. Innovation is both a forward-acting and a feedback system, in which the processing is done by people with diversified skills, knowledge, and motivations. It therefore depends vitally upon communications among these people. At least four factors influence and control such communications. We must pay attention to them all in order to stimulate cooperative action toward a common goal.

*First, there is language.* If people do not understand one another, if their levels of scientific and technical knowledge are too different, they cannot communicate effectively.

*Second, there is space.* Even when people are educated to the same extent and able to talk the same language, distance can still be a barrier to effective and frequent communications. Spatial separation of different specialists can be a block to easy "eyeball-to-eyeball" dialogue.

*Third, there is organizational structure.* This should correspond closely to the well-defined basic functions and interconnections of the innovation process. Person-to-person dialogue and decision-making must occur directly across specialist interfaces at all levels. Delays, noise and distortions will result if communications must go up and down organizational lines.

*Finally, there is motivation.* There must be commensurate challenges, freedoms, and rewards throughout the process, from basic research to marketing and operations, so that everyone will want to communicate for the common good.

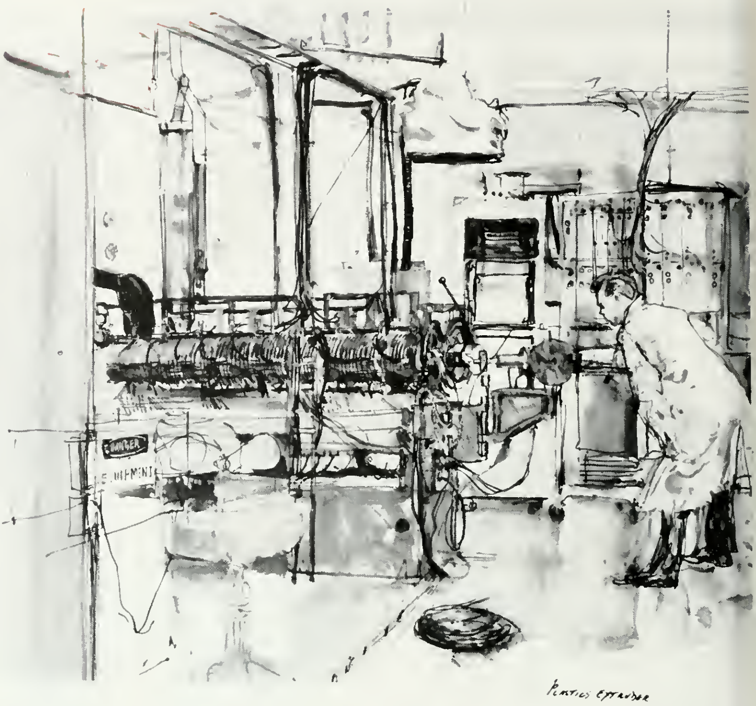
### Barriers and Bonds for Communications

In terms of these four communications factors, we can do things that will inhibit the flow of information and other things that will encourage it. We can build barriers and bonds—ofttimes working together in complementary fashion—to optimize the flow of information and action throughout the innovation process.

Although there is a prevailing idea that Bell Laboratories is completely autonomous, this it not at all true. Of course, Bell Labs is organizationally separate from the Western Electric Company, since each has its own president and board of directors. In this sense, Bell Labs is autonomous, and we believe this to be a good thing. If both organizations reported to a common head too low in the System, a screaming manufacturing emergency, for example, could bring research to a halt. Not only could we lose our long-term research, we might lose our researchers too! Early in the game, this was our situation—the laboratory functions were not corporately separate and we did have some such experiences.

But total autonomy and isolation are not the answer, either. If this were the case, how could research know about and be moved by the System's over-all goals and problems? How could research identify the relevant areas of science or foresee new potentialities? How could development determine the economic manufacturability of its designs or be influenced by innovations in manufacturing?

Until the end of World War II, two barriers to communications existed between Bell Labs and Western Electric people. One was organizational, and this barrier still exists. The other was spatial; Bell Labs was a long distance from many Western plants. These two barriers, together with the different training and the desirably different motivations of the people in the two organizations, made communications between them infre-



quent, formal, and time-consuming.

This spatial barrier has since been replaced by a spatial *bond*. We have moved our development-design people into laboratories on Western Electric premises. *Organizationally*, they belong to Bell Laboratories; *spatially*, they are strongly linked to Western people. On a day-to-day basis, design for best performance and reliability can be balanced against design for minimum cost of manufacture. The close interaction required between design and process in today's technology can be tackled jointly with minimum delay. Mutual understanding and respect develop continuously in such an arrangement.

Of course, creating this bond betwee design and manufacture resulted in spatial barrier between Bell Labs' ap plied research and its developmen design. To offset this barrier, these tw functions are integrated *organizationall* within Bell Laboratories at the lowes level consistent with group size an common technology. Such a bond aids i the timely and effective flow of infor mation and people across the spatia barrier. It reduces duplication and rede velopment, matches people's skills t jobs more effectively, and helps to main tain equality of competence in bot applied research and development design.

On the other hand, an organizational barrier at the highest possible level (vice president) protects the freedom and continuity of Bell Labs' basic research. The temptation and opportunity to distract the researcher with development problems is inhibited and prevented. Conversely, basic research and applied research should have close, day-to-day, beneficial communications. Spatially, they are located as close together as possible—preferably they are intermixed in the same building. Such an arrangement makes it easy for information and people to flow across the organizational interface (because of the close spatial bond), but without fear that one function will dominate or impede the other (because of the organizational barrier).

### Bonds and Barriers in Complimentary Fashion

Thus, we try to use bonds and barriers in complementary fashion—wherever we have a space barrier we try to have an organizational bond, and vice versa. Two barriers should never exist together, lest information flow be impeded; two bonds should never exist together, lest one specialist group dominate the other.

We must always remember, however, that information is generated and communicated by people. Although organizational structure and spatial relations can help, all can still be lost if people's common language, motivation, and respect are absent across specialist interfaces.

The idea, still held by some, that all the bright people are in research and all the drones are in development and manufacturing is passé. Our research people are themselves the staunchest defenders of this faith. They well know that the stronger the people in applied research, design and manufacture, the more freedom the research people will have to explore new relevant frontiers—and the more assurance they will have that their efforts will be fruitful. Equality of competence, challenge, and reward—together with the timely flow of people and ideas across specialist interfaces—are necessary ingredients in the innovation process.

### The Role of Systems Engineering

We have discussed how Bell Labs' research and development are coupled internally and with Western Electric to produce rapid conversion of science into new technology for service. But Bell Laboratories must also couple to the world of science, to AT&T, to the operating telephone companies, and to the general marketplace. These relationships aid its judgments as to what science is relevant and what technology is needed.

Through their publications, professional societies, and university associations, research and development people are well-coupled to the world of science and technology. But the other important links—to AT&T, the general marketplace, and the operating companies—are numerous, geographically dispersed, and quite different in content. As a result, it is sometimes difficult for specialist research and development people to absorb, understand, and be challenged by economic and social needs and opportunities.

For this reason, we have a distinct Bell Laboratories function called "systems engineering." Systems engineering is not in the research-development-manufacture line. What, then, are the main functions of these people, and what kind of people are they? Generally, they are former specialists of experience and judgment. They usually are top technical people who have broadened their viewpoints and knowledge to include several disciplines, including economics. In short, they are the generalists of Bell Laboratories. One of their big jobs is to build information bridges connecting

Bell Labs to AT&T, and the operating companies.

Systems engineering people, because they are an essential part of Bell Labs, are in constant touch with current and potential science and technology. By relating technological possibilities to known business needs, they develop plans for proposed new system developments. These plans formulate all the technical requirements for a new system, develop all the relevant cost-effectiveness tradeoffs, consider some of the possible solutions, and take inventory of all the technology needed for the new system's success. No project for a new large-scale system should be launched without full knowledge and calculated risk of missing critical capabilities. This is particularly important since large commitments in time and manpower must be made in the development-design phase. Generally speaking, the development-design part of the total process may range from five to twenty times the cost of the original research that gave it birth.

## Each Group Must Establish Subgoals

But each group, whatever its specialty, translates the Bell System's over-all goals into subgoals for its own area of expertise, and makes its choice of relevance in those terms. If they know and understand the needs, specialists are able to make the best decisions within their own areas. Choosing the relevant areas of science is the responsibility of basic research people. Similarly, in applied research the decision of what science to apply for what new technology is the choice of applied research people. And, finally, when management decides to act on a systems engineering proposal, development-design people make the choices of the best technology to meet its requirements.

It is the big job of systems engineering to know business needs and technological possibilities, to translate these into systems proposals and evaluations, and to catalyze the work of the research and development specialists into innovation for the Bell System.

Technological innovation is not a single function nor a random collection of unrelated acts. To be effective, it must be a total process of specialized but connected parts all responding in a coordinated way to over-all systems goals.

In general, to become more competent systems must become more complex. As our technological systems become more complex, so also must our people-processes for innovating them. Increased specialization and coupling are common to both. Through specialization, depth of understanding and creativity are enhanced. Through proper coupling among specialists and with the overall purpose, total system effectiveness is enhanced.

## Each Must Operate Above Critical Threshold

One essential idea of the "system approach" is that each basic part of the total process must be operating above some critical threshold. Equally important, but difficult to achieve in the people-process, are the critical couplings between the essential parts, especially when they are not part of the same organizational entity. Whatever the goals and scope of a particular enterprise, whether integrated or specilized, managers must understand innovation as a total process. An enterprise must achieve a critical level of excellence in its chosen specializations *and an adequate coupling* to all the other parts, whether in or out of house.

Another essential idea of the "system approach" is that no one specialized part of the system should be optimized in itself to the detriment of the whole. Such autonomy is a form of system cancer—it may lead to death for the whole system—or surgery for the cancer. In this sense, as part of the Bell System, Bell Laboratories restricts its work to areas relevant to communications.

In summary, technological innovation is a process—as such it can be studied and improved through the systems approach. Within the laboratory part of the Bell System, besides the coupled functions of basic research, applied research and design, systems engineering provides over-all guidance, judgment and coupling to communications needs and opportunities. Systems engineering, as part of the whole, promises not complete assurance, but a reasonable prejudgment of relevance and cost-effectiveness before large expenditures are made. As Frederick R. Kappel, chairman of AT&T's Board of Directors, has said—"Looking before you leap need not shorten the jump—it may assure that you land on your feet."

Technological innovation is above all else a "people-process with a purpose." It depends not only upon the creative excellence of all its specialists; it is vitally dependent upon the communications barriers and bonds between its specialists—and upon the unifying challenges and rewards of the overall system goals.

## About the Author

Jack A. Morton

In writing on "The Innovation Process," Jack A. Morton draws upon his extensive experience in technical management at Bell Laboratories. He has written and lectured widely on the philosophy of this increasingly important subject, and to a considerable degree, has helped to shape the amazing technical revolution of the semiconductor industry.

Now vice president in charge of Electronic Components Development at Bell Labs, a post he has held since 1960, Mr. Morton devoted his early years of work there to research in coaxial cable repeaters and microwave amplifiers. When the transistor was ready for applied research in 1948, he was put in charge of all semiconductor development work. In 1952 he became assistant director of Electronic Apparatus Development, including the transistor, and a year later he was named director of Transistor Development. In 1955, as director of Device Development, he was responsible for both the fundamental development and development for manufacture of electron tubes, solid state devices and electromechanical and passive devices.

Mr. Morton received the B.S. in Electrical Engineering from Wayne University in 1935, the M.S. in Engineering from the University of Michigan in 1936 and the honorary Doctor of Science from Ohio State University in 1954 and from his own alma mater in 1956.

# excellence of service:

## the bond between customer and shareowner

During the presentation of testimony and cross examination in the current Federal Communications Commission interstate rate hearings, there have been questions as to the relevance to the customer's interest of our testimony on the need for a rate of return that would meet investor interest.

AT&T Vice President and Treasurer John J. Scanlon best answered these questions when he said: ". . . While I shall be speaking for the most part from my experience with investor interests and expectations, I do so recognizing that meeting these needs and expectations is but a means of achieving our primary goal of service. . . . We can best meet our goal of service—the customer's interest—only as we realistically meet the investor's interest as well."

In cross-examination, Mr. Scanlon discussed what he meant by the customer's interest: "In my view, the customer's interest is in high-quality, low-cost service, when he wants it, where he wants it.

"The customer's interest is in a service constantly growing in convenience and usefulness.

"The customer's interest—increasingly—is in services and rates especially adapted to his needs, whether they be those of a residence subscriber, a bank, a government agency, or a nationwide industrial complex.

"And the customer's interest is in low rates."

Mr. Scanlon added, "In the final reckoning, the telephone companies must price their services at levels attractive to consumers vis-a-vis other claims on their income, and in many instances, vis-a-vis competing communications services." Only through this combination of low rates and excellent service can the Bell System maintain earnings that will continue to attract investors and their capital.

But low rates and efficient service do not automatically follow once money is invested. Bell System witnesses testified on the role of research and capital expenditures in providing communications service.

Dr. William O. Baker, Vice President-Research at Bell Telephone Laboratories, spoke on the role of science research in meeting the service needs of all communications customers, from the housewife, to the large corporation, to the television network. Said Dr. Baker: "It is clear that the public wants and needs communications service with sufficient flexibility to transmit and obtain information in whatever form is most appropriate." To provide these complex services, he said, requires great scientific efforts and entails risk:

"If we are to continue to provide the high quality service which the public has grown accustomed to expect from the Bell System, we must dedicate substantial resources to a comprehensive research effort to be followed up by heavy capital expenditures for benefits that can only be realized in the long run. Moreover, the rapidity with which we must make such commitments if we are to meet the needs of our users inevitably entails a high degree of risk. . . . Obviously, these risks cannot be undertaken unless the benefits we can realize are sufficient to justify them."

This element of risk in the business—from research through implementation to an operating service—makes the investor's role important: His confidence in the company, his belief that the excellence of its service will produce increased earnings, must outweigh the risk. Excellence in service becomes the bond which unites customers and investors by reducing risk and stimulating further growth. As AT&T Executive Vice President Ben S. Gilmer pointed out, "The fundamental motivation of our businss is to enhance the value of our service, for only in this way can we meet our responsibilities to customers, employees, and investors."

# serving the nation


Benjamin H. Oliver, Jr.
*Vice President, Government Communications*
*Long Lines Department, AT&T*


**In this huge underground room beneath Strategic Air Command (SAC) headquarters near Omaha, Nebraska, Air Force and telephone people work together, around the clock, to maintain one of the vital communications links in our nation's defense system. The Bell System's committment in government communications, dating back many years, is described in detail on the next ten pages.**

## serving the nation

Half a century. That's how long it took the telephone to reach the inner circles of the White House and to become the indispensable tool of government that it is today.

The first White House phone was installed on Dec. 1, 1878 in a booth *outside* President Rutherford B. Hayes' executive office. It stayed outside until March 27, 1929, when President Hoover had the phone moved inside and placed on his desk. That move symbolized the vital role communications was destined to play in the years and decades ahead.

The Federal government has grown bigger since then, and its reliance on all forms of communications has steadily increased. Big government means big communications. More than one million persons serving in the military and in civilian agencies around the world are assigned to various kinds of communciations duties. And, approximately $30 billion has been invested by the government over the years in communications equipment, everything from underseas cables to walkie-talkies.

The government's dependency on communications probably exceeded all previous highs during President John F. Kennedy's administration. It was then that the Hot Line, a teletypewriter link

Wherever the President of the Unit
speaks publicly, the press is well supp
a battery of phones for on-the-spot r

between Washington and Moscow, wa installed. It was then, too, that tele phones sounded throughout the capita with an almost incessant ringing of bell There is a story, possibly apocrypha that the White House switchboard wa so heavily used by the New Frontiers men that it practically blew a fuse a least three times.

The telephone has continued to be vital instrument of command in the ad ministration of President Lyndon B Johnson, whose personal use of phone has been mentioned so often in the pres that it is already legendary.

Whenever the President of the Unite States travels, communications faciliti are arranged beforehand to assure hi continuous contact with Washingto Likewise, facilities are set up for th press, television and radio to provid instant nationwide news coverage of th President's activities. For security rea sons, details of the communications sys tems provided the White House and th President's ranch in Texas cannot b made public.

President Johnson is rarely out of reach of a phone; this Call Director telephone is on a coffee table in White House Oval Room.

## serving the nation

Speculation about who's calling whom from the White House is always popular on the Washington cocktail party circuit, but the really important telephone news in the capital is the government's greatly increased use of switched service communications. In the past, the military and civilian branches of government relied solely on point-to-point hookups which were designed to serve one purpose or one agency or department. Now, two large common-user networks developed by the Bell System and patterned after the public Direct Distance Dialing network are working for the government, knitting together vast numbers of civilian and Armed Forces personnel.

Some point-to-point government circuits are still in use, of course, and it is often these highly specialized channels which present the greatest challenge to communications technology. For example, top priority defense lines are necessary to warn of an enemy attack and to signal the retaliation; space flight circuits have to link orbiting astronauts and tracking stations around the globe; and high-ranking military officials must be made accessible at all times to the emergency ring of a telephone.

In short, the government's needs are unique, unmatched either by the general public or in industry. These needs, by virtue of size and sophistication, have made government the Bell System's biggest single customer.

Providing the government with the kind of communications service it needs requires an extraordinary degree of Bell System teamwork. AT&T's Long Lines Department, with its experience in making interstate and international connections, acts as the overall co-ordinator because so much government traffic crosses state boundaries and extends overseas.

Within Long Lines, the Government Communications management group is the key liaison between the Bell System and top echelons of government in arranging new military and Federal agency services. It gets involved in the who spectrum of government communication Once the government's needs have bee determined, Long Lines Eastern Are headquarters takes over, co-ordinatin plant, engineering and traffic details o a nationwide basis. Its task is to mak sure the blueprints become operating re alities.

The associated companies, as well a independent telephone companies, pro vide and maintain government circuit within their boundaries. The Chesapeak and Potomac Companies are the busies in this respect, and a few figures tel why: C&P is responsible for 290,00 government phones in metropolitar Washington, 180,000 in the District o Columbia itself; in the Pentagon alone there are 32,000 phones.

Bell Laboratories and Western Electric are also intimately involved in government communications. Special require-

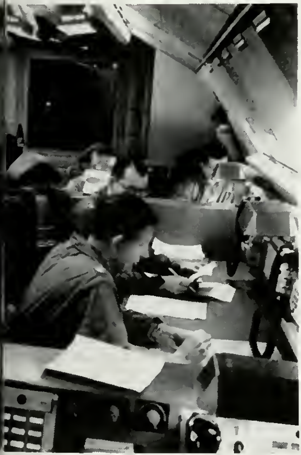

Main battle staff position at NORAD headquarters, Colorado Springs, gives hemispheric view of airborne objects.

ments call for special equipment, and the government frequently looks to Bell Laboratories to develop the new devices and to Western Electric to make them. Both have been deeply engaged in the task of helping the government bring into being the two new common-user networks.

These two networks AUTOVON (Automatic Voice Network) and FTS (Federal Telecommunications System) —are already the largest private line networks in the world, and they are still growing. By 1970 they conceivably could have nearly 100,000 circuits between them, which is approximately the total number of Long Lines telephone circuits in use last year for public long distance service.

AUTOVON, which was built for the military, will be the larger of the two. Many Army, Navy and Air Force installations in the continental United States and Hawaii have access to it now.

Telephone status rooms take fast action to correct any trouble on military circuits. Wall panels represent defense networks.



Communication-equipped jets, airborne around the clock, can control SAC's global force if needed.


Bell System and Air Force experts at SAC constantly check status of worldwide telephone and radio channels.

Pay phones are installed at the press center in Cocoa Beach, Florida, near Cape Kennedy, for convenience of reporters.

Canada will be tied in late next year an Europe within two years, according t current plans. Of the 19,600 circuit which will be in operation by the en of this year, approximately 15 per cen will be used for data.

The new network was initiated in 196 by connecting into it 700 circuits fron the Switched Circuits Automatic Net work (SCAN), which predominatel served the Army. Other military units including the North American Air De fense Command (NORAD) and mor recently the Semi-Automatic Grounc Environment (SAGE) networks hav been added.

AUTOVON has several built-in fea

tures designed exclusively for military use. One of these is the 16-button Touch-Tone® phone which permits ranking military officers to pre-empt busy lines in times of emergency. This phone, with its multiple levels of priority, is an example of equipment designed by Bell Laboratories and manufactured by Western Electric for the government.

Other special AUTOVON features include: connections on calls anywhere on the network within 10 seconds or less, direct dialing between a military installation and an airplane in flight, unusual conferencing arrangements and the ability to press a button and get a "hot line" connection through the network. To provide maximum clarity of transmission on long distance connections, AUTOVON was designed as a four-wire network rather than as the usual two-wire system.

Protection from enemy attack, a paramount requirement for military circuits, received careful attention in the AUTOVON design. Switching centers were built outside possible target areas, and a new polygrid routing arrangement was devised to reduce the strategic importance of any single switching machine.

When the worldwide network is complete there will be about 100 switching centers, or major intersections, along this intricate web of communications routes. The network started with No. 5 crossbar switches, but the new equipment being added will be of the electronic switching type. The change to ESS will permit greater flexibility in meeting changing demands and will facilitate providing the more sophisticated communications requirements of the future.

AUTOVON is managed by an interdepartmental Long Lines team from an office near Washington. There, the blinking lights of a status board reveal the up-to-the-minute condition of the network. The operating team works closely with Long Lines' Defense Communications Systems personnel who control the procurement and arrangement details for the trunk lines and co-ordinate management of the access lines. Part of the FTS network also is managed at the DCS center.

Some military units rely on AUTOVON for their administrative and backup traffic while using a separate special-purpose network for operational traffic. For example, the Strategic Air Com-

Voice communications with NASA officials and astronauts in orbit are controlled and switched through this special board at Goddard Space Flight Center in Maryland.

mand's primary alerting system is a separate network which enables the SAC Commander-In-Chief to establish immediate contact with the President of the United States and a worldwide strike force of missiles and manned bombers.

The nerve center of this communications complex is a cavernous room deep beneath SAC headquarters near Omaha, Neb. Highly specialized telephone consoles, manned around the clock, link the headquarters with NORAD, the Joint Chiefs of Staff and all SAC and missile bases. Sophisticated Bell System equipment and a dedicated team of Air Force and telephone people are the foundation of this important part of our defense system.

The Ballistic Missile Early Warning System is another national defense asset with a highly individual communications system designed and coordinated by the Bell System. Dual communications routes flow from BMEWS' three widely separated outposts in the northern part of the world to NORAD headquarters in Colorado Springs. The proven dependable performance of these circuits assures the United States of advance warning in case of enemy attack by missile.

For the Federal agency side of government there is the second big Federal network, FTS. This huge system has become the administrative workhorse for more than 70 agencies. Some 700,000 government workers in 525 cities and towns in the United States now use it for their long distance calling. Prior to the creation of FTS, they used individual agency networks or the public long distance network.

FTS was developed with two primary missions in mind: to handle day-to-day administrative traffic; and to give the government supplementary circuits in times of national emergencies, when the DDD network might become overloaded. In its role as emergency backup to the public network, for example, FTS kept government channels open during the

SAC underground command post, cramme
with special communications equipmen
can alert world-wide air striking forc

Alaska earthquake in 1964 when regul circuits to that state were clogged b calls from worried relatives.

The full-scale network had been orig nally scheduled to go into operation las year, but the General Services Adminis tration urged that it be readied a yea earlier than planned. Throwing its ol time schedule away, the Bell System re doubled its efforts and launched the net work in July, 1964.

FTS has been expanding at an un precedented rate ever since. The origina 5,000 circuits will soon be tripled. And instead of handling 13 million calls a year, as forecast, FTS is handling thre and a half times as many.

Washington's awareness of the tele phone as a quick, economic and efficien way to conduct business has been greatl sharpened by the addition of FTS. As for government employees, they hav welcomed the new system despite th occasional "busys" on the FTS line. Fo

On Ascension Island—a tiny, remote, rocky dot in the mid-South Atlantic—Western Electric engineers check the massive radar antenna used for tracking ICBM's fired down the Atlantic Missile Range.

one thing, government workers are no longer required to get specific authorization before making a long distance call. For another, they are now calling more and writing less.

As in the military, many agencies have their own separate operational networks. An example is the National Aeronautics and Space Administration's NASCOM, an 829,950-mile manned space flight network. This vast tracking system is controlled through the Bell System-designed SCAMA II console at the Goddard Space Flight Center in Greenbelt, Md. The Gemini Launch Data System (GLDS), created for the Gemini flights, is part of NASCOM. This radio and cable complex of data, television, telephone and teletypewriter circuits comprising GLDS funnels critical information on Gemni and Apollo missions from Cape Kennedy in Florida to the Manned Spacecraft Center in Houston, Texas.

The Bell System, which engineered GLDS, also provides intricate communications services for the Federal Aviation Agency's air traffic control systems and for the Weather Bureau's ESSA and Tyros satellite programs. Other Federal agencies using private line services range from the Voice of America to the Veterans Administration and from the Atomic Energy Commission to the Bureau of Reclamation.

A feature of the Bell System's total communications service which has special implications for the government is the emphasis placed on survival and continuity.

In the last 10 years more than 10,000 miles of broadband routes have been constructed *around* large cities and other likely target areas so that an enemy attack on a major site would not destroy vital circuits. The blast-resistant or hardened cable is another major survival feature. Hardened cable systems, with their underground communications centers and emergency power equipment, would provide substantial protection against nuclear attack.

If regular telephone administration offices were ever knocked out by the enemy, emergency control centers are prepared to assume temporary command. Unannounced daylong drills are held periodically to test the readiness of personnel assigned to these centers.

To minimize normal disruptions in service, and to function whenever needed for emergencies, restoration control offices and plant status centers have been located strategically throughout the country. Alternate routing plans covering every conceivable situation have been developed to bypass trouble spots and keep traffic moving. The status centers, incidentally, keep in close touch with the Defense Communications Agency, notifying it immediately of any failure affecting defense services.

This stress on survivability and continuity has impressed government officials responsible for overseeing Federal communications. It is a worthwhile asset in the government's defense ledger, one of many recorded by the partnership between government and the Bell System.

This partnership requires everyone involved in it to shoulder substantial responsibilities. The preservation of the nation literally depends on the effectiveness of its communications circuits. This fact adds a tremendous stimulus to the work of those people in government communications.

Obviously, the technical demands on telephone people to establish top-flight performance on all government communications channels are often exceptional. But the final goal is disarmingly ordinary, easy to understand and the same one that the Bell System has always held to be fundamental to our business. It is simply to provide the best possible service.

Closed-circuit TV cameras focus on SAC officer. Information gathe forms basis for "alerts" over Primary Alerting

**About the Author**

Benjamin H. Oliver, Jr.

As one of the men responsible for all communications services which Long Lines furnishes to the government, Mr. Oliver is eminently qualified to write upon the subject. In July, 1962 he was named director of government communications in Washington, and, since 1964, has been vice president in charge of government communications for Long Lines. He is recent past president of the Armed Forces Communications and Electronics Association, and is a member of the American Legion and the 35th Division Association.

A graduate of Stevens Institute of Technology, Mr. Oliver served in many posts in the Plant Department of the New York Telephone Company. In 1955 he joined AT&T as assistant vice president—Plant Operations. Three years later he was appointed vice president—Upstate Territory for New York Telephone, the position which he held until going to Washington. During World War II, Mr. Oliver served with the U. S. Army Signal Corps, attaining the rank of colonel.

# PHONE

# IN A GILDED CAGE

Fashion is a fickle mistress. Her essential quality, at least in the commercial sense, is change. Change implies something new or a new version of something old. Paradoxically, where fashion—and fad—are concerned, it may also be an old version of something new.

This could account for the present, and growing, desire on the part of telephone customers for exotic phones out of the past or from foreign lands. Whether or not the whimsies of fashion have generated today's popularity of "antique-decorator" sets, the fact remains that many of them are being made, offered for sale and bought by the public.

And there, as Hamlet said, is the rub.

The external appearance of a telephone may have little to do with the way it works, but what is inside does. Any customer should be able to pick up his phone and, by dial or operator or both, reach any other phone anywhere—rapidly, reliably, economically. This kind of service is the telephone companies' reason for being. The communications system that makes it possible is the largest, most complex, most sophisticated in the world. It is designed as a unit, and in order for it to work properly as a unit, every part must be compatible with every other part and of equal quality, down to the last wire, switch, relay, transistor—or telephone. And all of this immense nationwide network is not only designed as a unit but also it must be maintained as a unit, with all of its millions of operating parts kept at a uniformly high level of efficiency and performance. It follows that what is inside the customer's telephone is just as important as what is in the central office, or in cables or microwave relay towers or any other part of the system.

It also follows that the only practical way to insure that performance will meet design is for the telephone companies to control and maintain every part of the system, including the telephones themselves. Regulatory agencies hold the companies responsible for providing efficient, economical service to their customers. Therefore, over the years, these agencies have upheld and reaffirmed this principle of the telephone company's providing the complete service.

Furthermore, if telephones were owned by customers rather than by the telephone companies, this private ownership could be a barrier to improvements in the communications art, which are being made continually. Private owners might be unable or unwilling to replace existing items in which they have an investment and which become incompatible with improvements in the system. For example, the introduction of dial, with the resulting service improvements and economies, could not have been made as rapidly or as smoothly under divided ownership.

Transmission quality has improved greatly over the years. Again, this would not have been possible if the Bell System had not been able to improve the phones its customers use. Indeed, the telephone on the customer's premises is one of the most essential working parts of the communications network.

Enter lady fashion with a seductive assortment of exotic phones, offered for sale in stores or through printed advertising. They have the attraction of novelty. A woman may consider a white-and-gold "French" phone more consonant with the décor of a French Provincial living room or a Regency bedroom than many of the models offered by the telephone company. She is not thinking of performance; she is thinking of appearance. She will not like it, however, if the fancy thing for which she has paid a fair sum of money doesn't work—unless it is solely for decoration.

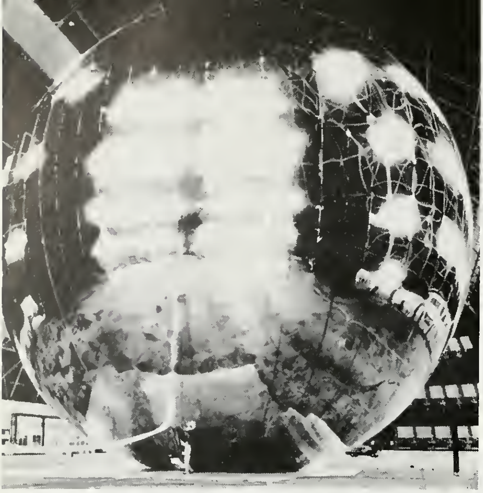
She will like it even less if the telephone company, to protect the quality of its service as a whole, refuses to connect her foreign set in the first place. Some customers may have thought the company was stuffy—even unreasonable, arbitrary—when, out of sheer necessity, exactly that has happened. Actually, there are sound technical reasons for the fact that the telephone companies must insist on uniform quality in the phones connected to the system. If the buyer's beautiful antique set has poor transmission, or if its dial is unreliable so that she consistently gets wrong numbers, then it is not only impairing her service but also the service of everyone who calls her, or is annoyed by wrong numbers.

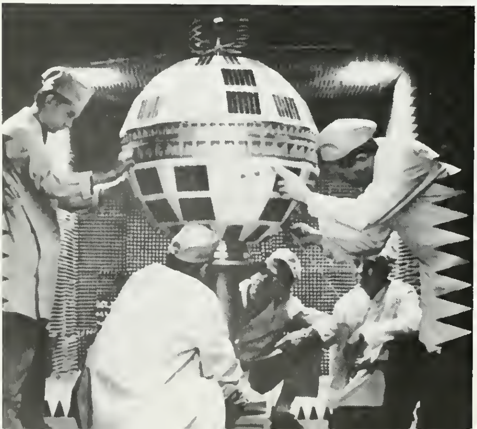
And yet, the demand for antique-decorator telephones persists and grows. Having stated the case for company ownership and control of telephones, can the telephone companies pretend that the problem has ceased to exist, or that there are not customers ruffled by what they see as an arbitrary policy? The answer to the question is no, and one of the solutions to the problem has been found, so to speak, inside the telephone itself.

The Bell System companies are now offering a Custom Telephone Unit. This is an assembly of telephone components which conforms to operating specifications of standard phones and which can be installed in antique-decorator enclosures. The Bell System will supply to any manufacturer, on request, the design specifications of the Custom Telephone Unit. If the manufacturer then wants to make and market an antique-decorator enclosure of whatever period or persuasion which conforms to the specifications any Bell System company will install the unit in the antique enclosure for a $10 one-time charge. Starting this fall several concerns will make available enclosures of exotic design which meet Bell System specifications.

For customers who already own or may purchase in the future antique-decorator phones which already contain electrical parts, the telephone companies will, if possible, arrange to convert these instruments into compatible telephones for a one-time charge, usually about $25. As of the end of May, 1966, about 1,600 of these antique-decorator sets have been modified by Western Electric Company. In any case, once the phone is installed and working, the customer pays only the applicable regular monthly charge for main or extension service. There have been and may continue to be some instances where the modification is either impossible or too costly to be practical.

The offering of the Custom Telephone Unit is a sincere effort to give our customers what they want. It is planned and implemented to insure that the quality of service—everyone's service—will not suffer, as it must not, at the hands of lady fashion. At the same time it makes a polite bow to the lady herself. And the woman who has solved the last decorating detail in her French Provincial living room can have the best of both worlds—the antique-decorator telephone she yearns for, and the quality of service she needs and expects.







In this day when space launches are second nature to us, some of the pictures on these pages may seem to be ancient history. If so, it is only because developments in space technology—especially in satellite communications—have literally rocketed ahead at such bewildering speed that yesterday's marvels are crowded back into history, almost before they can be remembered, by tomorrow's plume of flame on the next launch pad.

The Bell System's direct involvement in space dates back to 1954, when Bell Laboratories' Dr. John R. Pierce made the first concrete proposals for satellite communications. Echo I, shown here, was launched in 1960 and Bell Laboratories' horn antenna at Holmdel, N.J. relayed the first voice signal from earth to space and back. Since then, the Bell System's involvement in space communications has mushroomed into multimillion-dollar commitments. AT&T Vice President Richard R. Hough recently pointed out that the Bell System has spent about $78 million in research and development specifically for satellite communication since 1959. Even that is a small fraction of the one and a half billion dollars spent by the Bell System since the end of World War II in fields generally applicable to satellite communication.

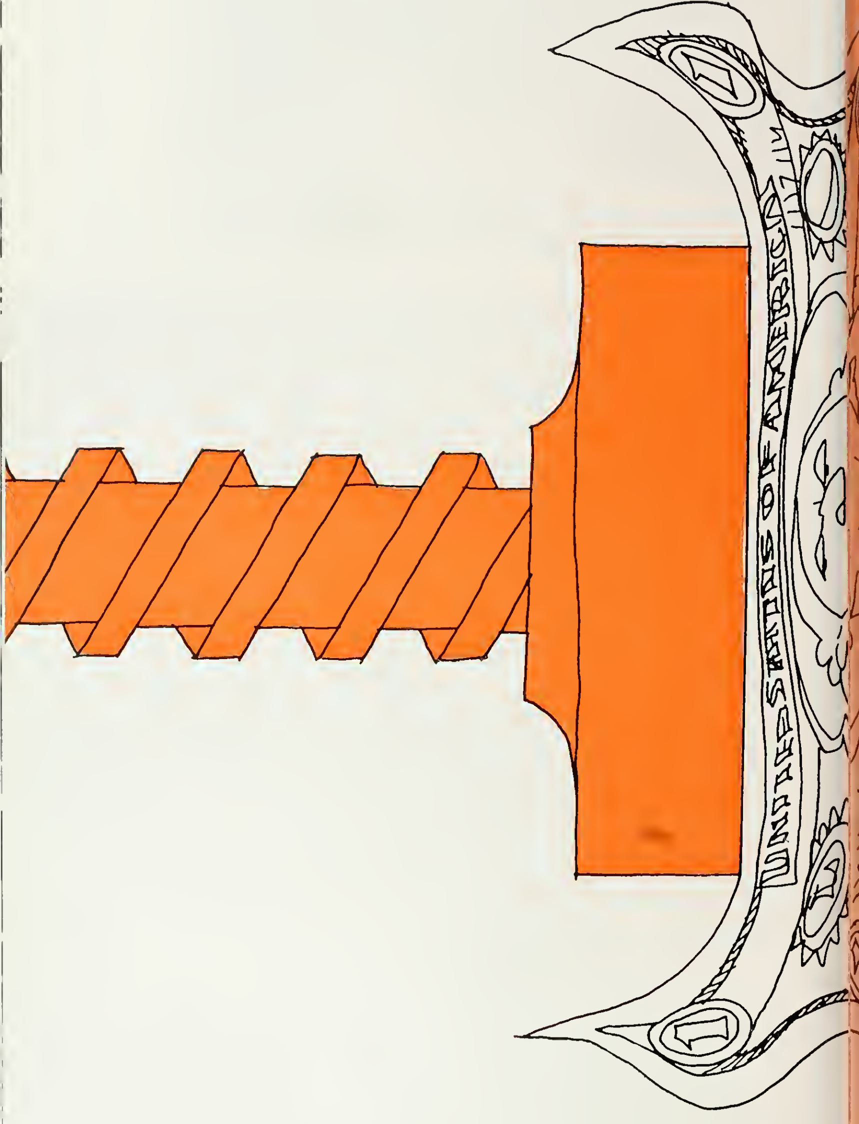
The System's research in the communication art has produced major contributions to space technology. Without such developments as the transistor, solar battery, super-sensitive, low-noise receivers using ruby maser amplifiers, new forms of antennas, modulation techniques, waveguides and traveling-wave tubes, the Telstar® satellite (lower left) might never have electrified the world with the first live transatlantic television transmission.

## Bell System seeks accelerated satellite development, paralleling planned undersea cables, to meet communications needs of the futu[re].

Since the first Telstar experiments were made by the Bell System four years ago, solutions to problems of technology and problems of administration have been running neck-and-neck to keep up with the burgeoning demands of overseas communications. The Communications Satellite Corporation—Comsat—has been leasing the Andover earth station from AT&T since June, 1964, and recently reached an agreement with AT&T to buy the Andover installation, shown on these pages. (The FCC has ruled that Comsat should own the three initial U.S. ground stations.)

AT&T, faced daily with the need for commercial circuits to handle growing overseas calling, is anxious to speed development of satellite communications, and feels that joint ownership between the international communications companies and Comsat is necessary to ensure coordination between terrestrial and space facilities.

To assure dependability and to meet the demands of overseas traffic, the Bell System proposes to use both cable and satellite circuits in whatever combination is needed to provide the best, most economical system. With about eight million overseas calls handled in 1965, AT&T foresees a need for 3,225 satellite circuits for international communications by 1980—in addition to planned supercapacity cables which one day may carry up to 2,300 circuits each.


UNITED STATES OF AMERICA

# DOLLAR SQUEEZE

Housewives grumble about it. Businessmen fret over it. Union leaders are plagued by it.

It makes politicians nervous and economists argumentative. Though no one likes it, inflation is with us. In fact, it's been a persistent problem in our economy over the last quarter century.

While almost everyone will accept that statement at face value, government officials and private individuals will agree on little else about inflation. Exactly what causes inflation and what its best cures are, are highly debatable questions among economists, politicians, and businessmen. Depending upon one's point of view, answers will differ greatly.

But this state of affairs is not at all surprising when the complexity of the subject is considered; economics, politics, business and international events all influence the course of inflation. There is no question, however, that inflation has a potent influence on families, the government, and businesses, including the Bell System.

## All Indicators Up

Though economists do not completely agree on either its symptoms or its effects practically all will accept the broad meaning of inflation today as *a persistent rise of prices in general.* This eliminates both temporary price fluctuations and increases in particular prices which are both normal in any healthy economy.

Inflation is usually measured by the general price indexes prepared by the U. S. Departments of Labor and Commerce, including the Wholesale Price Index (WPI), the Consumer Price Index (CPI), and the Gross National Product Price Deflators. Economists point out that the CPI has some inherent upward bias because it does not reflect quality improvements made in products each year, and that the WPI does not include the prices of services rendered directly to the consumer; thus neither shows the complete price picture. Viewed together, however, they generally give the best overall view of inflation we have. Over the past decade, the CPI has increased at the rate of about $1\frac{1}{2}$ per cent per year and the rise seems to be accelerating this year.

The symptoms and effects of the present inflation are visible in many places. Housewives grumble particularly about rising food prices in the supermarkets, businessmen fret over growing costs, and labor unions are restive about the cost of living.

Inflation also hits hard at the nation's international position. The U. S. has had a balance of payments deficit for many years. In other words, our expenditures abroad have exceeded our receipts. As a result, we have lost some 40 per cent of our gold supply over the past eight years. Although this has been due to many factors other than inflation, the higher prices which inflation brings makes it harder to sell our goods abroad and easier for foreigners to sell their goods here. Thus, unchecked inflation, if severe enough, could lead to international bankruptcy.

Price increases hit hardest, first, at those with fixed incomes (pensioners, government employees, etc.) whose purchasing power is eroded, and second, at those in the lowest income groups, who can least afford rising prices, and who are least apt to have assets that normally increase in value in inflationary periods. Higher costs for businessmen mean not only a choice between inadequate profits or raising prices, but also difficulties in making needed improvements, and expanding.

There are many complex reasons for the current inflation, and economists have yet to agree on its particular series of causes. However, it appears that it is possible to state, with many qualifiers, that there is a general pattern of economic, political and international facts behind today's rising prices.

To stimulate the growth of the American economy, the government, over the past six years, has generally pursued a policy of fiscal and monetary expansion, involving increased government spending, deficits, low interest rates and a rapid expansion of the money supp. This worked well for some time, and the economy thrived while prices remained relatively stable.

As the expansion continued, these policies, particularly the tax cut in 1964, led it to assume the proportions of a business boom. A major segment of this boom was the huge increase in plant and equipment spending. At the same time the economy began to see the early signs of inflationary pressure developing.

Then, two more expansionary forc were added to the already boomi economy, both involving further increas in government spending. Federal spen ing for domestic programs was increase further, while the war in Vietnam adde greatly to Federal defense spending. Th cost of the war and the demand pressure it has generated overheated the econom The result, in large part, has been i creasing prices.

### Cost-Push vs. Demand-Pull

There are, in the main, two basic way of looking at the causes of inflation, th demand side, on the one hand, and th cost side, on the other. Economist refer to these views more formally a *demand-pull* and *cost-push*. In the firs instance, an increase in demand—mor correctly an increase in *spending*—o the part of consumers, businesses an the government will drive prices up; i the second prices and wages may ris independently of demand. However, th two are not mutually independent, an there are many forces at work today tha are strengthening both demand and cos increases. Many economists think tha the immediate inflationary balance i ow shifting from demand-pull to more ost-push.

There is another factor related to gov-rnment spending in the inflation picture. The passage of the Employment Act of 1946 committed the nation to a policy of maintaining employment and income at high levels. (High employment is viewed not as full or 100 per cent employment, which is impossible, but as a low rate of unemployment with roughly 4 per cent as a target.)

One way to increase the total number of employed workers in the country is to increase the Gross National Product (GNP), and this is in fact what has happened, through government encouragement by aggressive monetary and fiscal policies. While these policies do not lead inevitably to inflation, during the early and mid-sixties they led to easy credit policies and deficits which brought increases in demand which, in general, have encouraged business and labor groups to push for larger incomes, and to drive prices up.

As AT&T witness G. L. Bach, Professor of Economics and Public Policy at Stanford University, pointed out before the FCC in the current interstate rate hearings: "While in principle such aggressive monetary and fiscal policy to maintain high employment need not involve rising prices, there is always the danger . . . that it may produce some price increases. . . ." The Employment Act of 1946, however, is generally viewed as *de facto* recognition by the govern-


ment that a small amount of inflation is more tolerable than unemployment. Exactly what amounts of each, however, is a very moot question. In fact, it may be that the combination of economic factors we seek—high employment, business growth, and stable prices—is impossible to sustain over a long period of time.

All of these causes are involved in the current wave of price-wage increases. In addition, problems—not formally inflationary and often beyond economic or political control—have contributed to rising food costs. The current drought, for example, has driven up the cost of many farm products. And the current high prices of meat actually had their origin in low meat prices during 1964 which led farmers to reduce their subsequent production.

### Turning the Tide

In all then, the inflation facing the nation today is extremely complex, and caused by many factors. But are there remedies? Are there any means of at least slowing inflation down, if not restoring price stability?

The answer has to be a qualified yes. There definitely are remedies that can be taken, but economists and government experts are still not certain of how to best use the tools at their command, and the international situation and domest politics place limits on the actions t government can and will take. It is difficult to know just how much effect given fiscal or monetary action will hav however, or what might happen to oth factors operating in the economy at t same time. Against this danger, of cours is the very real danger—almost inevi ability—that inflation itself, if u checked, will bring on a recessic through the distortions which it creat in the economy. It is this narrow tigh rope which must be walked: enoug anti-inflationary measures to check infla tion firmly and quickly, but not so man that the economy is turned into recessio

Some of the possible remedies for in flation are now being spooned out i large doses, but so far they have faile to halt the rise in prices. A recent casu alty, for example, was the President' wage-price guideposts calling for volun tary restraints on labor and business.

### Interest and Money

The Federal government, most econo mists agree, has two main weapons t use against inflation: monetary polic and fiscal policy. Monetary policy refer to the measures that the Federal Reserv

Bank may take to raise or lower the quantity of money available to banks, and thus to businessmen and consumers. Fiscal policy refers to the manipulation of Federal spending and taxation for economic purposes. To restrain the current inflation, until recently the government has relied almost entirely upon a limited use of monetary policy.

Combined with the strong demand for funds within the economy, the use of monetary policy by the Federal Reserve Board to curb inflation has been felt severely in the business world. Interest rates for most kinds of loans are the highest since the 1920's and in some areas, loans are difficult to get. On a recent bond issue, for example, AT&T had to pay over $5\frac{1}{2}$ per cent interest, the highest rate since 1923, and Bell System operating companies have had to pay even more.

The home building industry has been hardest hit by the tight money situation. As interest rates for mortgages have gone up, construction expenditures and home building have gone down. Builders are finding it difficult to obtain construction loans and to get commitments for mortgages for buyers. Besides high interest rates, home buyers have to cope with high mortgage placement charges, and points, a fee that discount buyers pay lenders for low-interest loans.

By making money more difficult and expensive to borrow, a tight money policy slows or holds back investment and production and thereby dampens inflation.

## The New Economics

The government's other major weapon is fiscal policy, and this involves a number of alternatives within the confines of "The New Economics"—a complex of economic theories based on the work of the English economist, John Maynard Keynes.

The New Economics maintains that tax changes and the rate of government spending provide rapid and efficient means of altering the nation's economic course. In boomtimes, the government can slow inflationary trends by increasing taxes and cutting government spending, taking money out of the hands of consumers and corporations. In a recession the economy can be perked up by cutting taxes and increasing public spending. Tax increases are also flexible in that they can be across-the-board increases, or more selective increases aimed at one segment of the economy.

One example of a selective increase is the suspension of the seven per cent investment tax credit on business. This tax provision has allowed non-regulated companies a credit against taxes equal to seven per cent of new investment. (Utilities are allowed a basic rate of three per cent.) Suspending it would contribute to slowing business investment, a segment of the present inflation some economists view as the most out of control. However, a general increase in corporate and personal incomes taxes is favored by some economists and businessmen and might be voted next year.

Fiscal policy also involves federal spending: another way to fight inflation is to cut overall government expenditures. With the war in Vietnam heating up, this possibility seems rather remote. However, there is pressure to cut back

on non-essential domestic spending, even though non-defense spending cutbacks and a general tax increase carry heavy political penalties, particularly in an election year.

Speaking before the House Ways and Means Committee on the proposed suspension of the investment tax credit, AT&T Board Chairman Frederick R. Kappel said: ". . . as one businessman who has a sincere interest in seeing that the country has the economic good health to serve the best interests of all, I applaud the President for taking positive and immediate steps to moderate the pressures on costs, the availability of money and the resulting inflation that is now with us. . . . I would suggest that the overriding importance of prompt and meaningful reduction in government expenditures and appropriations cannot be overemphasized. . . . To my mind this is essential to impress upon all segments of our economy—government, labor, business, and the consuming public—the imperative need for voluntary restraints upon their own respective economic activities and demands. All segments of the national community must become deeply involved in this undertaking. No single segment can do it alone."

### More Drastic Less Palatable Measures

More drastic to the economy would be actual wage-price controls, as were used during World War II and the Korean War. While this remedy will probably not be applied—because of the severe distortions which it tends to create within the economy over time—it might have to be used if the conflict in Vietnam were enlarged to a great extent.

Finally, another possible measure to halt inflation would involve national legislation calling for compulsory government arbitration of certain strikes inimical to the national interest. Theoretically, this would include recent labor battles which notably smashed the guideposts. Public discontent over lengthy strik, coupled with rising prices, could ma such compulsory arbitration a reality a though it would strike a blow at or concept of a free economy and migt lead to more serious problems later o.

The business world looks at the curre inflation with all these causes and po sible remedies in mind. It also has oth inflationary problems to worry abou depreciation, investment and constru tion, stocks and bonds, and rising pric and labor costs. These problems weig especially heavily on regulated indu tries, which generally have huge inves ments in plant and equipment, and whic find it more difficult to react quickly t the many effects of rising costs.

First of all, inflation hits hard a investment and depreciation by makin it impossible for a business to recove the true costs of the assets it uses up i the course of its business. Dr. Bach tol the FCC that: "During inflation, busines depreciation charges based on historica original cost fail to recover for asse owners the value of the assets used u in terms of current purchasing power Thus, inflation may lead to a statemen of accounting profits which are large than 'real' profits, in economic terms and an adjustment should be made o accounting profits in making net incom comparisons among economic groups . . . Use of depreciation formulae based solely on historical original cost dollars will fail to recover the full investment in the asset in current dollars during inflation . . . . If a company invests 100 cent dollars and recovers later only an equal number of 75 cent dollars, it has lost a quarter of its real capital, even though in dollar terms the depreciation shows a full recovery."

Therefore, the steady inflation in the years since World War II, Dr. Bach said, has clearly led to massive underbooking of real depreciation. Because of the rise in costs during inflationary periods, regulated firms must look particularly hard or ways to cut costs since they are constrained in adjusting prices upwards by egulatory lag, and are thus denied the najor escape valve available to other rms. Dr. Bach concluded that inflation hould be recognized by Federal and state egulatory authorities on grounds of both quity to stockholders and economic fficiency.

Because of the involvement of Federal nonetary and fiscal policy in inflation, ie said, it is especially appropriate that 'ederal regulatory authorities should nake an allowance for inflation in their reatment of regulated industries. Basically, this should consist of an "allowance of actual user costs by computing lepreciation charges on the basis of current dollars rather than historical dollars ind recognition of current dollar costs n the rate base . . . ."

Aside from the main problems of investment and depreciation policies and ising costs, inflation also upsets other acets of the business world. For example, he current tight money situation makes t more difficult to raise capital and has lriven up interest, or the cost of money. In the eyes of some analysts, this has made bonds more attractive than stocks to many holders of large portfolios, and has contributed to the current general decline in the stock market. This has an immediate impact on a business's financing plans—for example, whether it will offer shares or issue bonds to raise money for investment—and the price it will have to pay for the new capital.

Thus, like all businesses, the Bell System faces the realities of the current inflation—rising costs for materials and equipment, higher wages for employees, a tight money market and inadequate depreciation. Besides continuing cost reduction efforts, the Bell System is taking a careful look at its overall construction expenditures to make sure they are used as effectively as possible to meet the needs of our customers without adding unnecessarily to inflationary pressures.

President Johnson has called inflation "the most unjust and capricious form of taxation," and as such, it is the responsibility of all—consumers, businessmen and politicians—to do all they can to combat it.

*All businesses need quality controls, but a service industry requires a special kind to provide*

# THE HUMAN MEASURE

When a person buys a new television set, a washing machine or an automobile, he expects he will get reasonably trouble-free performance. Part of the reason he has such an expectation is that the manufacturers have applied a number of measurements—quality controls—to determine whether the products they produce meet standards of quality and performance. But what about a service industry? How does it determine whether the service it provides measures up to its own standards and the expectations of its customers?

This question has been a concern of the Bell System since the early days of the business. The problem is especially difficult in the communications busine because of the large number of relative brief over-the-telephone contacts wit customers.

Over the years, the Bell System ha developed a variety of measurements t determine how well operating units a meeting both our own standards and th needs of our customers. These measure ments fall into two general categories external surveys such as the Service At titude Measurement program (see *BTM* Summer 1966), which help determin customers' opinion of our service an their attitude toward the company, an internal observations of employee an equipment performance.

These internal measurements date ack to just after the turn of the century nd have been responsible for a host f improvements in service: better trans- ission, fewer cut-offs and interruptions, nd more pleasant and faster service.

Over the years as communications echnology has improved, there has been growing use of highly technical sophis- cated equipment, much of which has s own built-in quality control devices. nd in some cases where individuals ere once required to check equipment erformance, mechanical means have een found to do what people used to do.

Despite rapid technical strides, tele- hone people have not been able to de- elop a means by which mechanical quipment can evaluate the way an oper- tor, for example, handles a long distance all for a customer or a service repre- entative takes an order for new tele- hone service. Only a competent, highly rained individual can determine if the mployee is pleasant, helpful, efficient nd attentive in her dealings with a ustomer. An individual must provide the uman measure.

Although the manner in which a spe- ific customer is treated is important, serv- ce observers are not concerned with the erformance of an individual employee. nstead, service observing seeks to de- ermine the level of the service provided y an entire work unit so training pro- rams, equipment re-arrangements, and ew procedures can be developed to im- rove the over-all level of service.

A sampling of the way in which opera- ors handle calls to Information indicated few years ago that operators were still ommitting faults such as giving out in- orrect numbers, ignoring pertinent de- ails, and interrupting customers.

With such specific information at hand, upervisors were able to develop training nd motivational programs to improve perator techniques and work habits. In ddition improvements were made in the ormat of the Information records so perators could more quickly and accurately locate numbers. As a result the level of unsatisfactory service dropped by one-third.

In one Bell System office where service observing was discontinued because of equipment modification work, the lack of quality control was sharply felt. When service observing was resumed it became apparent that the quality of service that customers were getting had deteriorated during the six-month lapse. With the data obtained from renewed observing, weaknesses in the performance of the work group were identified, corrective action was taken, and within a few months, the quality of service returned to the previous high performance levels.

The wide variety of the types of calls handled also makes it necessary to have some means to pinpoint weak areas so programs can be directed at their improvement.

The need to obtain specific indications of the job being done was pointed up in 1964 when calls to operators from coin telephones were first observed as a separate item. Although the level of operator answering speed overall was good, observing indicated that the speed with which operators answered calls from coin telephones was below satisfactory levels. An analysis of the data showed that operators needed special training in handling coin telephone calls, and force and equipment adjustments were needed. As a result, the average time it takes an operator to answer a call from a coin telephone has been almost cut in half during the past two and one-half years.

Such are the typical benefits of a comprehensive quality control program in an industry that has tens of thousands of people and huge quantities of equipment handling the personal requests of customers. Service observing is the management tool that measures the functioning of our facilities and—uniquely and importantly—gauges the kind of personal service telephone people give. It's the human measure of quality, which only an individual can provide.

# in the news...

Bell Labs Symposium

TWX Rate Changes

Caribbean Communications

Services for Handicapped

CCSA Triple Cut

Chicago-Denver Cable

## A BTL Symposium

A two-day symposium, "The Hum Use of Computing Machines," was co- ducted by Bell Laboratories this summer f some 260 members of the scientific and ac demic communities. The symposium w arranged in order to make available to the communities an accumulation of knowled and experience in the development of co puter technology resulting from communic tions research.

Computers have wide-spread applicati in research which requires close and freque dialogue between man and machine; Be Laboratories, which has participated in th development of both digital and analog con puters, has developed and uses technique which enable man to work closely and con municate with computers. Many of thes methods have general application in a nun ber of fields; hence, the symposium wa intended for those who wanted to appl computers to problems in their special field rather than those interested in computers a such.

The guests, predominantly college an university professors, came from across th U.S. and Canada and represented such d verse fields as business administration English, engineering, medicine, psychology humanities, physics and music, in additio to the computer field. There were also guest from such federal agencies as the Nationa Science Foundation and the Smithsonian Institution.

Bell Labs scientists and engineers pre sented eleven papers during the symposium subtitled "A Symposium Concerned with Diverse Ways of Enhancing Perception and Intuition." The program demonstrated some of the many applications of computing machines which are being carried out at Bell Laboratories. It showed how more effective communication between people and computers can be achieved by developing special computer languages and by attaching special devices to computers.

The papers illustrated various aspects of the revolution in computer technology and philosophy. The applications described included: design of electronic circuits, editing and typesetting of text, production of sounds ıd pictures for psychological experiments, ɔeech research, carrying out of routine ıathematical manipulations, and display of ·aphic output for educational films and ther purposes.

Bell Laboratories people presented eviənce that computers are at last feasible for se by people who are not specialized in ɔmputer technology. The digital computer as demonstrated as a realistic tool for use ı a rapidly widening range of investigations, gain with significant reductions in the exertise required of the user.

Until now, computers have not been fully xploited because only computer experts ere able to control them. Even expert comuter programmers have had difficulty in ying to apply the computer to activities eople can carry out with ease. This dilemma ; rapidly diminishing, largely because the cientist or engineer is now better able to ommunicate with the computer. This imroved communication is possible because ew languages for giving instructions to the omputer have been developed which enable fficient programs to be written for a wide ariety of special problems.

The computer is now not only responsive ɔ conventional punched cards and tape, but ɔ the turning of knobs, instructions of light pens, and signals from experimental apparatus. And computer results are displayed in ways more easily assimilated by human operators, through the use of graphs, audible responses, charts and motion pictures.

*Manfred R. Schroeder of Bell Labs, at right, ıas impromptu discussion during symposium.*

The evidence indicated that the term "computer" has become a misnomer. The hardware it describes is no longer merely a gigantic arithmetic machine because new computer software (computer programs or languages) has been developed and because a wide variety of electronic equipment can be attached directly to the computer. For example, with more advanced software and hardware attachments, the computer can now find hidden insights in complex data and display them. It can draw charts and graphs from the data and manipulate symbolic algebra. It can synthesize delicate subtelties of speech and repeat them for language studies. It can use a carefully constructed form of the English language—with the potentiality of analyzing text. It can also generate stereo movies.

In his closing remarks, W.O. Baker, vice president of Research and Patents, stated that ". . . our nation, and to some degree mankind altogether, have become trustees for one of the heroic capabilities so far evolved from science and engineering—that of the giant computing machine and its associated networks of interactions and man-machine complementarities.

"We believe that you are the ones who, especially in your cardinal roles of organizing and transferring all the realms of human knowledge through education, can best see the vast meanings of these machine aids to logic and reason, to the processing of great volumes of coded information—aids to perception, to display, to creativity itself.

". . . The basic thrust of the small but symbolic sampling of progress that we have been able to discuss during this symposium . . . can be realized only by the schools and colleges and universities of this nation becoming the forewave of the new tide of learning, in which computing machines will be known and perhaps accessible to most of the faculties and students in our land. This is probably the greatest single step ahead that education and scholarship could take in our time."

## New TWX Rates

A new one-minute minimum rate schedule for users of Teletypewriter Exchange Service (TWX) went into effect September 1 under tariffs filed with the FCC. The changes include revised monthly rates for basic service and will result in increased charges in some cases and decreases or no changes in other cases. In authorizing the new rates, the FCC deferred a final decision in the TWX case, which has been on the docket since November 1964, and consolidated it with the general rate investigation of Bell System interstate services.

The one-minute minimum period, which will mean savings for many TWX customers who send short messages, reflects the changing use of TWX. Business machines and data processing equipment now generate and interpret many of the messages. According to a Bell System study, about half of today's TWX traffic consists of messages less than three minutes duration. There also is an increasing use of faster teletypewriters which can send 100 words a minute, as compared with older equipment with a capacity for 60 words a minute. The new rates are expected to cause a shift in equipment demand to the newer, faster models.

Under the revised schedules for basic monthly rates, customers will pay $45 per month for the 100-word per minute service using a keyboard sending and receiving teletypewriter. They will pay $60 per month for 100-word per minute service using an automatic sending and receiving teletypewriter. The monthly rate for 60-word per minute service for stations equipped with a basic keyboard sending and receiving teletypewriter will be $40.

In another development pertaining to Bell System services for large business users, AT&T has announced that it will not appeal the U.S. Circuit Court of Appeals ruling that upheld the FCC's order on Telpak. The order was taken to court by AT&T and eight other intervenors.

This means that Telpak A and B offerings, which were found to be not competitively justified, must be withdrawn and "unified" with other private-line rates. AT&T must also submit for Telpak C and D additional cost data and such revised tariff schedules s may be indicated by this data. The FCC h held that Telpak C and D were justified y competitive necessity but that they we unable to determine whether or not the rat were compensatory. AT&T expects that co pliance with the orders will involve increas in charges for most Telpak customers.

## Caribbean Communications

Within the last few months there ha been a number of developments to he serve the rapid growth in the demand f communications to points in the Caribbea

Direct customer dialing of telephone ca between the United States and the Virg Islands was formally inaugurated on Septer ber 19 by AT&T and the Virgin Islands Tel phone Corporation. The improved service w enable telephone customers in the contine tal U.S. and on the islands of St. Thoma St. Croix and St. John to dial one anoth directly.

This step marks the first time that U.S mainland customers are able to dial direct to an overseas telephone. With the introdu tion of the service, the Virgin Islands con pany became the first telephone firm abroa to initiate DDD service to the States.

*Venezuelan workman removes float from new submarine cable as C.S.* **Alert** *stands by.*

In other developments, AT&T has an-nounced new cable and radio facilities to improve telephone communications to several Caribbean points. The facilities provide 11 additional direct circuits between the U.S. and Barbados, six more direct circuits to Antigua, and two additional ones to Trinidad. In addition, the system, which represents an important addition to the growing network of facilities designed to assure the dependability and diversity of communications in the Caribbean, gives improved service through connecting facilities to Grenada, Tortola, Montserrat, Dominica, and St. Lucia, St. Vincent and St. Kitts. The facilities include an underwater cable between Bermuda and Tortola and an over-the-horizon radio system from Tortola to Trinidad, which have been constructed by Cable and Wireless (West Indies) Ltd.

Earlier in August, a new cable was opened between St. Thomas in the Virgin Islands and Venezuela. Tied in with the U.S.-Virgin Islands cable, it completed the first telephone cable link between North and South America (see **BTM**, Su. 66). In addition, AT&T has pending before the FCC a proposal to lay a super-capacity 720-circuit undersea cable between Florida and St. Thomas.

## Services for Handicapped

Under a research agreement between New York University and AT&T, the Institute of Physical Medicine and Rehabilitation of the New York University-Bellevue Medical Center has been studying the telephone needs of amputees and people handicapped by paralysis, muscular dystrophy, arthritis, Parkinsonism and other motion disabilities. This research project, which was to have been completed last June 30, has been extended until next June 30, in order to study more patients in a number of disability categories and to prepare more authoritative recommendations for physicians, therapists, patients and telephone people concerned with providing service for the handicapped. Funds for the project are provided by a Bell System grant.

Initial results of the study, which is part of an overall Bell System program to provide special services for the handicapped, show that most motion handicapped people can be helped by the use of existing—or slightly modified—Bell System products and services. Touch-Tone® dialing, for example, has been found to be ideal for all but the most severely disabled. Speakerphones and telephones equipped with a jack and headset also have wide applications.

Besides studying the application of existing services, the Institute will also try to determine gaps in the Bell System product line and recommend new equipment that would help meet the needs of motion handicapped customers. Results of the study are intended to help the Bell System meet the communications needs of many of the 25 million handicapped persons in the U.S. In addition, the Associated Companies are engaged in a program to make Bell System services known and available to customers with hearing and speech handicaps.

## Triple Cut to CCSA

Three large companies, with a total of 130,000 telephones, have recently inaugurated CCSA—Common Control Switching Arrangement: Westinghouse, Western Electric, and Boeing.

CCSA is an efficient and economical private-line communications system for large companies with offices scattered throughout the country. Under the system, an employee in a company can call another employee in a distant city by dialing only an access code and seven digits. This direct dialing feature brings about a dramatic savings in time over operator-controlled private-line systems.

With CCSA, most extension users have direct dialing access both to their companies' internal network and to the nationwide network. The systems also have the ability to transmit data communications similar to the regular DDD network.

The Westinghouse system, dubbed WIN for Westinghouse Information Network, connects some 30,000 extension users in about 500 locations. Calls pass through six major switching machines using over 700,000 miles of circuits with terminations in 33 states and involving all Bell System Companies and 13 independent companies. Boeing's CCSA system unifies the aircraft manufacturer's 25,000 phones at some 25 locations.

The Western Electric system, called CORNET for Corporate Network, consists of 75,000 extension users at 105 locations in 73 cities. The network interconnects 86 W.E. locations—including distributing houses, manufacturing locations, regional headquarters and most installation offices—17 Bell Laboratories locations, and two locations of the Teletype Corporation, a subsidiary of W.E. For incoming calls, it also includes Long Lines Department and AT&T headquarters in New York City.

The work behind the three cutovers was a team effort involving the Long Lines Department, all Bell operating companies, independent telephone companies, and Western Electric.

The advantages of a CCSA system are rapidly gaining acceptance from many large companies. Present customers include the Federal government through its Federal Telecommunications System (FTS) and Automatic Voice Network (AUTOVON) (see p. 18); American Airlines, General Electric, Lockheed and the New York Central Railroad. By 1970, over 60 customers are expected to have common control switching systems.

## Chicago-Denver Cable

Plans for a 61.3 million dollar blast-resistant telephone cable between Chicago and Denver have been announced by AT&T.

When in full operation in 1969, the cable will add 32,400 voice-grade circuits—funneled through 20 pencil-thin coaxial tubes—to the Bell System's telephone network. All cable, communications centers, power and amplifying stations will be underground and engineered to withstand natural disasters—blizzards, tornadoes, hurricanes—and nuclear blasts short of a direct hit.

The route extends 1,200 miles from Plano, Ill., near Chicago, to Longmont, Colo., with cable legs into North Bend, Neb., and Denver. It avoids large cities and major target areas and will pass through five states: Illinois, Iowa, Nebraska, Wyoming and Colora

At Plano, the cable will be joined to a coaxial cable from Chesterfield, Mass. Chicago, which opened earlier this year. Eve tually, the route will be extended to Oaklar Calif., giving the Bell System a second bla resistant transcontinental communicatio route. The first such route was placed operation in December 1964. Existing fac ties between Chicago and Denver will operating at maximum capacity within thr years; the new route will provide urgen needed circuits and will help insure con nuity and survivability of communications.

The cable will be buried four feet de with nearly 600 auxiliary amplifier statio and 11 main centers strung along the rout The main centers will be two and three-sto buildings of heavily reinforced concrete e tirely underground. In emergencies, the ce ters will be able to generate their own pow and provide living quarters, food and wat to operate during adverse conditions for least three weeks.

## Computer-PHOTAC Trial

The New York Telephone Company an Western Electric have reported succes ful results of a trial in which they applie computers and phototypesetting-composin (PHOTAC) equipment to the production c white pages of telephone directories an Traffic Information records. The trial, whic started in 1962, demonstrated that compu ers and PHOTAC equipment could accurate maintain and update records of customers listings; abbreviate, alphabetize, position in dents, justify lines, and compose column and pages according to specifications; an activate a phototypesetter and composer t produce films and plates of pages from whic directories and information records could b printed.

The system provides the flexibility t change the format, scope, content and type size of directories or information records, and improved accuracy resulting from the effi ciencies of one skeletonized input for updat ing all records—white pages, Traffic records, delivery records and Yellow Pages advertising. In addition, the system is compatible with the planned structure of Bell System business information systems and permits savings in directory and printing expense.

The New York Telephone Company is planning to convert all directory operations to this system by 1972. The computer programs have been made available to the other Bell System companies.

## W. E. College Gifts

Western Electric's College Gift Program, now in its 39th year, will distribute over 500,000 surplus items to more than 500 colleges and universities this year. Unique for U.S. industry in size and scope, the gift program donates items such as resistors, transistors and oscilloscopes for use in engineering and scientific laboratories of colleges and universities. The purpose of the program is to strengthen education and increase scientific research.

Although the surplus or obsolete items may not be worth much to W.E., they are often an invaluable aid to the students and professors in the college laboratories. Throughout the year, Western Electric's College Gift representatives select suitable materials that are slated to be discarded. The items are assigned to one of 11 special storerooms where they are classified. A complete catalog that lists all available materials is sent annually to about 750 science and engineering departments of educational institutions around the nation. This year's catalog runs 69 pages and lists 1,885 items.

*Elon College president reviews special gift allocation with W.E. executive, left.*

The program started modestly when 18 surplus oscilloscopes were donated to several northeastern schools. Today it has grown to the point where the law of supply and demand makes it difficult to include additional colleges and universities in the program.

W.E. contributions also meet certain special needs. For example, this summer a special allocation outside the regular College Gift distribution program was made when Elon College in North Carolina lost much of its laboratory equipment in a fire. Since commercially ordered replacement material could not have been delivered by the start of the fall semester, W.E. donated 108 pieces of scientific equipment.

## Pacific Cables

The last decade has seen a communications explosion in the Pacific. The boom was touched off in 1957 when AT&T laid its first underseas cable between California and Hawaii and has mushroomed with each improvement in Pacific communications facilities.

AT&T, in partnership with other communications companies and foreign nations, followed up its first Hawaiian cable project in 1964 when it installed cables to Japan, the Philippines, and a second cable from California to Hawaii. In addition, AT&T also acquired circuits in the COMPAC and SEACOM cable systems built by British Commonwealth nations.

Sharp increases in the volume of messages between the U.S. and Pacific points have resulted from the improvements. U.S.-Pacific messages totaled 1.2 million in 1964, climbed to 1.8 million in 1965, and are expected to exceed two million in 1966.

In each case where a cable has been opened, the number of messages between the U.S. and the overseas point has tripled within a short time. In 1963, for example, there were 86,000 messages a year between the U.S. and Japan. The following year, with the opening of the cable, the figure rose to 145,000 and increased to 218,500 at the end of 1965. Telephone messages between the U.S. and the Philippines reached 95,000 during 1965, more than three times the total in 1964; in December of that year a cable was opened to the Philippines via Guam.

AT&T expects similar increases to occur in the flow of messages between the U.S. and Southeast Asian countries as a result of the opening in August of the SEACOM cable, providing the first direct cable link between the U.S. and the Southeast Asia area. AT&T has acquired 15 circuits which will serve Hong Kong, Singapore and Kuala Lumpur, the capital of Malaysia. AT&T will also acquire circuits in the Guam-Madang-Australia portion of the SEACOM system when it is placed in service early next year.

At present, AT&T has no plans for additional cable facilities in the Pacific area. Instead, it hopes to utilize 20 to 25 circuits in the new satellite which Comsat plans to loft later this year over the Pacific in connection with the Apollo manned flight project.

## Coin Service Trial

Coin telephones which tell the user that the phone is working and permit him to dial the operator without depositing a coin were introduced on a trial basis in August. Part of the Bell System's coin telephone service improvement program, the "dial-tone first" concept is being tested initially in Hartford, Conn.

In the Hartford trial, the coin telephone caller knows immediately that the phone is working when he lifts the receiver and hears the dial tone. He then inserts the money as usual.

To obtain the assistance of an operator, the caller dials "0" without inserting a coin. Local emergency calls, such as calls to the police or fire department, are put through by the operator at no charge. Only calls to the operator can be dialed without a coin.

The trial, which required modification of phones and central office equipment, is limited to outdoor public coin telephones. Trial objectives are to determine the extent of service improvements to the customer, customer reaction, instruction requirements and the effect on telephone company operations. Other trials of the services are lso planned.

## Southeast Asia Assignment

At the request of the Defense Cm-munications Agency, the Western Ec-tric Company has undertaken a systems n-gineering study of defense communicat ns facilities on the Southeast Asia mainland. he work will require W.E. to recommend immdi-ate service improvements and to draw u a long term engineering and operating plan f a fully integrated system in Southeast Asia.

People from the Bell Operating Compa s will work with W.E. in varying assignme s, some at project sites in Vietnam or Thail d and others in Washington, D.C.

## Mercury Memo System

Mercury, the immortal messenger, s traded his old-fashioned sandals fo a computer. Mercury is Bell Telephone Labo-tories' computer-aided system which curre y distributes technical memoranda on mat-matics and the computing and informati sciences. Eventually, the system will exte to other subject areas.

The Mercury system, which was conceiv by J.F. Traub and W.S. Brown, members f BTL's Mathematics and Statistics Resear Center, enables any employee to recei promptly new memoranda written by spe-fied authors or departments. Requests a made on a brief form and channeled to t center of the system, which is operated the Technical Information Libraries.

The system also distributes memoran not specifically requested by users but per nent to their stipulated areas of interest enable readers to keep abreast of new deve opments. Authors can command distributi not only to specific readers and organiz tions, but to any employee who has indicate interest in a subject.

Vital to the flexibility and growth of th system is the Mercury Thesaurus, writte by Mr. Traub. It is a short, structured voca ulary of the mnemonic codes used for eac subject. Authors and readers use it whe specifying subjects wanted for distribution.

From the point of view of Mercury users, ıe system centralizes and expedites disəmination of information. It also affords ıpid transfer of memoranda from authors to readership which formerly was only potenally within reach.

## Reliability Testing

Western Electric squeezes years into minutes to produce durable telephones ɔr the Bell System. This compression of me is done in the Performance and Reliabily Laboratory at W.E.'s Indianapolis Works here facilities are designed to give telehone equipment such a rough ride in a hort time that it will equal long periods of ormal use.

The testing gives Western engineers reaonable insight into how a mechanism will erform, say 15 or 20 years hence, the norıal service life of a phone.

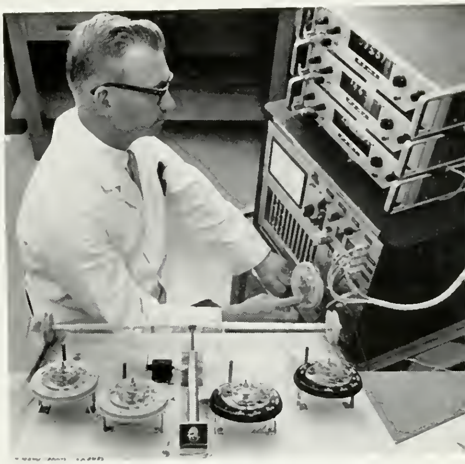
In another phase of testing done by the &R Laboratory, problems of environment re re-created to determine how telephones vill function when exposed to the saltiness f coastal living, or the extremes of temperaures from the Dakotas to Florida.

All designs of new models, ideas for adance product development and cost reducion are put through an exhaustive series of tandardized and improvised tests conceived t the laboratory. Only the best survive.

Set off from the cadence of telephone production, the P&R Lab consists of two spotless, air-conditioned rooms where relative humidity is kept at 50 per cent.

The lab is a veritable side-show. A "drop est" mechanism, which resembles a guilloine, simulates the stress on a phone accidentally dropped from a desk or table-top. Another machine removes and hangs up receivers to subject equipment to the rigors of accelerated time involving several hundred thousand repetitive operations. Another unique apparatus which looks something like a wheelbarrow simultaneously drives several telephone dials to failure; it usually takes a couple of million rotations—the equivalent of about 160 years of average use.

Two eraser tipped poles operated by compressed air, which makes them sound



*Wheelbarrow-like device tests phone dials.*

like a toy steam locomotive, perform a life test of the recall button on the Trimline[R] phone. The button, built into the phone's receiver, permits a conversation to be ended without depression of the switchook. Failure usually occurs after 100,000 depressions.

Sheltered from these sounds are about 100 square feet of silence: the quiet room. Here, amidst walls of fiberglass wedges that consume sound, tests are made that determine the audio qualities of buzzers, ringers and gongs used with the telephone.

Other test apparatus includes a temperature-humidity chamber where telephones are exposed to temperatures ranging from 60 degrees below zero to 160 degrees above zero at a relative humidity exceeding 90 per cent. A corrosion test cabinet gives a telephone a 24 hour salt spray bath equivalent to 20 years of continuous exposure in a typical salt fog atmosphere much like that found in coastal regions. There is even a transportation simulator that subjects telephones in cartons to the knocks they are likely to receive during transportation.

The end result means telephones that defy both time and environment.

## American Academy Honors

Edward E. David, Executive Director of the Research Communications Systems Division at Bell Laboratories, recently became the twelfth Bell Labs person to be elected a Fellow of the American Academy of Arts and Sciences, one of America's oldest honor societies. That number is by far the largest representation from any one industry.

David was one of 150 Fellows and Foreign Honorary Members elected at the Academy's 186th Annual Meeting. Among the new members were such diverse personalities as civil rights leader Martin Luther King, Jr., polio vaccine discoverer Dr. Jonas E. Salk, historian Bruce Catton, novelist J.D. Salinger, president of the Soviet Academy of Sciences M.V. Keldysh, and General Electric president Chauncey Guy Suits. Members are chosen from among those who are "eminent for their discoveries or attainments" in four classes: mathematical and physical sciences, biological sciences, social arts and sciences, and humanities.

Bell Labs people previously elected are President James B. Fisk; retired President Mervin J. Kelly; Research Vice President William O. Baker; Military Systems Engineering Vice President Hendrick W. Bode; Executive Director John R. Pierce and Associate Executive Director John W. Tukey. Other BTL members include Walter H. Brattain of the Surface and Atomic Physics Research Department; Conyers Herring of the Theoretical Physics Research Department; Bernd T. Matthias of the Solid State and Low Temperature Physics Research Department; Executive Consultant William Shockley, and Mathematical Consultant Claude E. Shannon.

## Arches of Science Award

Dr. Rene Dubos, a microbiologist ıd experimental pathologist with the Roc-feller University, has been named as e winner of the Arches of Science Award of the Pacific Science Center. The award, nand for the five distinctive arches which s above the Seattle science institution, carr a cash prize of $25,000 and a gold medal.

Sometimes called the "American Nol Prize," the award is sponsored by the Paci Science Center Foundation, a non-pr agency of business, scientific and educatio leaders in the Pacific Northwest, and ma possible by grants from the business co munity of the Northwest, most notably Paci Northwest Bell Telephone Company.

In his citation of Dr. Dubos at the a nouncement ceremonies, Dr. Dael Wolfl chairman of the Arches of Science awa committee and executive officer of the Ame can Association for the Advancement Science, noted that "the contributions he ha made to the better understanding of th meaning of science have spanned man years." The citation stated that "he has dis tinguished himself by helping man to unde stand more deeply the fundamental meanin of scientific activity and to appreciate mor fully and more accurately the changes i human society that are resulting from scien tific knowledge and the relation of science to other aspects of man's life and culture."

Dr. Dubos, widely known as an author and lecturer, first demonstrated the feasibility of developing germ-fighting drugs from microbes more than 20 years ago. Some of his most recent work concerns the environmental effects which influence human life.

# Somebody loves a loser

The Bell Telephone Hour has been on radio and television for 26 years. In its radio heyday, it had as many as 7 million listeners on some memorable Monday nights.

Since moving into television in 1959, it has been a shaky performer in Nielsen ratings. Last year, we averaged 12 million viewers per show — far below the 33 million average of the top ten network shows.

Despite our anemic ratings, we hang doggedly to the idea that the millions who seek fine music and musicianship on TV are splendid citizens who make a lot of telephone calls, and that The Telephone Hour is a good advertising buy for A.T.&T.

This season, we're back again — losin viewers to the Pow! Crunch! Zonk! show — with a new musical excursion. Usually we'll set forth with mike and camera t involve TV viewers at firsthand in som of the excitement of the music world. Visit ing places of musical renown. Filmin intimate profiles of great artists at work Documenting major musical events, her and abroad. Bringing back 15 hours o musical experiences. Perhaps not ever show will be distinguished. But that's wha we'll be trying for.

In the TV ratings race, we may be back ing a loser. Whether you're a music buf or not, you may find some excitement i joining our exploration of the world o fine music. Tune in and give it a try.

AT&T Bell System
American Telephone & Telegraph
and Associated Companies

January/February 1967

# BELL

telephone magazine


AT&T

# BELL

## telephone magazine



**VOLUME 46 NUMBER 1 JAN/FEB 1967**




Shown on the cover are capsule images drawn from five of the feature articles in this issue. Reading clockwise from the left you see *A Cable for Growth*, the story of the new Boston-Miami cable; *Wasteland Revisited*, an examination of cultural programming on commercial television; *Organization Renewal*, which tells how new management development efforts are aimed at the total organization; *Communications Satellites*, a brief description of AT&T's recent proposal to meet mushrooming communications needs through 1980; and *The Campus and Business*, an insight into young people's attitudes on business.

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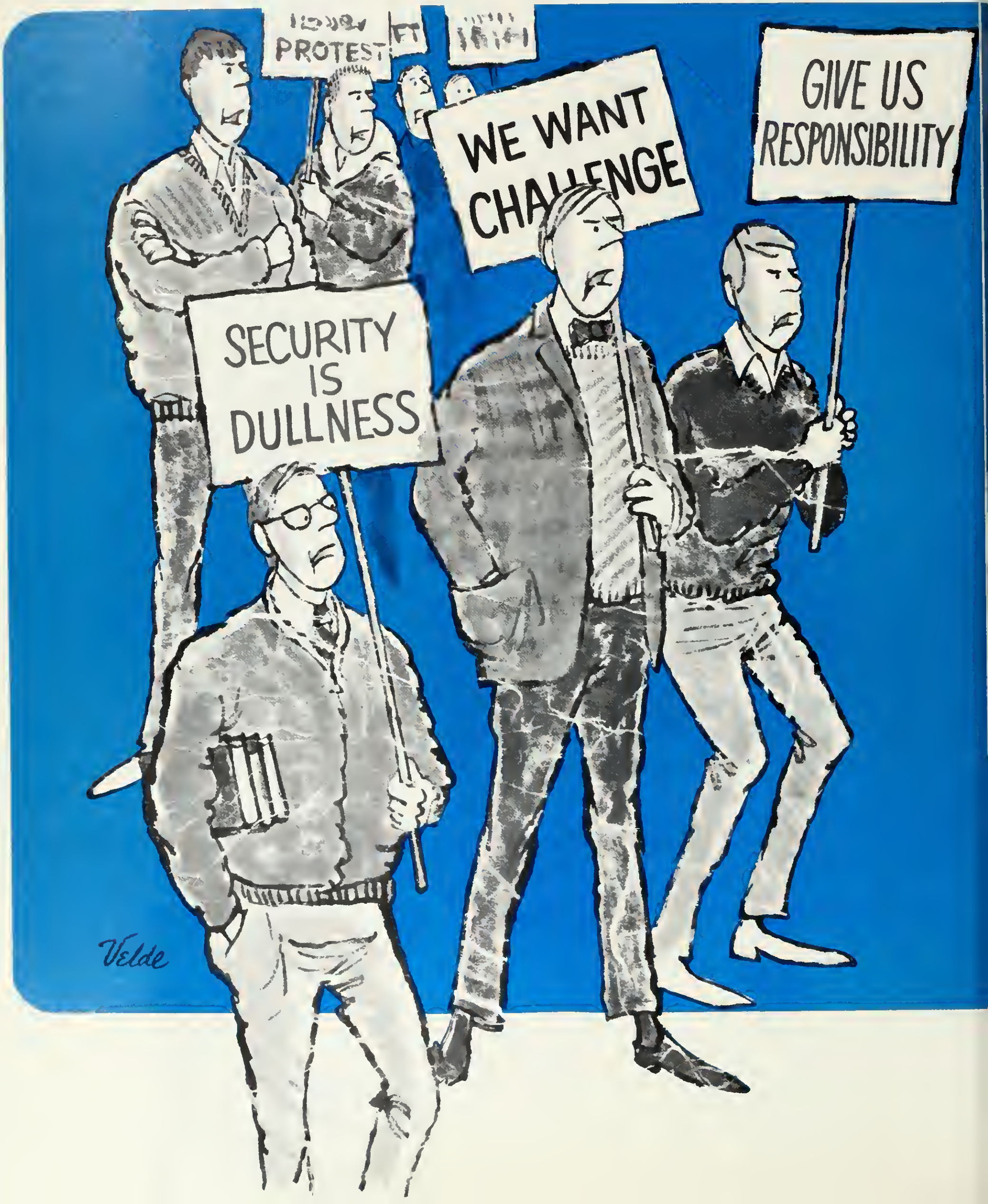

PROTEST
WE WANT CHALLENGE
GIVE US RESPONSIBILITY
SECURITY IS DULLNESS
Velde

# The Campus and Business

The United States is fast becoming a young country now that more than half of our population is under 28 years of age. Because young people are important to us more than just as customers, the Bell System and several other organizations joined with the Gallup organization to survey the attitudes of over 1,100 college students at 57 campuses across the country.

Like several other studies, the Gallup results indicated that young people have mixed emotions about business and its role in society: 84 per cent commend business for what it has accomplished, but almost as many (76 per cent) offer criticism. Three out of four business administration and engineering students may lean towards a business career, but other students (which make up 80 per cent of the total) have much less preference and regard for business: two-thirds of them say they prefer education or government work.

For an insight into the thinking of the college generation, BELL TELEPHONE MAGAZINE asked a University of Missouri graduate student to give us his thoughts on the attitudes of college students and explore some of the reasons behind them. A native of St. Louis, Ted Warmbold is currently finishing up his requirements for a master's degree from the School of Journalism. While an undergraduate, Ted was active in a wide range of student activities and is now looking forward to a career as a newspaper reporter. And to get the young businessman's reaction to this summary of college attitudes, we asked several recent college graduates now working for Bell System companies for their comments.

## The Campus View

By Ted Warmbold

Never has a generation been more analyzed and criticized, more praised and pampered, more coddled and condemned—and more misunderstood—then today's college generation. Especially disturbing is student apathy toward big business.

Though industry still obtains substantial numbers of engineering and business administration students, it seems to be suffering a decline of interest among undergraduates as a whole. College graduates, in increasing numbers, are turning to public service and education for employment.

Why? The answer lies in this younger generation: Never have so many had so little experience or contact with war, hunger, poverty and disease. We have hugged the headlines with our riots, rebellions, Beatlemania, Vietnam protests, LSD experiments, draft-dodging and our craze for James Bond and Batman. And with it all, we find the hope of the world in our laps and the threat of war on our shoulders.

In dress, bizarre and shocking fashions, the mod look, are "in." Music — our songs are no longer romantic. Today they are serious and startling social commentaries. We don't embrace while dancing but perform as individuals — the extreme is the discotheque: the dancer go-goes it alone.

Intellectually, we think we outshine our elders, many of whom never had comparable educational opportunities. Politically, we are far from apathetic and, in fact, are too often attracted by the extremes on both sides. The art we enjoy — both "pop" and "op" — makes even Picasso seem old-fashioned.

Not everyone is like this, to be sure. But the leaders of this revolt affect our attitudes, if not our overt behavior. Emotionally, all of us support the revolt against the older generation, the "Establishment."

But where does business fit into this picture? That's the point, it doesn't!

Many responsible businessmen are perplexed and bewildered by the attitudes of the younger genera-

## The Business View

Each of the nine recent college graduates now working for Bell System companies agreed that business has a problem communicating with college students. They also agreed that most graduates want to become quickly acclimated to the business world by being given responsibility and the opportunity to express themselves. Here are excerpts of what they said:

**Ed Paul, New Jersey Bell:** The college student looking at business doesn't see anything that really takes his fancy, anything he can really get his teeth into, anywhere he can make his mark. We should send people back to job and career seminars and have former graduates representing various industries go back to discuss business with undergraduates. We should also publicize what we are doing in the field of education.

**Ilse Werzer, AT&T:** People coming out of college are used to having an intense, pressure environment where they can produce and where they have immediate recognition for what they produce. They feel that in business this kind of feedback may take months. They are looking for an atmosphere where there is more pressure, responsibility and human contact. We should give students summer jobs that are not just a training program.

*Paul*

tion. But students themselves are quick to explain their attitudes. Criticism is often pointed, and highly personal: "Today's business world just doesn't turn me on," moans a graduate student. "After all,.there's more to life than making a buck."

Some rebel against the unrelenting drive for profits. "A businessman has to think in dollar signs to survive," exclaims a 22-year-old education senior from Kansas City. Others object to increasing competitive pressure. "All you get for a gold-plated salary is a gold-plated ulcer," says a math major from St. Louis. Still others view the modern corporation as a faceless tomb of conformity. "I'd rather polish shoes than work for a corporation where men aren't capable of having an original thought," says an 18-year-old college freshman. And some, like the coed who worked for two years as a secretary in New York City, just can't take the boredom. "The four executives in that office couldn't even keep one secretary busy, much less four of us."

To some students, big business seems a jungle where acceptable standards of ethics are readily compromised by corner-cutting in a drive to meet competitive pressure, to turn a fast buck. Ethics has always been a preoccupation of youth. But to this generation, it is especially important. They cannot forget when John F. Kennedy issued his challenge: "Ask not what your country can do for you, ask what you can do for your country."

In the opinion of many students, it seems that big business, instead of heeding JFK, has willfully turned his exhortation on its head, to read: "Ask not what you can do for your country, but ask what your country can do for you." Most students are patriotic, many are prepared to risk their lives for their country in the jungles of Southeast Asia. And yet they think some big businessmen are embarked upon a course of acquisition and selfishness, often at the expense of the country for which the students are prepared to risk their own lives.

**John Conahan, Bell Telephone Laboratories:** The important word to college undergraduates is 'commitment.' It's hard for the student to apply this commitment to the business world. They have an impression that business is narrow: they can't see that there is a broad spectrum of opportunities in business. We should publicize the fact that background and accomplishment are recognized in business just as they are in education.

**Angelo Donofrio, Bell Laboratories:** The problem is one of information. The fields of education and government have outlets of information on

*Werzer*

*Conahan*

*Donofrio*

They see, for the sake of a few million dollars in extra equipment, thousands of industrial plants filling rivers daily with tons of polluted waste. They see, for the sake of a small percentage increase in sales, an endless chain of billboards plastered along the nation's highways. They see industry executives being sent, like naughty schoolboys, to prison for price fixing. They see the pressures brought to bear to defeat the truth-in-lending and truth-in-packaging bills.

And the younger generation could not help but witness the reluctance of top auto industry officials to introduce safety features. Though cancer remains a number one killer, youth sees business concerned with cigarette sales.

These incidents, to be sure, are peripheral. The vast majority of big business is not guilty of such sins. But the good that 95 per cent do is oft-forgotten in the headlines about the other five per cent. Most students realize that only five per cent of business has been caught up in this ethical quagmire, but they resent the fact that the older generation expects them to believe these incidents never happened.

Our impressions of big business are also contradictory: We know businessmen are diligent workers, well-trained in their fields, creative, dedicated and, at times, intellectual. But, we get the impression they are selfish, lacking in public spirit and insincere.

Idealism is the key to understanding the younger generation and its attitude toward business. Its standards are high — and they are severe. Not because youth hates big business, but because it has come to expect so much from it. The new breed does not challenge the right of big business to make a profit but it does ask how businessmen use this profit — whether it improves the quality of American society.

If it does not, big business is blamed—but strangely enough, not usually the big businessman. Why? Because big business is so impersonal. How many top business executives can the average student name? The few that come to mind are those who have left

the campus, but business doesn't. There is a missing personal element. We should send a young alumnus back to school with the recruiter.

**Joe Turri, Long Lines:** Money is no longer a major motivating factor. The student wants a constant feeling of responsibility, achievement and recognition. Today, the professor will suggest something like graduate school because he feels it stresses individual growth. We have to convince professors that we are bent on individual wants and needs, that we're not going to take the college graduate and sap him. We have to make them realize we want individuals to grow.

**John Kurtz, Western Electric:** The student has a stereotype to combat. Whereas he views himself as an individual, industry may look upon him as becoming part of a stereotyped class. We must bridge this conflict, dissolve this barrier. We must get it across that we do not view him this way. He must feel that we will recognize his attributes, give him something challenging to do.

**Joseph McCann, Western Electric:** The time a student feels that it takes just to get oriented in a company simply doesn't fit into his structure. He is not used to the long term. He wants to have impact. We have to be community-oriented as a company and encourage individuals to be that way. We must fulfill our expectations.

*Turri*

**Tom O'Brien, New York Telephone:** We must create an image that appeals

industry for public service — Robert McNamara of Ford, Charles Percy of Bell & Howell, Sol Linowitz of Xerox, George Romney of American Motors — men who were interested in more than industrial profits.

Aside from the ethical picture, a major student beef is that business is just plain boring. "An unexciting rut," says a business student who spent last summer as an industrial trainee and vows he'll never return. "I spent the day trying to distribute one hour's work over eight." Or take the case of the Ph.D. who quit industry after a year and a half to teach marketing at a midwestern university. "I turned out to be their 'consumer relations man,' " he reports. "I picked people up at the airport, took them on tours of the plant, slapped them on the back and gave them gifts. Some challenge!" Students view big business as a high pressure, conformist place where superficial values prevail — where men in gray flannel suits indulge in gray flannel thinking.

And where do such notions come from? From the university professor who five years ago left a successful career in industry to teach economics — obviously he finds the classroom more stimulating than the executive suite, whether or not he ever mentions it to his class. It comes from the student's father, as he bemoans the office "rat race" or the dismal future of certain automation and possible unemployment.

urtz McCann

O'Brien

Russell

to the idealistic-minded college student. Let students and professors know that we are involved in civic affairs. Go out to the college campus and show a movie about how we are helping youths in Harlem. They know we can operate a telephone, but they should also see that our employees can be active in the community.

**Hans Russell, New Jersey Bell:** The only representative of business that ever shows up on campus is the recruiter. When you see him, you are immediately on the defensive. We should get younger people that are not that far-removed from college to go back and talk to students.

Today's student has no great urgency to get a job and make money. Unlike the Depression and World War II generations, today's student has money in his pocket and usually takes it for granted. He sees no reason to turn in his college sweatshirt for a white collar — and so, he frequently turns to graduate school or the Peace Corps. Security is dullness. Today's college generation wants action — plus challenge.

Alumni tell us that many of those initially enthusiastic about a business career are often quickly disillusioned by the training programs of large companies. As one college administrator said in a national magazine: "A lot of companies take good men in and bore them something awful. Second-rate people run training programs and grind guys through all kinds of dull assignments. The trainee never sees really bright people."

Big business of today must not only compete for the college senior, one industry with another, but it also must compete with rival vocations. To many idealistic seniors, law, medicine, teaching and journalism hold an appeal unmatched by the prospect of sitting behind a walnut desk with a bevy of beautiful, efficient secretaries. In the past decade, the rise in prestige of these professions has been accompanied by a rise in salary. At the same time, these professions hold an appeal for the student aroused to the challenge of the New Frontier. Less supervision, more responsibility and less pressure has forced the situation where big business no longer can select the cream of the college crop, but must compete in a wide-open market with the professions, to say nothing of graduate schools.


And unlike the youth of a previous generation, today's college student faces the ambiguity of the present-day selective service system. He is unsettled and this feeling permeates his attitude toward big business.

What can be done to improve big business' image on campus? What can be done to change the image created by limited personal experience, the shape of the news and the student's important but indirect contact with the commuter mentality of the corporate world: the fairytale fantasy of "The Man in the Gray Flannel Suit" and "Cash McCall" and the vapid, back-slapping of "Death of a Salesman"—to say nothing of the soapbox serials and the unflattering wasteland of so much of television drama? Frankly, I don't know how business can best tell its story on the campus, but I do think today's college generation will turn to big business if it sees a challenge there. Today's graduate demands the unusual business, with sophisticated research laboratories, freedom to think on his own, the latest management techniques and an opportunity to be treated like an educated man. Yes, youth is demanding — but demanding challenge. If business can offer this, business can win the confidence and respect of the younger generation. ■

To meet the long distance communications needs of America in the '70's, '80's—"and beyond"—the Bell System has proposed a new plan for

# Space-Earth Communications

Sometime in the seventies, your voice may travel the 2,800 miles from Los Angeles to New York via a 46,000-mile trip to outer space. This is one possibility that could result from the latest Bell System proposal on how to unclog the earthbound voice, data, and TV communications highways of tomorrow.

Based on ten years of Bell Laboratories research into satellite communications, the proposed system utilizes the latest technology of space communications. Here's an outline of the proposal recently presented to the Federal Communications Commission:

• Beginning in 1969, orbit two synchronous satellites similar to the kind currently being considered for domestic use by Comsat. Each of these satellites would have a capacity for 9,600 voice circuits or as many as 12 TV channels. This capacity would be integrated with the Bell System's nationwide wire and microwave network and permit the telephone companies to select the most economical pathway to meet a given need.

• The first two satellites would be "locked on" to large transmitting and receiving stations in the vicinity of Los Angeles and New York. In addition, some 73 smaller TV "receiving-only" earth stations would be built in selected locations across the country from which terrestrial microwave links would connect to TV broadcasting stations. Initially, the system would provide facilities for the equivalent of about 3,200 two-way voice circuits, 8 full-time TV channels, and 12 TV channels for "occasional" use. This first phase would be completed about 1970 or 1971 with the construction of another large transmitting and receiving station near Chicago, and the launching of a third satellite.

• Initiation of the second phase of the plan would begin about 1972 with the introduction of an advanced-design satellite capable of providing 12 TV channels and over 30,000 voice or data circuits.

• Increased communications capacity will be possible through use of previously unused higher frequencies, highly directional satellite antennas and new transmission techniques. Four of these advanced design satellites would be launched: two about 1972, one about 1975, and one about 1976. The last two would replace the three satellites launched during the first phase. The 73 TV receiving stations would be supplemented by 26 new transmitting and receiving stations.

• On the question of ownership of the proposed system, AT&T's position remains consistent with the approach it has taken on satellite service in the past: Comsat would own the satellites and the common carriers who use the ground facilities would own and operate them.

The Bell System proposal offers important advantages over any other plan seen so far.

Number one is cost. The new space-earth system would save money in at least two ways. It avoids the waste and duplication of facilities that would result if a number of privately owned systems were constructed. And the state of the art is advancing so rapidly that it probably will be cheaper to construct new bulk circuit capacity via satellite than it would be to build new "overland" facilities — at least at distances over about 1,300 miles.

Besides providing maximum service at minimum cost, "Phase II" of the plan helps avoid crowding the sky with radio signals. By using the higher frequencies made possible by advanced satellite and ground station design, the new system would not add to the clutter caused by the ever-increasing demand for lower-frequency microwave channels.

Also among the main advantages cited for the new plan is its complete flexibility. This means that the system need not be pre-committed to any particular use. It would be capable of handling full-time program transmission services for the three major commercial TV networks, a fourth major commercial TV network, a nationwide educational television network, and anticipated communications requirements of the public and the government — civil and military. Yet, for any given occasion, terrestrial facilities would be used if they were the most economical, considering the over-all nationwide demand for circuits at that particular moment.

In submitting the new plan, the Bell System stressed that its recommendation was based on an objective study of future communications needs. These studies, said AT&T, "involved no commitment for or against the use of satellites. . . . Rather did they involve an objective addressed to the broader question: How can the growth requirements for United States common carrier services be met at lowest cost. The overriding criteria . . . were quality of service and cost." ■

*Initial phase of AT&T's proposed Space/Earth System calls for two satellites intermixed with ground facilities.*

*Combining terrestrial facilities with satellites provides reliable communications, even if one ground station is obstructed.*

The development of new computer programs and display devices which can read and draw pictures helps designers and engineers make more efficient use of machine technology

# Computer Graphics

Without knowing it, millions of Americans watching television recently saw in action one recent development in computer technology that is rapidly pushing outward the boundaries of the man-machine relationship. Last November 8, election results on the CBS network were graphically illustrated in constantly changing pictorial representations on a device resembling the TV tube itself. Although computers have been used before — and were used that night — to compile and predict results of the nation's voting, it was the first time that the general public had seen output from a computer's computations shown directly in visible, pictorial form.

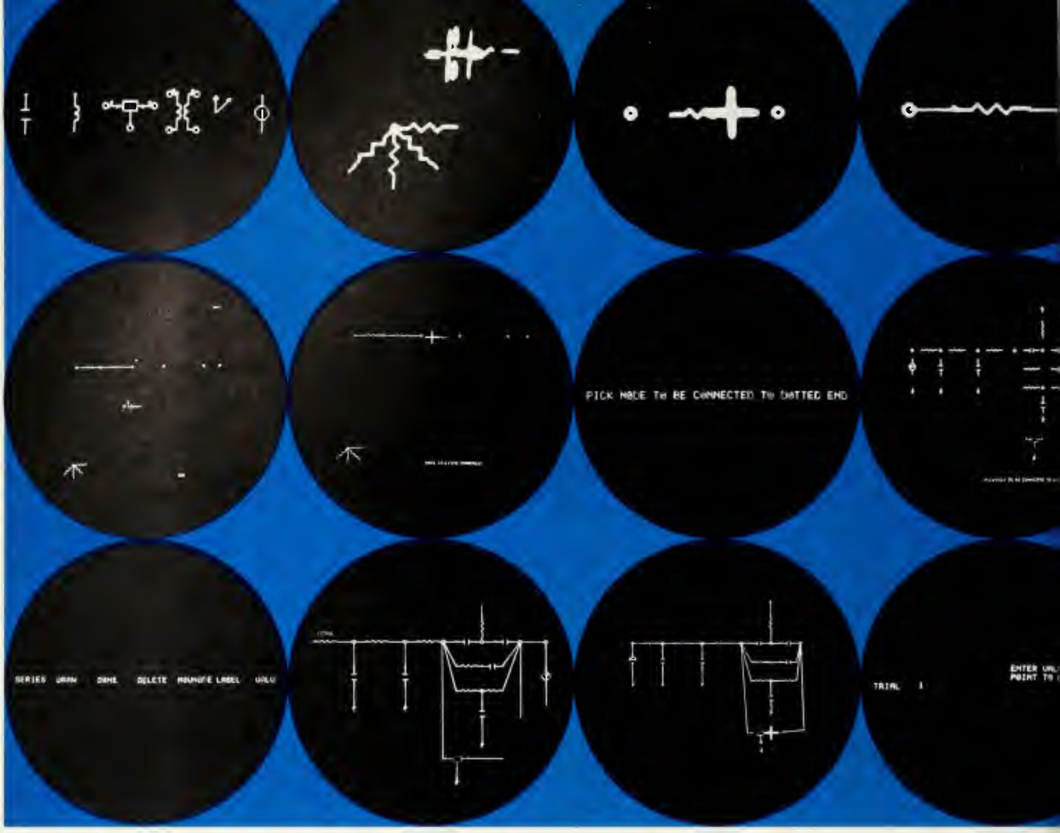
It was just one manifestation of what has rapidly become one of the most dramatic and exciting advances in computer technology: computer graphics.

Computer technology itself has developed at a fantastic pace and is now facing new horizons in science and industry. Indeed, Dr. Kenneth G. McKay, engineering vice president of AT&T and former executive vice president of Bell Laboratories has said, "There is now virtually no segment of research or development that does not depend vitally on computers. Their use has not only accelerated the pace of discovery but it has enabled us to attack problems which previously were far beyond our reach."

Bell Laboratories has for some years been depending more and more on computers to aid in research, analysis and, more recently, in electronic design.

The problems referred to include many containing such vast numbers of complex variables that their solution by ordinary means would be utterly impractical, entailing thousands of man-years of tedious, repetitive human calculation. The electronic computer can perform such calculations in minutes and deliver a workable result. The machine, however, must be told by the man what to do before it can deliver anything. Televised projections of final election results were amiss probably because of inadequate programming of the computer. The workable result traditionally — if so new an art can be said to have a tradition — has been in the form of "long dull lists of numbers" (in the words of one computer expert). Both the instructions to the machine — input — and its responses — output — must be translated from human language into machine language, and then back again.

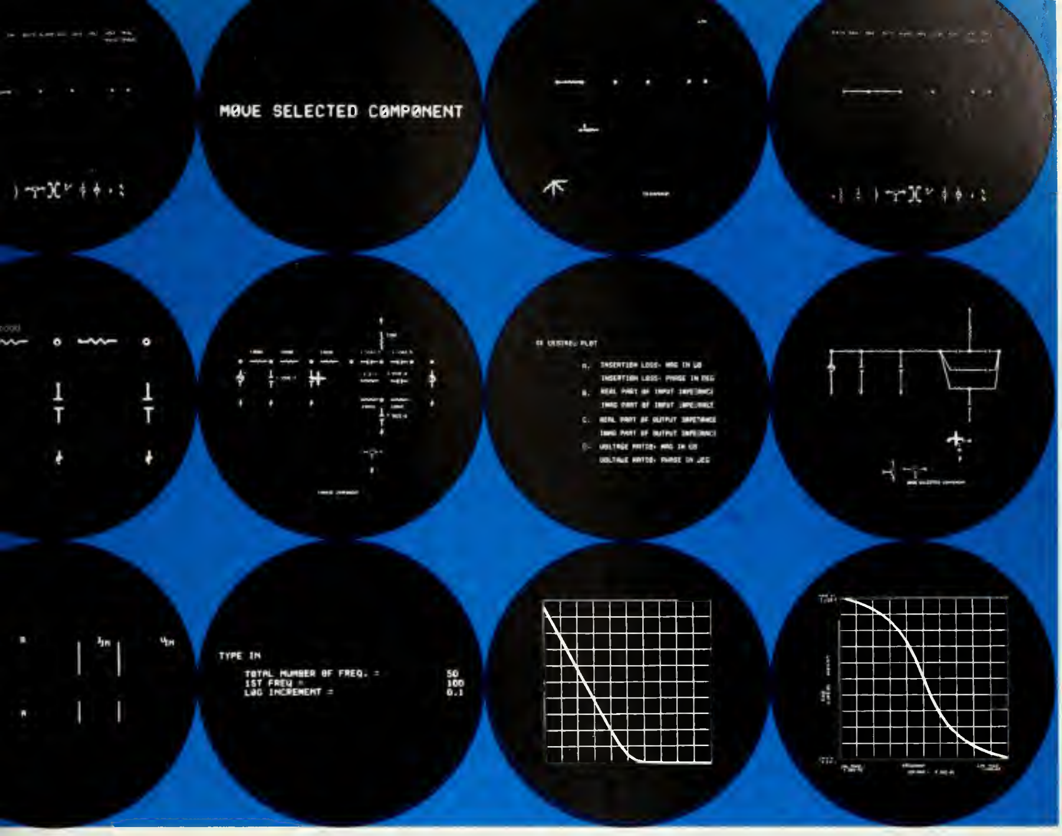
While tasks of incredible complexity have been,




and are being, performed by computers, it has been evident for some time that a more tractable, more natural relationship between the computer and its operator was becoming not only desirable but also increasingly necessary. Dr. John R. Pierce of Bell Laboratories has pointed out, "Easy interaction between man and machine is an essential element in forward-looking uses of computers. . . . We are just at the beginning of new and profitable uses for computers. In the impressive advances we are making, the needs for adapting the computer to the man are becoming more acute."

Men could draw pictures before they could write — and writing itself, of course, is merely a series of refined, drawn symbols. Today, most small children draw naturally some time before they can string stylized symbols together to make words. Today, also, trained engineers, designers, and scientists envision and solve many problems through the essentially natural medium of drawing — from rough sketches to finished technical designs. The new revolution in computer technology is a happy marriage of the machine's unique capabilities and the man's predilection for his most ancient means of communication — the picture.

Basically, computer graphics is made possible through special input devices which can read data *from* pictures and output devices which can *draw* pictures. The physical means of exchange between the machine and its operator is the face of a cathode




ray tube (CRT), which can display drawings, diagrams, or symbols of anything which can be stored in the files of a central computer. The CRT at which the operator (engineer, designer, whomever) works is associated with a small, "satellite" computer and a few simple controls. In an ideal system, the local computer would have access to a larger, central computer on a "time-sharing" basis. The local computer is programmed through a series of instructions, called subroutines, oriented specifically toward the kind of problem being dealt with by the operator.

In practice, the operator is seated at a console facing the cathode ray tube. Within easy reach are a a typewriter-like keyboard and a device called a light pen. About the size of an ordinary pocket pen, it operates through photoelectric cells to pick up light from displays on the cathode tube, and with it the engineer controls size, shape, and position of images on the tube. The designer can apparently draw on the face of the cathode tube, moving or changing symbols, lines or whole forms, and creating new ones on a blank screen.

*Frame enlargements from a motion picture produced at Bell Laboratories show some of the steps in designing an electronic circuit. Computer gives printed instructions at key points and shows performance curves for the finished product.*

Suppose the operator is an electronics engineer who wants to design an amplifier to be built on a printed circuit board. He invokes one of several programs stored in the computer which displays on the screen visible symbols of basic electronic compo-


nents—building blocks—for amplifier circuits. He also is given an array of "light buttons," which take the form of command words, such as *connect, comment, move, delete, cancel,* etc. The engineer, by choosing conventional electronic symbols displayed on the tube and connecting them with lines with the light pen, gradually builds, piece by piece, a block diagram of his circuit. As he goes along, the computer can show him what kind of performance he will get from various combinations of components as he tries them. It also provides him a variety of choices: The circuit works, but does it work well enough? Can I remove this or that component, making a simpler, more reliable job that will still deliver specified performance? Can I cut something here or there and save money in production? By using the light pen he can make changes and immediately see the results on the screen. He has at his command one form of simulation, which is one of the computer's most valuable contributions to engineering design.

## "On-Line" Interaction

There are potential savings in design costs. Furthermore, a great deal of insight can be gained into the design process itself. The significance of the whole concept is that the man *interacts* with the machine "on-line," while computation actually occurs. He is intimately involved in the computer-aided design process, rather than being separated from it by a barrier of specialized machine languages. He may try many different designs; within minutes he can change component values in a circuit — or the proportions of a boat hull, the shape of an airfoil, the dimensions of a building — and see resulting changes

*Carl Christensen, one of the computer program designers at Bell Laboratories, draws with the light pen on the face of the cathode ray tube at the Graphic I console, demonstrating direct on-line interaction between man and computer.*

in performance or appearance. He has at his fingertips immediate answers to that most perplexing of questions facing the engineer-designer: "If I do *this*, what will happen?"

As a computer expert at Bell Laboratories remarked, "An engineer can design a circuit, select components, make changes, check results, arrange the physical parts for mounting on a circuit board, and know exactly how the finished product will work — without ever walking into the shop and picking up a soldering iron. And he can do this in minutes or hours rather than in the days or weeks it would have taken by the cut-and-try method over drawing board and bench."

The advantages of such computer-aided design through graphics are even more obvious when the job at hand is a large project on which several engineers must work concurrently, each dealing with a discrete part. Such projects are infested with problems that may develop when one engineer designs and positions a part that interferes with some other part when the two are put together. This can be an expensive and frustrating experience when it is discovered during actual construction. Such anomalies can be prevented, however, if the graphic output from a computer displays all design elements of a project and permits the engineer to make changes before any physical object is built.

An important point in this whole process is the fact that the engineer — electrical, electronic, mechanical, civil, geological, aerodynamic, hydrodynamic, automotive — need not be, and usually is not, an expert in computer technology. He need know nothing more about the machine languages, programming or internal workings of the immense electronic machine he commands than the technique of operating the relatively few controls at its graphic terminal. The design tasks have been divided between the man and the machine, each doing what it is best capable of doing. The computer performs hundreds of arithmetic calculations in milliseconds and yields a concrete result. The man brings to bear his specialized human knowledge in giving instructions, defining parameters, imposing constraints, accepting, rejecting. But, in using the raw materials stored in the computer's programs and files for his own creative purpose, the designer, working directly on the face of the cathode ray tube with the light pen, is interacting in a fundamentally natural way with the machine — by drawing and pointing.

## Learn to Walk Before You Run

It goes without saying, however, that this relatively recent extension of the computer's usefulness to man did not come to pass overnight. Actually, the computer has been producing graphic output in one form or another for some time. A technique known as passive computer graphics has been used extensively in industry and science. This is applied in various ways, but generally it is a non-real-time, off-line procedure — which means that there are usually long intervals between input and output, and the designer is remote from the calculation of his problem—remote, at least, in comparison with the immediacy of the light pen and the new real-time, on-line computer techniques and display devices.

For some time, the computer has been able to accept numeric or graphical information as input through such devices as image scanners and produce graphical output on recorders, cathode ray tubes and digital plotters. The latter devices translate numeric output from the computer to visible form by guiding a pen on paper. This provides "hard copy" which, depending on the application, may be finished engineering drawings or true perspective illustrations. The visible analog output may also appear on a cathode ray tube, which is photographed. The resulting images on film may then be converted to drawings.

Varieties of this method have been used at Bell Laboratories, which has been producing over 5,000 microfilm frames per month since about 1960. Variations of this technique have been used, among others, by the Ford Motor Company in windshield wiper design; by the ITE Circuit Breaker Co. for transformer design; by the Missile and Space Systems Division of Douglas Aircraft for wiring and cabling drawings; by the Boeing Company for studies of pilot visibility in a variety of aircraft; by North American Aviation for design documentation, and by the U.S. Navy, Bureau of Ships, for detailed ship design.

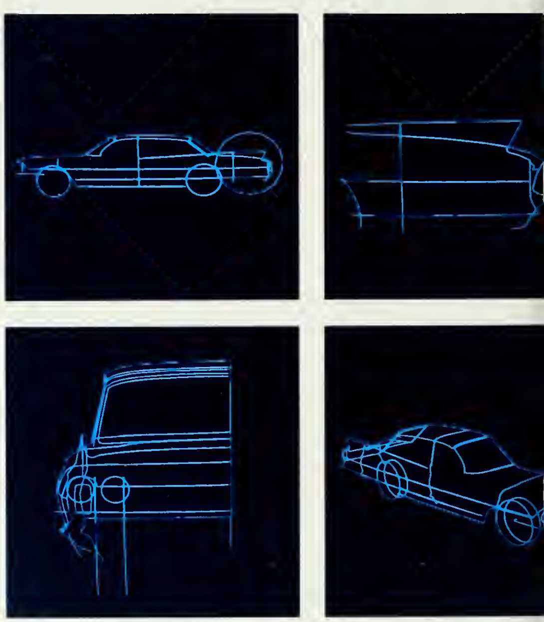
## The Art Has Grown

Industrial application of computer graphics began about a decade ago, when General Motors launched a study, the DAC-1 Project, to explore the potential role of computers in graphic design. It was aimed at a combination of hardware and software (programs) to permit flexible man-machine graphical communication. Dr. Ivan Sutherland, when a student working at M. I. T.'s Lincoln Laboratory from 1960 to 1962, took a pioneering step in proving the feasibility of man-machine graphical communication with cathode ray tube and light pen. His SKETCHPAD programming system has become a classic in the field. Project MAC at M. I. T. has been a major national program of research on advanced computer systems and their exploitation. Researchers there have made original contributions to the use of computer graphics in education by creating artificial environments — as, for instance, a display in motion on the cathode tube which simulates a trip down a road at near the speed of light. The Lawrence Radiation Laboratory at Livermore, California is also active in the development and application of sophisticated computer graphics, particularly in the field of computer-made movies which Bell Laboratories pioneered techniques for some years ago.

An essential element in adapting the computer to the man has been the development of problem-oriented machine languages, which are structured for specific disciplines in engineering or science. This fundamental groundwork must be laid before easy communication between non-expert operator and computer can take place. At Bell Laboratories, these developments are under way or completed:

- Programs to permit drawing and editing of schematics (circuit diagrams using conventional symbols) and to record these on microfilm.

*Cathode ray tube displays at graphic console of General Motors DAC-1 system show flexibility of man-computer communication in automotive design. (Courtesy GM Research Laboratories)*



- A program to convert a circuit drawn on the cathode ray tube to a form from which the computer can calculate frequency response.
- Programs to place components in a circuit within the constraints of a grid on the tube to reduce total wire length of all connections.
- A graphic command language to set up command structures on the face of the tube so data can be transmitted to programs in a computer that previously accepted only numeric data from punched cards.
- A graphic data processing facility to provide storage of many schematics which can be edited in variety of ways.
- Computer programs to direct a numeric-controlled machine tool to drill holes in circuit boards and/or to precisely position components on the board.

## Uses of Simulation

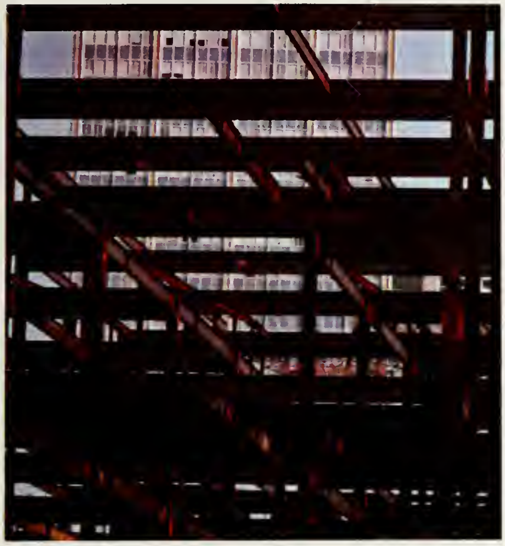
Because of its primary mission in support of communications technology, Bell Laboratories has, since it was established in 1925, devoted continuing research to studying the fundamental processes of speech and hearing. Now, modern techniques of simulation using computers are helping to analyze human production and perception of speech. Says Peter B. Denes, of Bell Laboratories, "All of us produce and perceive speech so effortlessly that we assume the process . . . must be unusually simple. On closer examination, however, we find that this 'simple' process is enormously complicated. . . . A better understanding of it would be extremely valuable for many reasons. On a practical level, it would enable us to design more efficient speech transmission systems, automatic speech recognizers and speaking machines. On a fundamental level, it would tell us more about the way information is processed by that remarkable computer, the human central nervous system. . . ."

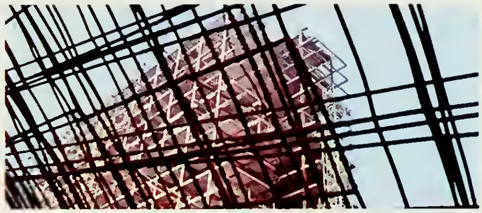
In pursuing this research, Bell Laboratories has developed a computer-generated model of the human vocal tract, which enlists the aid of graphic display devices. The researcher, synthesizing speech, can see an outline of the vocal tract displayed on a cathode ray tube and at the same time hear the sound produced by that shape. With controls at the graphic console, he can change both shape and sound.

Research into visual processes has also had a long tradition at Bell Laboratories. The Bell System is making increasing use of its transmission facilities for television and, more recently, for development of Picturephone[1] see-while-you-talk service. Consequently, Bell Laboratories has been studying the complex nature of visual perception — how we receive impressions and interpret the world around us. One aspect of this research is seeking to explain how we perceive and locate objects in three-dimensional space. Experiments at Bell Laboratories include generation of both two- and three-dimensional pictures in the form of both stills and movies. The three-dimensional effect is seen by viewing two slightly offset images through polarized glasses. The forms or figures generated by the computer can be moved, rotated, expanded, reduced and the apparent viewing angle changed so that the forms on the screen can be seen from any position. Visual research using computers and display devices has demonstrated that stereoscopic depth perception is a simpler process than was formerly supposed. This finding may hasten the day when stereoscopic visual information can be processed automatically.

A sizable group of experts at Bell Laboratories is working full time on such problems to produce sophisticated software which can further realize the immense potential of the computer. As Dr. John R. Pierce has said, "We are at the beginning. We cannot hope to see the end." ■

[1]Service mark of the Bell System






A $180 million cable project from Boston to Miami is helping communications keep pace with the eastern seaboard's economic growth

# A Cable for Growth

Although it represents a mere sliver of the geographic area of the nation, about one out of every three persons in the United States lives there. Though it's rich in historical culture and charm, it demonstrates a dramatic re-birth . . . a dynamic economy that's bursting at the seams.

The area, of course, is the eastern seaboard, stretching from New England to the tip of Florida. Within this complex of states, urban areas are re-building, new and old industries alike are creating more jobs, and fertile farm land is giving way to new homes, offices, factories and stores.

While all the eastern seaboard states have shared in the two decades of prosperity since the end of

*Population growth and the increased mobility of people have resulted in a spiraling demand for communications services.*

World War II, the most dramatic growth is centered in the southeastern quadrant where the commerce and industry boom is outstripping the nation as a whole in virtually every growth barometer.

The four states of Florida, Georgia, North and South Carolina form the heart of the area's "boom belt." In the last 10 years these states have registered a population increase of almost four million — a 27 per cent increase — compared to the national rate of 17 per cent. Income in the area has almost doubled, climbing some 30 per cent faster than the rest of the country. Factory and non-farm payrolls are increasing at twice the country's rate. As one southerner puts it: "We've had a taste of prosperity and we like it."

Such a skyrocketing economy, of course, creates demands for many goods and services, including expanded and more sophisticated communication facilities.

"Not too many years ago, I can vividly remember canvassing a town in the south to determine future telephone needs," recalls one Southern Bell telephone man, "No one wanted a telephone and didn't even know who he'd call if he had one. Now we're having trouble meeting all the requests we get. In the last 10 years, the number of telephones in our four seacoast states has more than doubled, and our investment in facilities and equipment and long distance calling has almost tripled."

The tremendous increase in long distance calling is responsible for one of the largest cable projects the Bell System has ever undertaken, a $180 million underground cable that will be capable of carrying 32,400 simultaneous telephone conversations. The cable, running from Miami up through the seacoast states to Boston, will relieve the over taxed communications facilities that now tie together the east and the rest of the nation.

## Economic growth makes new cable system necessary, but planning makes it ready when and where needed

Although it's only about the thickness of a man's arm, the Boston-to-Miami cable will be able to carry more simultaneous conversations than any other long distance transmission system now in existence. And like all other parts of the Bell System network, the new cable will carry all forms of communications — voice, data, teletypewriter, telemetry and television signals — without distinguishing between them.

The spotlight is currently on the southern part of the cable route since the section from Miami to Washington, D. C. is scheduled to go into service late this year. Most of the northern end will be completed next year when the entire route will be interconnected with other coaxial and microwave systems that crisscross the United States.

Field work on the project began more than two years ago when thousands of aerial photographs were taken to determine where the 20-foot right of way would slice through the 12 states along the eastern seaboard. Permission to bury the cable had to be obtained from more than 10,000 property owners, a figure that undoubtedly would be higher without a unique arrangement with the Sunshine State Parkway

*Cross section of the 20-tube coaxial cable demonstrates the intricate nature of the biggest cable ever manufactured by the Bell System. New Bell Laboratories-designed amplifying equipment is being used to increase the cable's capacity.*





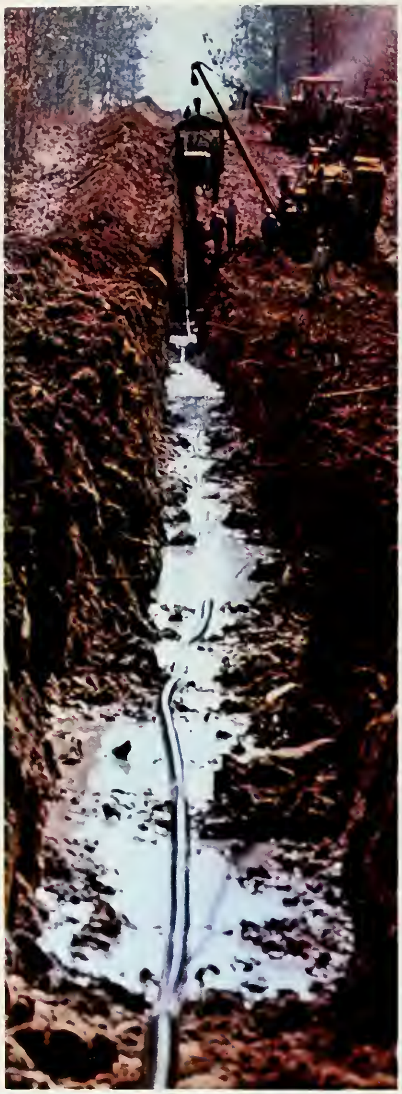
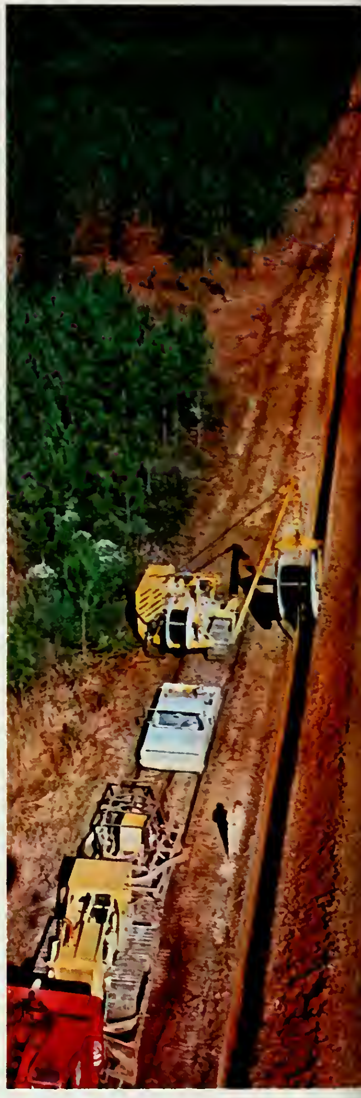
in Florida. There 260 miles of cable was placed in the median strip, the first time a major cable route has been placed in the middle of a state turnpike.

Actual laying of the cable began last March when a specially developed trenching machine began chopping a trench four feet wide and four feet deep near Elberton, Ga. Following closely behind the trencher, a cable-laying tractor lays out the cable from reels weighing up to nine tons and carrying about 1,750 feet of cable. After inspection, the trench is quickly refilled and the grass re-seeded. Only visible signs of the cable are markers spaced along the cable route to urge contractors to call the telephone company before digging in the area.

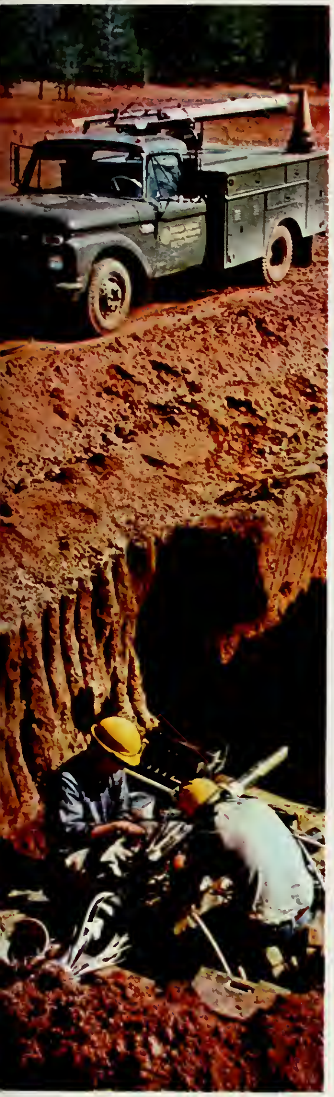
A wide variety of problems can arise as workmen weave cable through all types of terrain — from swamps to mountainous areas. In Florida, for example, snakes — "some six feet long and thicker than the cable," as one AT&T engineer says — plagued workmen. Underground springs in other areas converted the cable trench into a river bed and required the construction of small temporary dams. And at some points, rock formations required blasting before they would give way to the giant teeth of trenching equipment. On most small streams the cable can be placed directly in the water, but larger rivers like the Savannah and the Hudson require piping and special submarine cable.

Each step is carefully inspected before the next phase is started. One Long Lines inspector estimates that he will walk through four pairs of shoes and cover more than 1,000 miles on foot before his section of the project is completed.

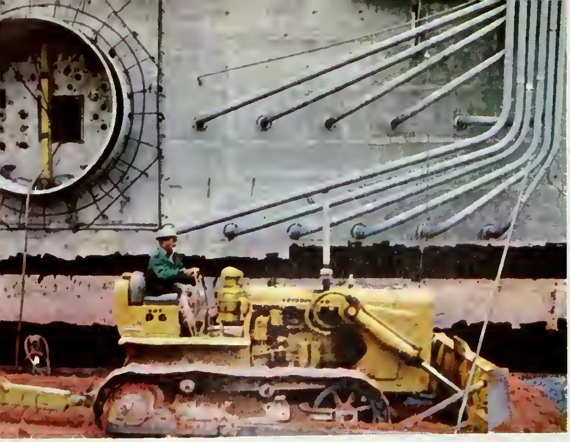
*Thirteen units of the Bell System, coordinated by the Long Lines department of AT&T, have joined forces in the cable project. The cable was manufactured at Western Electric's Baltimore Works where, at left, it is being tested to insure dependability.*

*Cable laying techniques vary from the relatively easy going along Florida's Sunshine State Parkway and rich farm land to the rocky terrain of the northeast. Work crews can normally lay two to three miles of cable per day when not faced with unusual soil conditions.*



*Two-man splicing teams join together the 104 wires and 20 copper tubes of the cable. An average of four splices per mile are needed and are then covered over with a 44-inch lead sheath. Splicing is done in open pits or precast manholes that also hold repeaters.*



*Gigantic air intake duct will be used in conjunction with the center's five air conditioning units that could cool 163 homes.*

*All communications and ventilating equipment is protected from damage by mounting it on coil springs and rubber cushions.*

*Only portion of the building above ground is garage-like structure through which people enter and leave building.*

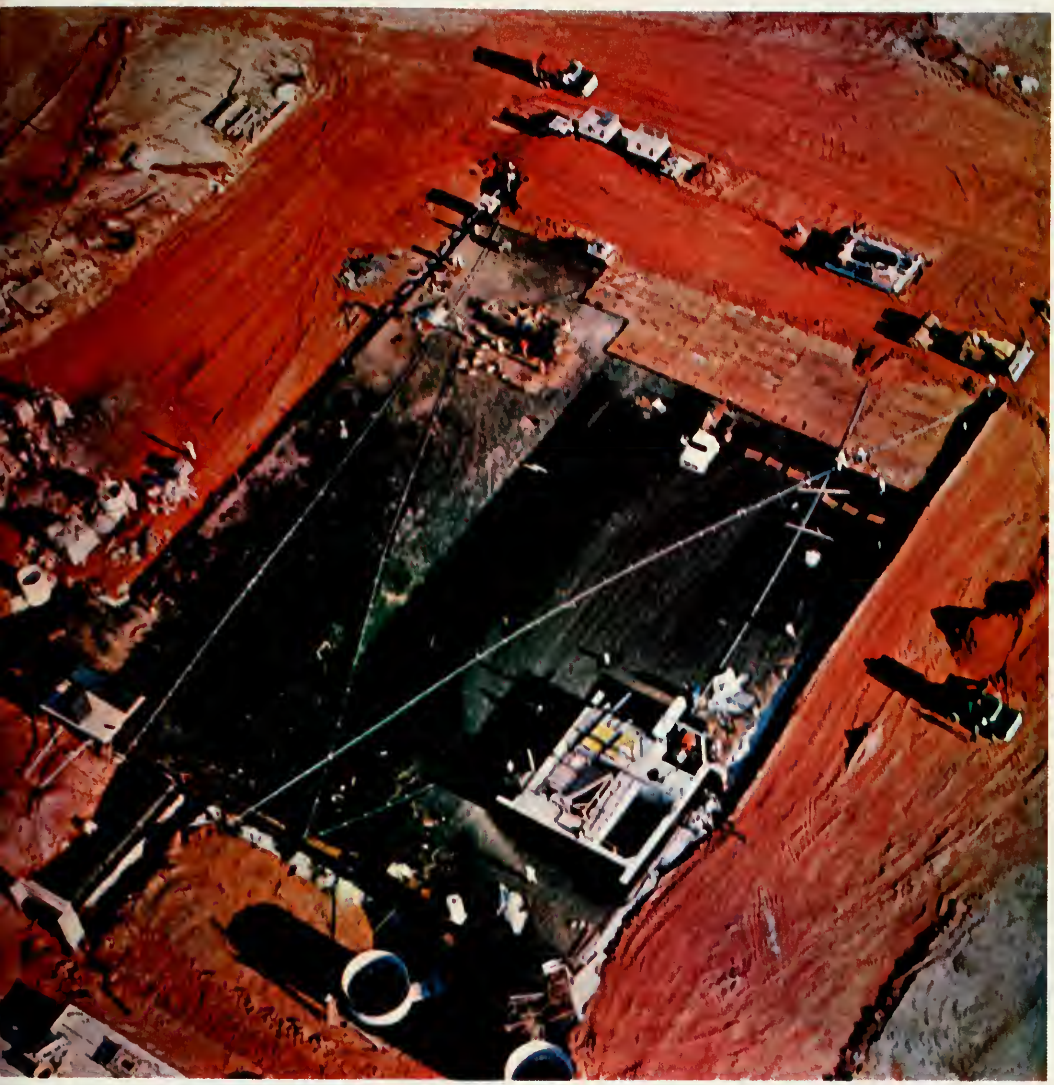
## New communications centers could serve city of 100,000 people

A string of 15 underground communications centers and some 900 unmanned auxiliary stations dot the route of the 1,800 mile cable system. The purpose of placing the switching centers underground is to protect the system from all natural — and most man-made — disasters, practically anything short of a direct nuclear hit.

For virtually all communications and building equipment in the centers, back-up facilities are installed and linked by fail-safe devices. In the event of a nuclear attack, sensors — poling up through the ground — slam spring-loaded blast valves shut to seal the building. During the emergency, auxiliary facilities provide water, power and ventilation. Beds, food, toilet articles, cooking facilities, refrigeration and everything necessary to carry on for three weeks is stored in the center.

But day in and day out, working in the gigantic underground building will be no different than the thousands of other telephone switching centers across the country. The building contains stand-by emergency power control units, battery equipment, telephone transmission units, administrative offices, ventilating and air conditioning facilities, maintenance and storage areas, and training rooms.

An average size junction center like Monticello will have about as much central office equipment as that which is required to serve a community of about 100,000 people. Although the buildings will not initially be filled to capacity, ultimately about 2,000 tons of equipment will be installed by the Western Electric Company. ■



*Nearly completed communications center at Monticello, Ga. will be covered with four feet of earth, a grass-sodded roof and a black-topped parking area. Measuring roughly 150 by 200 feet, the structure is equivalent in height to a two and one-half story building.*

Though some are being attempted, most cultural programs on commercial TV are n

# Wasteland Re-visited

**By Peter Benchley**
TV Editor, *Newsweek* Magazine

*Editor's Note: The current television season arrived amidst much talk about cultural programming. New shows were developed and some old ones changed, among them "The Bell Telephone Hour." To get a critic's appraisal of the season thus far, we turned to Peter Benchley, TV editor of* Newsweek. *Mr. Benchley, a 1961 graduate of Harvard University, is the author of two books and has contributed articles to such magazines as* Holiday, *the* New Yorker, Vogue, Diplomat *and* TV Guide.

Before it actually came into being, the 1966-67 television season was a press agent's dream. For the first time in recent memory, the network publicists had subjects they could tout without resorting to the burbling inanities that usually camouflage prime-time pap. Television was attempting to return to *quality*. ABC announced its ambitious "Stage 67" series of weekly specials. CBS, whose situation comedies have long held a lock on the Nielsen top ten, loudly broadcast the advent of "CBS Playhouse," and set aside $500,000 for the purchase of scripts. NBC began to assemble a Sunday series of experimental dramas, and announced that "The Bell Telephone Hour" would abandon its concert format and essay a series of 15 *cinema verité* musicals. A new Golden Age was proclaimed.

The season is now half over, and in retrospect it seems that the proclamation was somewhat premature. The 1966-67 season has so far merited accolades sufficient for, say, a Bronze Age, and even those deserts should be based more on lofty ambition than tangible results. The intent, the ambition, the deter-

ing up to expectations. A TV critic describes what is needed to improve the picture.

mination were all present, but the press agents may have out-flacked themselves. Despite certain notable achievements, a Golden Age is still far off.

At best, the TV year has been a mixed bag. There were one or two good commercial drama series, such as ABC's short-lived "Hawk," but they responded to the immutable Nielsen ratio: ratings are in inverse proportion to quality. ("CBS Reports," for instance, perennially grabs a Nielsen slot somewhere near 95th.) NBC's "Chrysler Theater" and "Hallmark Hall of Fame" as usual came up with some worthwhile productions. But they have been on the air for so many years that they generate little excitement. They are too often taken for granted.

"ABC Stage 67" has been an exemplary case of valiant purpose and dubious execution. The first show, "The Love Song of Barney Kempinski," was a wild attempt to exploit the bizarre humor of playwright Murray Schisgal and the dead-pan, otherworldly, hilarious capering of Alan Arkin. It missed its mark, but it was, at the very least, an honest attempt to do something different. On the other hand, "Olympus 7-0000," the Richard Adler musical, was a meretricious cop-out — as if the producers had thought to themselves, "Maybe if we put this mess into an arty series we can salvage some good reviews." And so it has gone with "Stage 67," from the respectably earnest to the sleazily slick, from (almost) *are gratia artis* to (occasionally) *épater la bourgeoisie*.

One of the few consistently rewarding endeavors has been the new "Bell Telephone Hour." The show itself is hardly new, having yodeled its way through 7 seasons on TV, and 19 more on radio before that. But the approach to the "Telephone Hour" is, indeed, innovative. Until this year, the show had geared itself to an exclusively aural format. Somewhere there seems to have been a rigid doctrine: music is to be heard, and visual extras are superfluous if not abrasive to the audience. There was little use — creative or even practical — of television as a medium. An orchestra would play, a singer would sing. Camera work was prosaic: head shots, full-body shots, long shots. The audience was assumed to be doing its knit-

ting, reading a book, or having dinner. "The Bell Telephone Hour" was, in effect, simply the most expensive long-playing record ever produced. Then this year Bell decided to change its tune.

"Corporately, we had become restless about our show," said AT&T TV advertising manager John A.

Howland. "It had become static. And being live locked us into a format. So we had to make a decision about a new direction. We wanted to do more, really, than just a fine musical variety show. On the other hand, you can't be *all* classical." Basically, Bell wanted to humanize the show, to release it from the stiff proscenium format and make the viewers want to *watch* it as well as listen to it. The per show budget was jumped about twenty per cent for 15 shows. Some of the country's best documentary news producers were engaged by producer Henry Jaffe to assemble individual shows.

The intention was to try to combine the appeals of both music and film, to create a new television form, the musical documentary. About half of a given show would present performers in concert. The rest would be a personal closeup of the performers: how they prepare for a concert, how they react to other musicians, how their temperaments blend and conflict. And in certain cases, like the first show, "A Man's Dream: Festival of Two Worlds," the documentary would try to show how a whole musical festival is put together.

For many of the shows, the film technique was to be *cinéma verité*, an inaccurate, overused and overabused term, but the only current description of the technique that even approached its meaning. In news documentaries, *cinéma verité* means that the cameraman uses a hand-held or shoulder camera. Thus unencumbered by heavy equipment, he can wander around unobtrusively and capture his subject as (supposedly) he really is. The film is often jerky, and quality changes radically as available light changes. But all this is (again, supposedly) compensated for by the *verité* — the truth — which is committed to film. (In movies, the technique is vastly more complex and has no real bearing on television.)

The technique is radical for a musical show, partly because, as Henry Jaffe has said, "the creative process begins in the cutting room." For some of the 60-minute shows, 70,000 feet of film were shot, and they later had to be reduced to 2,000. Ponder, if you will, the problem of synchronizing sound — which was recorded at the same time as the film — with little snippits of celluloid. Or of avoiding cutting a subject off in mid sentence, even though the film for the incident is lousy.

Critical reaction so far to the Bell shows has been generally favorable — and with reason. Drew Associates' production of "Festival" was a splendid opening hour, with a smooth intertwining of music and film. Leacock-Pennebaker's portrait of Van Cliburn was knocked for being desultory. Still, it was a fascinating — if not particularly incisive — look at the slender Texan. Throughout the first 7 shows, the blend has been excellent, and many of the portraits have been revealing — from the supreme self-confidence of Jane

Marsh to the classical composure of Thomas Schippers and fiery conducting of Zubin Mehta.

One ancillary element of the Bell Shows overwhelmed the justifiably jaded critics: the commercials. The programs are entirely uninterrupted. At the beginning of each hour, Bell announces that there will be a message after the show, and expresses a fond wish that the viewers will stay tuned. The two or three soft-sell commercials at the end of the shows are tasteful and quiet, and the phone company, which has permitted its shows to have continuity and musical flow, thus enhances its image by restraint.

Otherwise, the 1966-67 season has evolved very little from what it was in September — a series of ambitious promises. ABC's "Sunday Night at the Theater" has mysteriously ceased to exist as a topic for press releases but may be ready later this year. NBC's experimental dramas have not begun. And "CBS Playhouse," which may prove to be the most exciting dramatic enterprise, begins next month.

In many ways, it's just as well that the networks didn't throw all their big guns at the public at once.

Because of the miasma of flackery that inundated the press in September, critics were led to expect too much. Now that the balleyhooing has calmed down, they are likely to be more forgiving. And if the ambitious shows don't get murdered, the networks are more apt to keep programming them. For, after all, the networks did not begin to program quality out of sheer altruism. They were, as David Susskind said, "anxious to cultivate a public image." By going on a cultural binge, they could get their critics in the press and on the Federal Communications Commission off their corporate backs. But if the critics lambasted them unrelentingly, the networks could simply have adopted the pose of martyrs and returned to their normal schedules of unrelieved wretchedness.

Before this season began, the *New York Times'* TV critic, Jack Gould, wrote a piece entitled "Grounds for Cautious Cheer," urging the public not to expect too much, to take the so-called quality shows at face value, with a reservoir of admiration for a gallant try. Despite whatever failures have been broadcast so far, there are still grounds for, if not cheer, at least hope. Current and upcoming proposals such as those of the Ford Foundation, the Carnegie Foundation, Comsat, the Bell System and others may, if ever acted upon, establish a truly viable educational-*cum*-cultural network. And the Overmyer Network, which is offering nothing but news and Las Vegas shows, may take a cultural plunge.

But it is still up to the three networks and the sponsors to set the pace for quality television. By the middle of this year it will be clear whether or not such worthy work can survive. If the shows are good, if the critics respond responsibly, if the public encourages them by watching, and, most important, if more sponsors like Bell, Xerox and Hallmark will venture out on a cultural limb, then someday the wasteland may not be so vast. ■

# BELL
reports

H. I. Romnes

## Romnes succeeds Kappel as AT&T chief executive

H. I. Romnes becomes chairman of the board and chief executive officer of the American Telephone and Telegraph Company on February 1. Mr. Romnes, AT&T's president for the past two years, will succeed Frederick R. Kappel, the Bell System's chief executive since 1956, who is retiring.

At the same time, Ben S. Gilmer becomes president of AT&T, succeeding Mr. Romnes, and John D. deButts assumes the post of vice chairman of the board. Both were also elected directors of the company last month. Mr. Gilmer and Mr. deButts are currently executive vice presidents.

Effective on the same date, Angus S. Alston will become executive vice president, succeeding Mr. Gilmer. He in turn will be succeeded as vice president-personnel relations by William C. Mercer, who is now vice president-marketing. William M. Ellinghaus, assistant vice president-marketing and rate plans, was elected vice president and will succeed Mr. Mercer in the marketing post.

Mr. Romnes brings to his new position more than 38 years of extensive experience in communications technology and operations. His first Bell System employment was as a member of a Wisconsin Telephone Company line crew during his 1927 summer vacation from the University of Wisconsin, from which he graduated with an engineering degree the following year. After graduation he joined Bell Telephone Laboratories as a member of its technical staff engaged in circuit design work. In 1935, he trans-

*Ben S. Gilmer*

*John D. deButts*

ferred to AT&T and in the succeeding years rose through a variety of engineering management assignments there and in the Illinois Bell Telephone Company. In 1950 he became director of operations of AT&T's Long Lines Department, and two years later was named chief engineer of AT&T. After serving four years as AT&T's vice president-operations, he was elected president of the Western Electric Company in 1959. Mr. Romnes returned to AT&T as vice chairman of the board in 1964 and a year later was elected president.

Mr. Romnes is also a director of Pacific Telephone and Telegraph Company, Chemical Bank New York Trust Company, the Goodyear Tire and Rubber Company, United States Steel Corporation, National Safety Council, American Cancer Society, and the Downtown-Lower Manhattan Association.

Mr. Kappel's retirement from active participation in AT&T management comes after more than 42 years of Bell System service. He will continue as a director and will act as chairman of the executive committee.

His ten years as chief executive officer were years of vigorous growth for the Bell System. During that time the number of telephones the System serves has grown from 50 million to more than 80 million and, under his leadership, the range of the services it offers has been greatly diversified. The number of AT&T share owners has more than doubled and now exceeds three million — several times more than any other private enterprise in the world.

Mr. Kappel started his career in 1924 as a member of line crew for the Northwestern Bell Telephone Company in Minnesota. In subsequent years he progressed through a wide range of assignments to become vice president-operations and engineering of AT&T in 1949. In 1954 he was elected president of the Western Electric Company, and, in September of 1956, he became president and chief executive officer of AT&T. In 1961 he was elected chairman of the board.

Mr. Gilmer, a graduate of Auburn University, joined Southern Bell in 1926 as a telephone installer and progressed through a wide range of assignments in Southern Bell, Northwestern Bell and Pacific Telephone. He came to his present post after eight years as president of Southern Bell.

Mr. deButts, who joined the Bell System with the Chesapeake and Potomac Telephone Company of Virginia after graduating from Virginia Military Institute, has served in C&P, AT&T and New York Telephone. He became vice president-operations and engineering of C&P in 1959, elected president of Illinois Bell in 1962, and came to AT&T in March, 1966.

### Equal Opportunity Award

Unremitting effort to fulfill the promise of equal opportunity is a necessity for both business and the nation, Frederick R. Kappel, AT&T board chairman, said in accepting the 1966 Equal Opportunity Award from the National Urban League. The award is given annually to an outstanding industrialist and a union leader for promoting fair employment practices. Also receiving an award was Joseph A. Beirne, president of the Communications Workers of America.

In accepting the award on behalf of Bell System companies, Mr. Kappel said equal opportunity "is a critical national problem and it must be solved. . . . We must search out the people who can learn the work we have to do. We must locate them — open doors to them — help to teach and motivate them — stay with them to see that they really get the full opportunity they are entitled to." The Bell System is trying to do this in numerous ways, he said, including active cooperation with the schools in developing work-study programs that lead to jobs for people who can learn the necessary skills. "We think the motivating influence of these plans is very strong."

He added that he was pleased that the Bell System companies and the CWA "have been able to work together so cooperatively in this whole endeavor."

He also stated, "any company policy or program is only as good as the people in the business make it by reason of their personal understanding, interest, and initiative. . . . The growth of volunteer activities in counseling students, tutoring dropouts, and the like" are significant and should not be underestimated. "These activities," he concluded, ". . . do not relieve the company of responsibility," but "they surely signify a maturing understanding of what needs to be done, and they strengthen my confidence that when we point our policies in the right direction, the goodwill and energies of our people will take us where we ought to go."

### Aluminum Wire for Cable

Fifteen miles of telephone cable containing aluminum wire — instead of the traditional copper wire — have been buried four feet below the farmlands of Iowa so Bell System engineers can determine how well it performs.

A new emphasis on aluminum wire has developed for two reasons: (1) A new cable sheath design and new splicing techniques developed by Bell Laboratories and Western Electric show promise of overcoming the problems of corrosion and conductor joining that appeared ten years ago when some aluminum conductor cable was used, and (2) aluminum research has taken on new importance to the Bell System because of the continuing uncertainty in the price and supply of copper.

### New Vehicle Recommendations

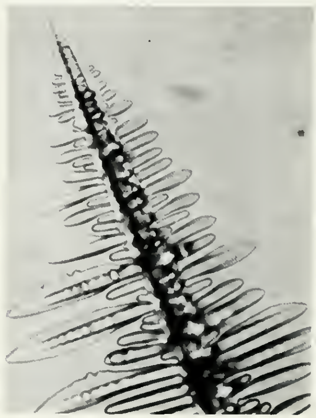
New passenger cars and light trucks purchased for the Bell System's motor vehicle fleet will include a variety of new safety features.

As operator of the world's largest private fleet of vehicles — about 100,000 vehicles which traveled nearly a billion miles last year with one of the finest safety records — the Bell System has long been interested in new automotive safety equipment. Many of the optional safety devices being added to 1967 models as standard equipment have been required on Bell System vehicles for many years, including seat belts, back-up lights and emergency flashers.

In addition to endorsing this new emphasis on vehicle safety, AT&T is recommending to the associated companies that all 1967 models purchased include air pollution control devices and other safety features planned for introduction on 1968 models.

### Molten Metal Model

A technique that now makes it possible to observe what happens inside molten metal as it solidifies has been devised at Bell Telephone Laboratories. The new technique is helping scientists gain a fundamental understanding of how metal changes from liquid to solid as it cools. This understanding should lead to improved



metal properties and thus more effective use of metals.

Prior attempts to see what takes place during solidification have been hampered because of the opacity of metals. By freezing certain organic materials which were selected specifically for their thermodynamic properties, Dr. Kenneth A. Jackson of Bell Labs found that it is possible to duplicate the internal growth of metals as they cool and crystallize. The model that is created can be observed in the same way one might watch water freeze and form ice crystals. The new technique is relevant to all metals and allows simulation of many of the phenomena associated with metal growth.

### Unigauge to Reduce Costs

The first installation of Unigauge, a new single-gauge concept of cable design, has recently been completed at Rockford, Ill. Under development since 1962, the use of the Unigauge concept in providing the connection between central office and customers' premises is expected to result in substantial savings for the Bell System.

At the present time, a variety of different sizes and gauges of cable is used. Unigauge will reduce the amount of copper needed for cable, cut manufacturing and inventory costs, and simplify outside plant engineering. Additional central office equipment is necessary to maintain transmission standards and provide adequate signaling, but the savings will more than offset the added costs.

The Bell System's investment in outside plant for customer loops is currently about $6.25 billion with $475 million being added each year. It is estimated that the annual investment can be reduced by about $44 million per year through the use of Unigauge.

### Bell System Financing

The sale of New Jersey Bell's $55 million debenture issue last month brought the 1966 Bell System capital financing through bond sales to a record $1,315,000,000.

The New Jersey Bell debt issue was the 13th Bell System debenture sale last year. Although 14 bond issues were sold in 1957 and again in 1960, the amount of debt financing last year reached an all-time high.

Interest cost to Bell System companies varied from a low of 4.85 per cent for a New York Telephone Company offering in January to 6.03 per cent that Pacific Telephone is paying for a $130 million issue sold in November.

Other Bell System companies which sold bonds last year include Ohio, Chesapeake and Potomac of Virginia, Mountain States, Southwestern, Chesapeake and Potomac of Washington (D. C.), Northwestern, Southern, and Southern New England. In addition, AT&T sold two $250 million issues in 1966.

### Cardboard Computer

Bell Telephone Laboratories has developed a novel computer to help stimulate high school students interest in physics. The CARDboard Illustrative Aid to Computation — called CARDIAC, for short — is a cardboard model which has the basic working parts of an actual digital computer.

It was designed by David W. Hagelbarger, a member of the Information Processing Research Department at

Bell Laboratories, for use in "The Man-Made World," a new program designed to improve the teaching of high school science.

With the aid of CARDIAC, students are becoming aware of the computer, not as a "thinking machine," but as a machine responsive to man's instructions. By following a red line path on the plastic and cardboard model, students can follow steps taken by a computer in executing programs and can use CARDIAC to solve problems. They can perform logical operations and see how abstract concepts of logic can be made concrete in circuits similar to those used in computers.

Thus, the cardboard computer gives the student a working illustration of principles discussed in "Logic and Computers," the first phase of the experimental course which was prepared by contributors to the Engineering Concepts Curriculum Project. Five Bell Labs engineers and scientists, professors from a number of universities, and several high school science teachers are among those contributing to the experiment, which is sponsored by the Commission on Engineering Education and funded by grants from the National Science Foundation. ■

Aiming broad-scale management development efforts at the total organization, rather than at individual managers, is having dramatic effects on employee performance and morale

# Organizational Renewal

Up and down the marbled, paneled or plastered hallways of a thousand offices they reign over empires of men, machines and paper.

They are the managers — the supervisors and executives — of our great institutions of business, government and education. Once they were engineers, accountants, teachers or students primarily concerned with their own functions; now they are concerned with overall management . . . with fulfilling the goals of their organizations.

But what makes them tick? How do they become *good* managers? Are they merely well oiled machines, conditioned to the organizational life? Or are they highly individualistic — inspired from within?

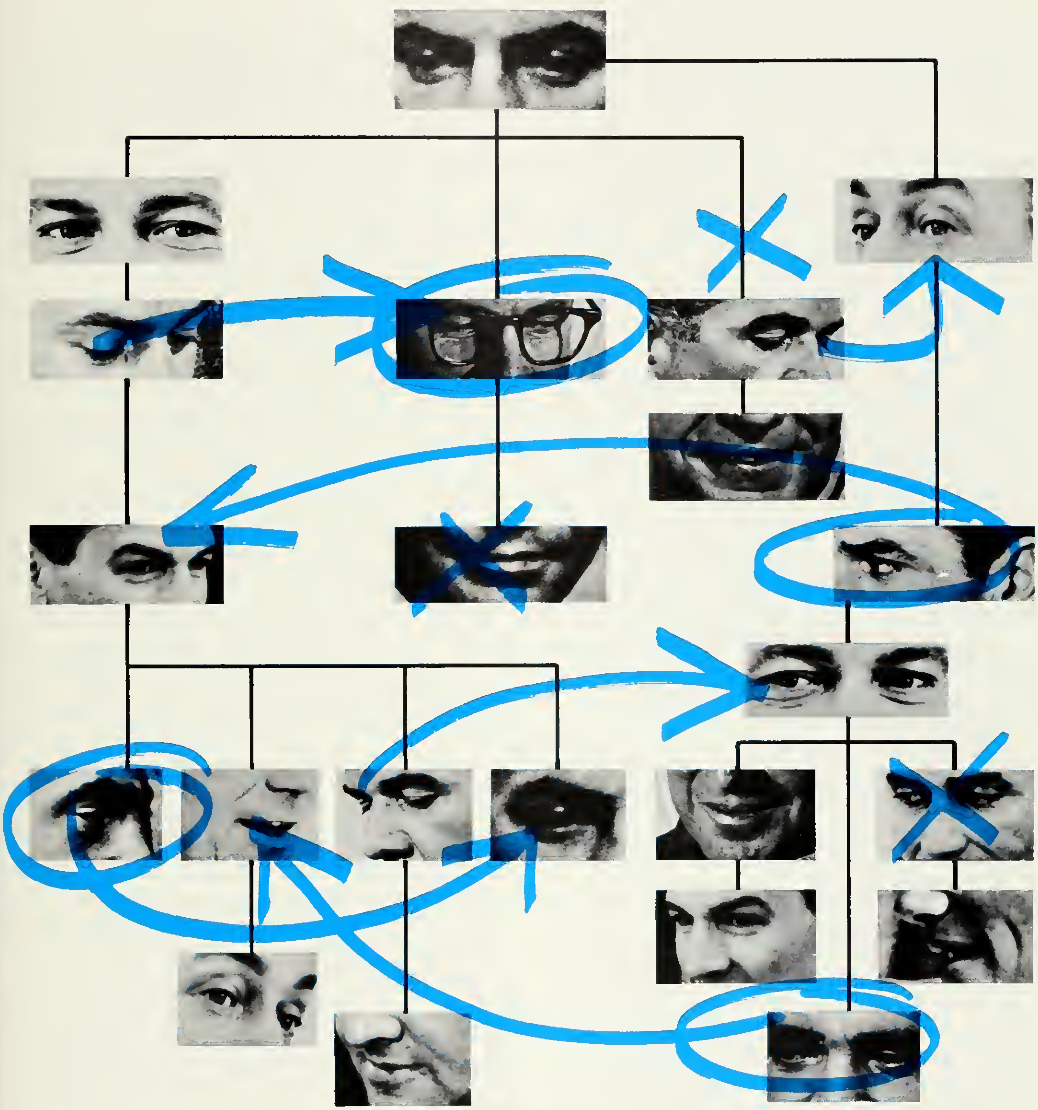
No one has yet answered these questions satisfactorily: Managers, like all people, are probably a bit of both. But psychologists and sociologists debate these opposing views of the individual in the organization. Usually sociologists hold that man's personality is plastic — it yields and changes to match the roles he is expected to play in an organization. Others, often psychologists, believe an individual's role in an organization is determined by his own unconscious motivations and personality structure.

What this implies is this: If any large organization wishes to improve and perfect itself, it must inevitably make the basic decision of whether to aim its improval efforts at the overall organization, or at the individuals that make up the organization.

Many businesses, government organizations, and non-profit institutions have developed and used various types of "development" programs in the past, with varying degrees of success. These have almost invariably been aimed at the individual, at promoting his own growth and understanding. It is probably fair to say, however, that rarely, if ever, have these programs made a significant overall impact on the organizations in which they have been used. In fact, they have sometimes met with cynicism and rejection.

In the past few years however, a number of organizations, including the Bell System, Hotel Corporation of America, Humble Oil, Union Carbide and others, have pioneered a new type of renewal program which aims at the organization as a whole. And the preliminary evidence indicates that these efforts are having a dramatic effect on the performance, morale, and structure of the organizations employing them. These new programs are particularly important since they come at a time when leaders of business, government and education are pointing out that organizations must undertake efforts of self-inspection and renewal if they are to meet the demands of the future.

The most prominent of these experts is Dr. John W. Gardner, Secretary of Health, Education and Wel-



fare and former president of the Carnegie Corporation. In an article entitled "Renewal in Societies and Men" which was based on his book, *Self-Renewal,* Dr. Gardner paralleled the aging of individuals and their growing resistance to new ideas with the same phenomenon in organizations. Of this process, he said: "The young organization is willing to experiment with a variety of ways to solve its problems. It is not bowed by the weight of tradition. . . . As it matures, it develops settled policies and habitual modes of solving problems. In doing so it becomes more efficient, but also less flexible, less willing to look freshly at each day's experience. Its increasingly fixed routines and practices are concealed in an elaborate body of written rules."

Dr. Gardner also pointed out other characteristics of the aging organization: low motivation, powerful vested interest, concern with *how* things are done rather than *why* they are done, and ultimately, if nothing is done to help, a deterioration that leads to the graveyard. Every organization however, says Dr. Gardner, has the potential to encourage and promote "continuous innovation, renewal, and rebirth," but it first needs to recognize that it has a problem.

## To Be Dynamic, Revitalize

Academicians and business leaders agree that even companies that do not have recognizable problems should strive to review and revitalize themselves if they are to remain dynamic and virile in an era of rapid change. As AT&T Board Chairman Frederick R. Kappel noted in his book, *Vitality in a Business Enterprise,* ". . . a business must generate vitality under all circumstances that confront it, not only in times of crisis, but just as much under conditions of success that may have persisted through many years."

For some time the Bell System has recognized the responsibility to make its managers more aware of the need for organization renewal. This recognition, combined with the idea that efforts aimed at revitalization must be directed at the entire organization's development — rather than only at the growth of individuals — led to the Bell System's organization development program.

## An All-Out Effort

OD, as the undertaking is frequently called, is not a mere training program administered by the personnel department. Instead of working through one individual, this effort is directed toward the entire organization and its work environment. It is an all-out effort by the total organization to improve its own effectiveness — a do-it-yourself project designed to improve payoff in terms of increased efficiencies for the business and improved job satisfaction for the employees. The program requires:

— Recognition of the need for improved effectiveness, or a genuine desire to implement a self-renewal program by managers who may be unaware of a specific need;

— An educational effort to create a common awareness of problem areas, to improve communications, and to develop a desire to work together toward solving problems, and

— An on-the-job continuing program to provide the organization a systematic method for working to improve their overall effectiveness. The program places the primary responsibility for development and change with the organization itself.

The Bell System's organization development program was the culmination of a long series of efforts aimed at improving managerial skills. Most of these consisted of training courses, and despite a wide variety of courses, the training people felt none brought about lasting improvement in managerial effectiveness: Most managers quickly reverted to their former habits when they returned to the job. "It soon became evident," says John Cogswell, AT&T management training administrator, "that the reason for this failure was that training was being conducted in a vacuum — the participant's boss and subordinates were not aware of what he had learned, and even resisted putting into practice any of his newly acquired knowledge." Many operating people also looked on training as the personnel department's "way-out" experiments, with little on-the-job value.

One critic noted: "Unless this management development activity becomes a regular part of the job, the anticipated growth of the business over the next ten years will have the effect of seriously diluting the benefits gained so far."

## Changing the Target

It soon became clear that the hypothesis that an entire organization could be renewed by improving the effectiveness of each manager in the organization was wrong; that in fact, the organization was much stronger than the sum total of the individuals in the organization; its norms were too firmly established to be influenced by the efforts of individual managers. Thus, if any lasting change were to be made, the organization itself had to become the direct target of the renewal process. In addition, the process had to be made an integral part of the organization's job.

As this change in basic hypotheses was developing, a number of experts in the business, government, and academic communities were also stating that renewal efforts must consist of more than mere training courses.

First of all, Dr. Gardner and Dr. Warren Bennis of the Massachusetts Institute of Technology's Sloan School of Management both pointed out that organization "dry rot" can infect an organization, and even an entire society, as it ages. Bennis, in an especially pessimistic mood said, ". . . the methods and social processes employed by bureaucracy to cope with its internal and external environment are hopelessly out of joint with contemporary realities."

Other researchers, such as Dr. Rensis Likert of the University of Michigan and Dr. Chris Argryis of Yale University, were interested in work groups and interpersonal relationships. Likert concentrated on the primary work group — the idea that organizational cooperation is maintained through key people and jobs. Argryis stressed that the relationship between individuals in an organization must be improved if the organization is to accept new values.

Although these ideas were not necessarily new, the manner of their use was different. Instead of focusing on the individual's effectiveness and relationship with workers, attention was given to their effect on "payoff," the return the organization gets from the managerial action.

Meanwhile, Dr. Robert Blake of Scientific Methods, Inc. and his associates developed the "Managerial Grid." This is a framework in which various management styles can be plotted and analyzed to determine an individual's concern for production versus his concern for people. Blake's solution is to maximize these two concerns in a state of "team action."

Finally, Dr. Frederick Herzberg of Western Reserve University and his colleagues, in studies of work motivation, spelled out the distinction between what he called "motivators" — work content, the job itself — on one hand, and "maintenance factors" — work environment or context — on the other. People appeared to be motivated positively, Herzberg said, by what their jobs actually consisted of, but not by the surrounding factors, such as benefits, work location, and to some degree, salary.

With these thoughts in mind, the management development section of the AT&T personnel depart-

*This Pacific Northwest Bell group of sales managers and communications consultants typifies the three stages of organization renewal: recognition of the need, an educational effort, and a continuing on-the-job program.*

ment began to formulate a training course that would eventually become the foundation of the organization development program. Into it, they incorporated two main ideas.

In 1963, they began to experiment with "family training." Ed Sutton, AT&T management training supervisor, explains: "Instead of training strangers at one level of management, or even unrelated groups of different management levels, we decided to work with two or three levels of management people with direct reporting relationships — work teams — together. Although we first feared that the presence of the boss would inhibit the freedom of his subordinates, this turned out to be wrong. This new approach permitted the work teams to identify some of the problems that existed on the job, problems that might be preventing team members from working at maximum effectiveness."

Secondly, the course itself was designed to provide the teams with a set of common standards and a common language with which to discuss their problems. It consisted of actual study of the ideas of Blake, Herzberg and others, as well as training exercises and demonstrations designed to illustrate various management styles and techniques. To relate the course as closely as possible to the organization's spe-

cific goals and objectives, an actual analysis of the work team's performance was used. Class sessions were scheduled to be alternated with work days in order to infuse the job itself with the techniques learned in the course.

Perhaps the most important step in development of the overall program grew out of the comments of researchers concerned with organization renewal. It became apparent, that although the family training approach had eliminated the "vacuum" effect of earlier efforts, the program would still fail unless every manager, right up to the president, took part in the overall effort. It was obvious that the entire plan would fail unless the entire management team was personally committed to and involved in organizational development.

Thus, the main goals of ODP became (1) to place the responsibility for the organization's development on members of the work team themselves; (2) to provide the organization with the framework and tools to analyze its performance and values; and (3) to set off a continuing program of self-examination within the organization . . . to make this part of the job. Specifically, it was hoped that an organization development effort would, if necessary, bring about changes in organization climate, human attitudes and values, management skills, managerial styles, and operating efficiency. How this has succeeded is best seen in view of one company's experience.

## One Company's Experience

Pacific Northwest Bell shared a common experience with other Bell System companies a few years ago: As a result of a desire to improve its operations, top management felt some type of management development effort was in order, particularly to improve communications between management and nonmanagement people. James Stubner, former personnel vice president of PNB and now an assistant vice president at AT&T, says, "Once it became apparent what the whole program was, we saw that it had the advantage of live participation, and got at the climate of an organization. We felt it would be a communications aid that would achieve real levelling and understanding in our work teams. Most important too, our operating people, who understandably take a hard look at the payoff in management development, saw that organization renewal could effect the bottom line and agreed to gamble on it."

Most, if not all, of the people in the first group to participate in the organization development effort were skeptical when they heard about the program; some had cynical comments about the fact that the boss would participate. But as the group saw the concrete relation of the program to the job, and as the work exercises and lectures in the classroom began to have their effect, management in each team began to open up with each other. Over a three-week period the work team's ability to work together and other aspects of the job began to emerge.

As one of the participants in the first group, Data Systems Supervisor Bob Norton, says: "After being together in the environment that the training people established, the work team really builds up the ability to level with the boss and with each other. There was a general feeling in the group, after the first couple of days, of being perfectly honest with each other."

The program has had an impact on the data processing people on the job. Bob Norton relates some of the changes sparked by ODP: "Before we undertook organization development, I had 15 first and second level people reporting directly to me. It's obvious that I couldn't give everyone all the time they needed, and we had some problems with communications. As a result of suggestions from the group, we've gone to a crew chief concept to give the second level people more responsibility a la Herzberg. This also lets the first level people get the benefit of ideas from the second level people and has created more of a team approach.

"ODP also helped us realize that our group — the staff computer people for the entire company — had a problem communicating with other departments. Organization development concepts contributed to the 'Comptroller's Operations Planning' — a manual of our EDP jobs sent out regularly to other departments to give them new ideas on how they can use our computer systems and programming assistance."

## Not A Panacea

Norton also points out, however, that organization development hasn't been a panacea: "We still have some problems that we haven't solved. And it's possible that the problems we've solved could have been taken care of without ODP. But the program has made us aware of what needs to be done and has developed an environment that helps create and accept change."

The second group to go through consisted of four PNB vice presidents, their staffs, and the then president of PNB, Walter Straley. These sessions resulted not only in the complete commitment of PNB's top management to organization renewal, but also in some concrete changes within the organization. For example, real communications have been established in many groups. PNB people cite the influence of Herzberg's ideas on achievement as well as Blake's management views as the reason for many of these changes. The experience of ODP actually fostered the climate that made it possible for the subject to be discussed frankly.

## Framework and Motivation

Organizational renewal has been underway at PNB for about a year now and has provided work teams the framework to begin self-analysis, and the motivation to see that they carry it out.

Mr. Stubner points out what he thinks is the real value of organization development in a large organization: "The saving grace of every large organization —the reason it can prevent people from becoming identical tiles in a symmetrical mosaic — is that every group is made up of intimate subgroups that are small organizations in themselves. ODP performs surgery on these subgroups and helps free the individual and make his job more meaningful. It sounds crazy to say this, but ODP is really the most exciting and exotic experience a boss could have."

To be effective, the program must find application in a continuing manner. PNB is just beginning to move into this phase of the program, so it is too early to predict the final outcome. But now that they've seen a bit of it, everyone in the company wants to go through the basic program so they can get involved with its on-going, continuing phases.

What the final effect of this self-renewal program will be on the Bell System may never be known. Complex sociological phenomena are not easily measured. The ultimate effect, of course, will be reflected in the overall performance of the companies using the program. But even this will not be easily determined. Pacific Northwest Bell, for example, was performing well before ODP. The question that should be asked, as Dr. Bennis and Secretary Gardner point out, is what would happen to the organization after a number of years *without* a program like ODP?

## Other Companies Participating

Apparently, not too many Bell System companies are willing to take the risk of *not* embarking on such an organization renewal program. Six other organizations, including Michigan Bell, Northwestern Bell, Mountain States, Southwestern, Southern New England, and AT&T's Long Lines Department, are deeply involved in organization development efforts. In the southern area of Long Lines, for example, all management people from the general manager down to the first level have taken the basic course and are now participating in the continuing phases.

Other Bell System companies, including Pacific Telephone, Cincinnati and Suburban, Wisconsin, Western Electric, and Bell of Canada are also trying organization renewal in varying degrees.

There will undoubtedly be those critics who will view organization renewal programs as one more attempt by large organizations to manipulate their people into a mold of conformity. But if ODP does change people, it does it in the direction of giving them a bit more freedom in choosing the alternatives available to them, and thus helping them find more meaning in their work. By acquainting them with new management styles, and by creating an environment of trust and confidence, it gives them new insights into the significance of their work. ODP may not be a cure-all, but it may be the beginning of an answer. ■

# BELL FORUM:

Statements of policy and opinion

*Editor's Note: Rebuttal testimony in phase one of the FCC's investigation of the Bell System's interstate earnings was filed in late November. Included was testimony of John J. Scanlon, AT&T vice president and treasurer, and Robert A. Lovett, a partner in the New York investment banking firm of Brown Brothers Harriman & Co. and former secretary of defense. Summaries of their testimony dealing with the Bell System's rate of return follow.*

## Rebuttal testimony John J. Scanlon

Mr. Scanlon's testimony deals with three significant areas in which witnesses for the FCC staff have challenged the Bell System position on rate of return: (1) The capital structure appropriate for the Bell System. (2) The relative risks of the Bell System. (3) The use of the comparable earnings standard to determine the equity rate of return required.

**Capital Structure**

All of the opposition witnesses urge, Mr. Scanlon notes, that the allowance for rate of return be premised on an assumed Bell System capital structure in which the proportion of debt is much greater than in the actual capital structure. They assert that the Bell System would lower its overall earnings requirement through greater debt financing, because of the "superficially lower cost of debt capital."

Mr. Scanlon points out that they did not discuss, however, the problem of how the Bell System might have achieved the recommended capital structure, given the company's enormous capital needs over the last 20 years and the response of investors to its security offerings in that period. And they did not attempt to compute in any realistic fashion what would be the current costs of debt and equity capital to the Bell System under the postulated financing program.

". . . it is my judgment that had we attempted to follow such a course of financing the resulting increase in both debt and equity costs would have produced a present overall earnings requirement equal to or greater than that shown by the company to be its requirement with its objective capital structure."

Mr. Scanlon submits that there is no valid basis for criticism of the Bell System's past financing policies, which have enabled the company to meet the enormous demands of the postwar years with the attraction of capital at reasonable costs. These policies have won the approval of the financial community, he points out, and have put the System in strong position to meet the demands of the future.

"Therefore, there is most emphatically no basis for the Commission, in its determination of rate of return in these proceedings, to use a capital structure other than that employed by the Company in its showing of its overall return requirements."

Mr. Scanlon comments on the argument of Dr. M. J. Gordon, witness for the FCC staff, that with a seven per cent overall rate of return and announcement of intention to finance in the proportions of two-third debt and one-third equity, AT&T would see the price of its stock advance to $74 per share.

"This so flies in the face of our actual experience with investors as to strain credulity. It is axiomatic, and abundantly clear in this record from the testimony of witnesses from the financial field, that equity investors pay less—not more—for lowered earnings, and that equity investors demand higher—not lower—returns where the financial risk of higher debt is increased."

One need only look at the current market for debt capital, Mr. Scanlon stresses, to realize that future debt financing by the Bell System in anything approaching the volume recommended by Dr. Gordon would be a difficult undertaking at best, accompanied by a substantial increase in interest costs. Moreover, starting in 1970, much of the System's $9 billion of debt will come up for refunding.

In the recently emerging economic outlook, however, it may be that the risks of debt financing will be moderated in the future, Mr. Scanlon said.

"Accordingly, it is our intention, conditions permitting, to place heavier reliance on debt in our future financing with the objective of having our debt ratio move toward the top of the 30 percent to 40 percent range we have regarded as appropriate. This will require a number of years. We can then consider whether some higher range of debt ratio would be appropriate in the light of conditions existing at that time.

"Meanwhile, there is no logical reason to assume that a prospective change in the objective level of debt in the Bell System capital structure, to be accomplished over some period in the future, would afford a valid basis for a downward revision in the System's present earnings requirement."

**Relative Risks of the Bell System**

One of the principal determinants of a proper capital structure, Mr. Scanlon notes, is the degree of risk to which an enterprise is exposed. "Thus, the Bell System, with a debt ratio of 30 to 40 percent, falls between the 15 to 20 percent typical in manufacturing industry, which is more risky than the Bell System's business, and the approximately 50 per cent debt ratio typical among electric utilities, which are less risky than the Bell System."

Testimony contesting this view was largely aimed at minimizing differences in risk between the Bell System and electric utilities.

"Dr. Thatcher (FCC staff witness L. D. Thatcher) supported his view that the Bell System is no more risky than an electric utility with little more than his personal opinion. . . . When cross-examined, he admitted to considerable unfamiliarity with the operating and market considerations that bear on risk."

Dr. Gordon apparently based his conclusion that Bell System earnings are no more unstable than those of electric companies on a study of variations in earnings for his sample of electric utilities since 1950, according to Mr. Scanlon.

He points out that an analysis covering this period is of little value in determination of risk, considering it has been a period of almost continuous growth with only brief periods of minor economic adjustments. For the Bell System, results of catching up on the backlog of service demand smothered the effects of any economic adjustments that did occur.

"It is of interest to note . . . that the U.S. Department of Commerce, in addressing itself to the question of volatility of demand, has specifically cautioned against reliance on the postwar period alone as a basis for any such determination. Studies over a longer period show Bell System revenues and earnings to be materially more sensitive to changes in business conditions than those of electrics."

Mr. Scanlon adds that under cross-examination Dr. Gordon also conceded a lack of familiarity with the basic factors affecting business risk.

"The fragmentary support adduced by the opposition witnesses clearly cannot be said to refute the extensive analysis of both past and prospective differences in revenue and operating characteristics, operating ratios, wage and expense rigidity, and pricing economics discussed in my testimony. It does not refute the study by Mr. Bergfeld or the opinions from the investor's viewpoint presented by the only representatives of the financial community who testified."

No claim of "absolute precision" in appraisal of investment risk to the equity holder has been made, Mr. Scanlon notes. Downward adjustments were made in earlier testimony in determining the Bell System's equity return requirement, "to allow for any possible differences in investors' evaluation of the relative risk of an equity investment in AT&T stock."

**Comparable Earnings Approach**

Mr. Scanlon emphasizes that the company presented evidence on its equity return requirement utilizing both comparable earnings and cost of capital studies, and that, realistically applied, the two approaches produce the same requirement.

He then deals, in turn, with four arguments advanced by critics of the comparable earnings standard: (a) It does not recognize the importance of market prices. (b) It presents an impossible problem of measurement. (c) There is no individual company comparable to AT&T. (d) Comparison of AT&T with an average of all industrials or all utilities is improper.

As to the first argument, Mr. Scanlon points out that the comparable earnings standard, both in theory and as presented in this case, does recognize the importance of market prices.

"A company is able to obtain the investor interest necessary to enable it to attract equity capital on sound terms only if its earnings on book investment are comparable to those of companies with comparable risks. If its equity earnings rate meets this standard, the market price of its stock should similarly be comparable."

He notes that witness Dr. Walter A. Morton and he both gave consideration to market prices in their studies, and that he relied in part on market prices in demonstrating the reasonableness of a return of eight per cent on total capital for the Bell System.

Mr. Scanlon says that the second argument is abundantly refuted in the record in this case.

"It is true, of course, that the comparable earnings standard is not applied through an automatic process of calculation. Study, evaluation and, above all, informed judgment are required. But these requisites are not eliminated by replacing comparable earnings with the complex mathematical equations that have been used by opposition witnesses to estimate the cost of capital. . . . For example, the involved mathematical analyses presented by Dr. Thatcher and Dr. Gordon require estimates of risk comparability or investor expectations as a starting point. If risk differentials can be determined with sufficient accuracy for cost of capital purposes, they surely can be determined accurately for comparable earnings purposes."

As to the third argument, Mr. Scanlon agrees that no two companies are alike in all respects. However, he points out, the comparable earnings standard requires only that the investment opportunity in AT&T should be comparable to the opportunities available generally in securities of other companies. Financial witnesses attested to continual investor comparisons of AT&T with other companies.

As to the fourth argument, Mr. Scanlon states he did not use the average of all industrials or all utilities in his direct testimony.

"Instead, I demonstrated that, in spite of differences, . . . the equity earnings rates of other companies tend to exhibit strong central tendencies. . . . I relied primarily on the central tendencies . . . in my analysis of the equity earnings rate required by AT&T. Beyond this, and to minimize controversy on this point, I made a downward adjustment in reaching my conclusion as to the appropriate range of equity earnings for AT&T . . ."

After advancing other evidence in support of the comparable earnings standard, Mr. Scanlon concludes:

"While I believe the comparable earnings approach to be superior in arriving at a rate of return, . . . to the extent a cost of capital approach is used, there should be a recognition that a fair rate of return requires something more than a bare cost of capital. . . . any determination should contemplate a range of allowable earnings rather than a precise figure. This would afford . . . the incentive for earnings improvement through cost reductions and improvements in operating efficiency that redound to the benefit of the customer.

". . . It is my opinion . . . that the range of $7^1/_2$ to $8^1/_2$ percent I have found to be necessary for total Bell System operations is the minimum appropriate for the totality of its investment in interstate and foreign services here under review.

"Lastly, it is submitted that there is nothing in the opposition testimony on rate of return that would warrant a finding of less than that range."

## Rebuttal testimony Robert A. Lovett

Mr. Lovett's testimony is presented in rebuttal to opposition witnesses but is confined to broad policy considerations. He counsels regulatory agencies to use restraint and caution in connection with higher debt, restrictive rate of return, or use of accelerated depreciation with flow through. This advice is predicated on the following fundamental thoughts:

**National Dependence**

The total role of AT&T embraces enormous responsibilities exceeding those of other companies in scope and critical importance. Thus, the country is unusually dependent "on the sound health and continuing technical excellence of the Bell System and the reliability of its performance."

Mr. Lovett further states, "AT&T in its nationwide and intercontinental communication and allied services is an absolute essential to national defense." But its responsibility goes far beyond communications, he says, because it includes activities in atomic development, early warning defense systems, missile guidance systems, antimissile missile programs and highly classified projects vital to the national interest.

**Technological Change**

Mr. Lovett stresses that the rapid change in communications technology has accelerated the rate of obsolescence "which must be taken into account if the present high quality of service is to be provided in the future for both the public domestic economy and national defense."

**Capital Requirements**

AT&T's need for capital is so large and so continuous that it is "especially necessary . . . to have a high degree of balance and flexibility in its capital structure so that it may successfully compete for funds and be able to take advantage of the changing tastes of investors and the fashions of the market at the moment."

Attaining this balance and protecting AT&T's access to the securities market, according to Mr. Lovett, requires "exercise of managerial judgment of the highest order."

Citing the railroad industry's "dreary record" in connection with low return on capital, the burden of debt, and the damaging effect of unpopularity with investors, Mr. Lovett says that "the telephone industry is considerably more fortunate . . . because it has given excellent service and maintained a high credit rating and therefore protected its access to the market." Mr. Lovett advises that reliance could be placed on AT&T management's past experiences and judgments in the capital field, under varying economic conditions, as suggested by the ancient saying that "good judgment is usually the result of experience and experience is frequently the result of bad judgment."

"For all these reasons," Mr. Lovett asserts, "I am convinced that it would be most unwise to impose by regulation on AT&T and its management a specific and higher debt ratio, or to restrict unduly its rate of return, or to introduce debatable accounting practices by financial short-cuts such as imposed accelerated depreciation for tax purposes with flow through to current earnings . . . The management of this company must pursue financial programs which will enable it to meet the unknown demands of the future in addition to its predictable responsibilities."

## Bell System and CATV

"The Bell System holds no threat to the future healthy existence of a privately owned CATV industry," AT&T Assistant Vice President William M. Ellinghaus recently told a group of CATV operators.

Although some independent telephone companies are becoming CATV operators, Mr. Ellinghaus said, the Bell System "never has, nor does it now plan to enter into the CATV business;" it is interested only in providing communication service for the transmission of television signals. "We consider the provision of channel service for use in a CATV system to be a normal common carrier function . . . similar to the television network communication service we have been furnishing to commercial and educational broadcasters, local and statewide educational systems, and business and industrial organizations for many years."

Mr. Ellinghaus told the CATV operators that the Bell System has no intention of discontinuing the granting of CATV pole attachment privileges. It is the Bell System's policy to give CATV operators a "free choice" between a pole attachment agreement or channel service providing there is no pole attachment agreement in effect or there are no other qualified operators applying for the same area at the same time. He also noted that, since the first tariff for channel service was filed in 1959, rate levels have been lowered considerably and are "subject to continual review and revision to incorporate cost savings and efficiencies made possible by the continuing improvement in the state-of-the-art."

## Business and the public interest

Two AT&T executives have emphasized the importance of business involvement in social problems.

Speaking at Butler University, AT&T Board Chairman Frederick R. Kappel said businesses must generate the economic support for improvements in the national environment. "Private enterprise — I mean the spirit and enterprise of responsible individuals in the business community — is just as important to the attack on social problems as it is to the production of industrial goods."

Among the foremost social responsibilities of business, Mr. Kappel said, is the creation of job opportunities for "the sadly disadvantaged." Even though companies cannot give jobs to people who cannot learn how to do them, ". . . we can go a long way to give disadvantaged people the chance to learn, and to help them to learn."

He suggested that community problems might be solved by a "systems approach" which he defined as "a rigorous effort to evaluate all the factors of need and cost and performance that are involved in creating a useful system." In the context of community problems, the systems approach "would require the joint interest of people in business, labor and government," Mr. Kappel said.

In another speech, John D. deButts, executive vice president of AT&T, stressed that business has an important stake in solving social problems and listed some of the actions that the future demands of business: "Build a better understanding of our objectives — or be misjudged. Involve with the community — or be shut out. Anticipate social change — or be left behind. Accede to the public interest — or invite government supervision. Work with elected officials toward common goals — or lose their support."

Business must "take a look at major national problems, then bring business know-how and efficiency to bear in helping to solve them." Among these problems are: unempoyment, education which "leans heavily on contributors from industry," interracial efforts where "leadership from business . . . is surely essential and desirable," welfare programs in which "we who are experts in building a sense of responsibility among our employees can exert a definite influence" in motivating people to help themselves, and urban renewal where "perhaps the greatest need is to be found, because poverty, civil rights and the broadest spectrum of social questions have their vortex in the cities."

Mr. deButts also suggested a creative dialogue between business and government. Emphasizing that the responsibility is mutual, he posed these questions to business: "Do we develop knowledge of elected officials and their problems . . . do we keep them advised of our situation . . . do we really help them in their efforts to do a good legislative job . . . do we try to learn the political ropes?"

"Involvement in community activities is not only good citizenship — it is also good business," Mr. deButts observed. "A solid demonstration of social responsibility on the part of all business from the corner store to the corporation not only raises the standards of the community but also those of business."

## Communications changes to affect society

The communications revolution now in progress will have a profound impact on all society, AT&T Board Chairman Frederick R. Kappel said last month in Chicago. He discussed four major aspects of this revolution, including advances in wordwide communications which will benefit international understanding.

Turning to satellites, Mr. Kappel said their present use is for international service, but they will also be an important factor in providing domestic service, especially if "tied in with the common-usage network to which the entire public has access."

The third aspect concerns the increasing variety of communications instruments, systems and services that are being introduced. "Methods for sending, receiving, handling, storing, retrieving and displaying information will steadily grow more capable, more versatile, more useful to mankind."

Fourth, the rapid increase in communications between people and computers will have "great consequences. . . . The most versatile problem-solving technology yet devised will become the low-cost servant of the average man . . . over the lines of communications, local and national networks." ■

**AT&T**

American Telephone and Telegraph Company
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# BELL

telephone magazine

A Man and His City Page 36

AT&T

# BELL
## telephone magazine

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**ON THE COVER** — Ray Garcia is a man deeply committed to his community, East Los Angeles, Calif. Ray, who expresses his views on the involvement of business and the individual in the problems of the city starting on page 38, has recently been appointed field deputy of Lt. Governor Robert Finch and will soon be taking a leave of absence from Pacific Telephone to serve in a liaison capacity between the Spanish-speaking community and state officials.

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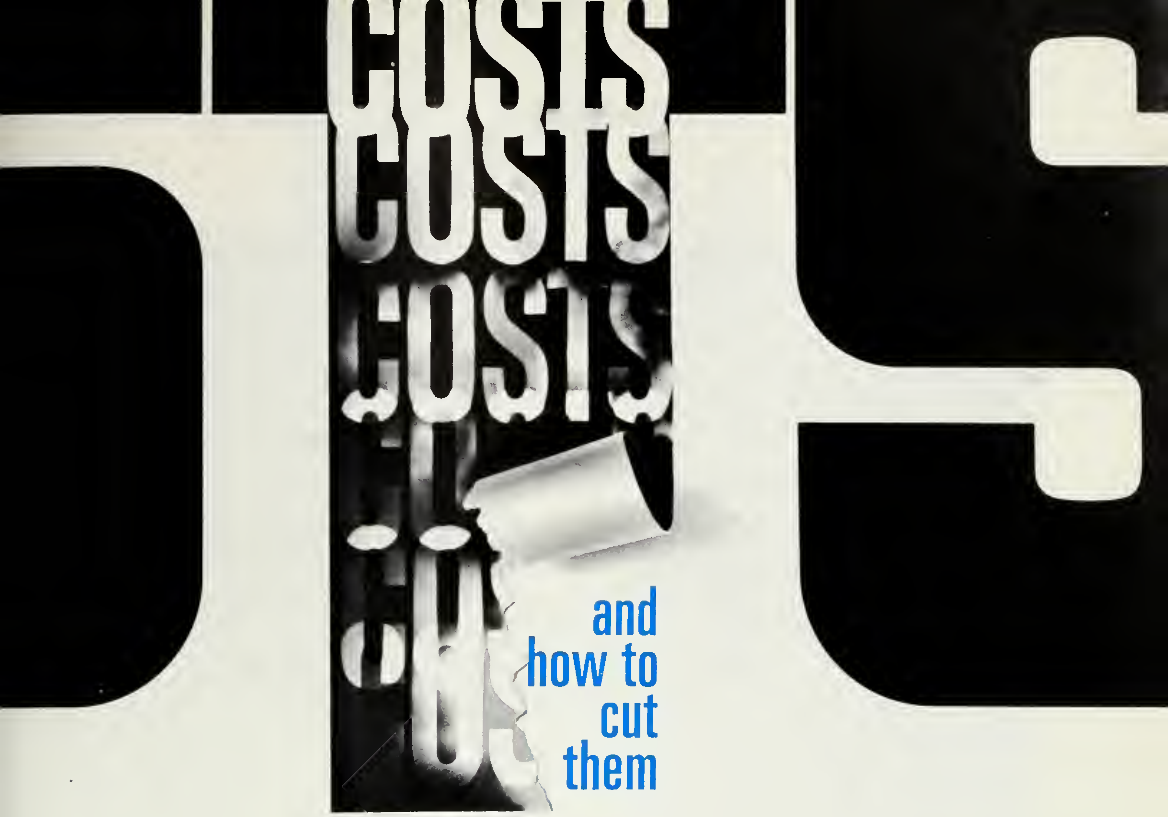
**Big savings — $30,000,000 last year — result from programs that assure accurate reporting, adequate recognition and management support**

It was a $2 million a year victory in the war on costs— substitution of factory-grown, artificial quartz crystals to replace the costly, hard-to-get natural material. But Bill Watson, an engineer at Western Electric's Merrimack Valley Works in North Andover, Mass., had no time to cheer.

Despite the savings in material costs, the tall engineer knew there must be better ways of testing the crystal units that are used to control frequencies in transmission systems. "The trouble was, if something went wrong in making the units, feedback of the cause was critically delayed — even an hour would be too long. By then the damage was done; a whole batch of crystals might be ruined."

After long hours of study, Bill submitted a proposal for an on-line, real-time computerized testing system to the plant's cost reduction committee. The committee liked what it heard: "the use of new technology for process control, audit and quality reports — *now,* while it's happening," and estimated savings of about a half a million dollars a year.

The experience of Bill Watson is typical of hundreds of engineers in the Bell System's manufacturing and supply unit, which last year processed 5,983 cost-




# and how to cut them

cutting proposals. And most of these recommendations came from engineers who consider finding new ways of producing quality products at less cost — and keeping the cost of telephone service down — "a way of life," as Watson puts it.

Like other manufacturers—and industry in general—one of the biggest hurdles that Western Electric has faced in its pursuit against rising labor and material costs is the need to create cost awareness and a climate of change and innovation. But over the years—its formal cost reduction program dates back to the mid twenties—Western has been able to instill in its engineers an attitude that changes designed to make a product at less cost are as necessary as meeting production schedules, attaining quality performance standards, or introducing new products.

"We've found that we must put the responsibility for cost reductions squarely on the shoulders of the product and planning engineer," says Quentin W. Wiest, general manager for engineering at Western Electric. "Give him the responsibility and hold him accountable, and he'll come through.

"It's only natural to give the primary responsibility to the engineer. After all, the philosophy of low costs starts with good engineering, or what we call cost avoidance . . . making sure you have effectively engineered the job so the item is produced at the lowest possible cost right from the start. By giving him the responsibility, you can make the best use of his talents and he can demonstrate his professional competence," explains Wiest.

"I don't believe full-time cost reduction specialists are the best way to achieve cost reduction. It is perfectly true that other duties command the engineer's attention as well as cost reduction, but this doesn't come close to offsetting the benefits of the intimate knowledge of the product or planning engineer who works on the job. The product engineer who lives with cost problems is the expert . . . even though he may freely consult specialists," Mr. Wiest says.

Western Electric has learned that a good cost reduction program is not a hit-and-miss proposition. Down through the years, it has formalized the program through the evolution of a series of scientific guidelines designed to make sure the company is really saving money through cost reduction proposals, and to establish an equitable means of giving credit to the individuals and organizations who are responsible for the work.

"When you formalize a program like this, you get a commitment from top management, and at the same time, set up the necessary management controls," points out William G. Seyter, who is in charge of coordinating cost reduction at Western Electric's headquarters in New York. "With appropriate controls, you can determine if estimated savings are actually attainable. You've got to be careful, though, that you don't get involved with so much red tape that you inhibit and frustrate the effort. Burdensome controls can be as bad as no controls."

How does the program work? Bill Watson's proposal for computerized testing is an example:

The quartz crystal unit shop used a system of tab cards to help evaluate the reasons why some batches of tiny crystal units do not measure up to the superfine degrees of tolerance needed to control frequencies in transmission systems. The tab cards are slow: it usually takes about a week to collect and process the data. By then defects have occurred and many units may be ruined.

"It seemed to me," Watson reports, "that modern computer technology could be put to use to improve our process methods and quality control. After some preliminary study, I reviewed it with four other groups that were involved, and after estimating the


*"Western Electric's cost reduction program is based on the premise that engineering effort, beyond that necessary to make the product, is worth every cent it costs, but savings must exceed costs," states Quentin W. Wiest, general manager for engineering.*

*"Management at all levels must have compelling, practical reasons for stimulating cost reduction and ensuring the program's continuance as a traditional element of the Company's operations."*

*"Ordinarily, good engineering—a gathering of new materials, new methods, new developments and new skills under new conditions at the right time—characterizes the most significant cost reductions."*

*"Secondary but indispensable factors are good engineering supervision, successful group effort spearheaded by the product engineer involved, and a cost-conscious management willing to cope with change."*

savings and how much the new process would cost, went to the cost reduction committee."

The committee, composed of top engineering management and representatives from other groups in the plant, agreed to recommend spending about $530,000 to purchase new equipment, rearrange the shop layout, and develop the computer program. It was worth the effort and the money, they felt, because they estimated savings at $372,900 the first year, averaging out to $530,700 per year over the next five years. In addition, it would make maximum use of facilities and increase yield.

The critical point in the life cycle of any proposal occurs when the engineer presents his recommendation to the cost reduction committee, according to Morris Burakoff, the department chief at Merrimack Valley who is responsible for coordinating cost reduction activities there.

"First of all, the engineer has to demonstrate that he's done his homework, that he knows the answers to a whole batch of questions that might come up. Next, the committee members should have a pretty good idea of what's ahead for the product under discussion: If it is going to be replaced by something new, for example. In the end, the committee must decide if the proposal is worth the time and the money to implement."

One of the biggest cost reduction cases in Western's history is now under way. Bell Telephone Laboratories and Western have jointly developed a new kind of wire used in installing phones. It's smaller than the former wire and has a slippery insulating jacket that will reduce the time and effort needed to pull it through conduits in apartment and office buildings. Cost savings to Western Electric will amount to about $1.4 million a year; labor savings may total $20 million for the Bell Telephone companies.

*"Take one cost reduction step at a time and introduce it smoothly, quickly and practically as possible, without insisting on the complete development of the whole idea," explains Engineer William D. Watson, left, who reviews an idea with his manufacturing counterpart in the Quartz Crystal Unit Shop.*

"It's not enough to say that cost reduction is important. You've got to give credit and recognition. And if results count in evaluating performance, it is important," according to Morris F. Burakoff of WE's Merrimack Valley Works.

"Fair and equitable controls in results reporting are absolutely essential, but you can over control. The balance must be established by experiment," states William G. Seyter, manager of engineering planning at Western Electric's headquarters in New York.

"Everybody can suggest ideas," says Marvin Hill who coordinates cost reduction at Merrimack Valley. "People on the production line, as well as our outside suppliers, are encouraged to work with the engineers to hold costs down."

"If you're really after big savings, you can't be afraid to spend money," Mr. Burakoff points out. "Today, technology is so sophisticated that it costs a lot of money to put some of these ideas into effect.

"At the same time, you've got to realize that you can't win them all. You may have to spend some money to find out that you can't save what you thought you could. Or sometimes you can try something and it won't work. Try it again some other time."

The continual pursuit of cost reduction is another essential ingredient in the Western Electric program. Although the schedule for any cost reduction case includes a "close case" date, none is ever filed away.

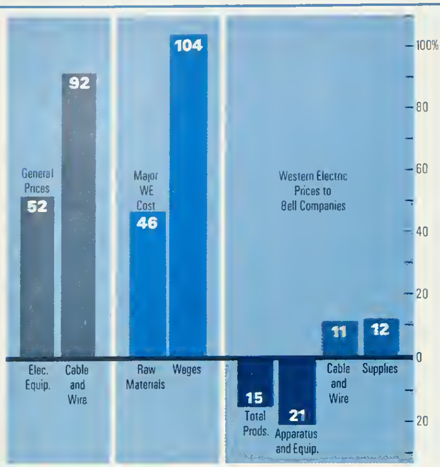
"We don't just take one shot at it, prove it in, then sit back with a contented sigh and collect the savings. You have to keep right on working with the same product, always looking for ways to improve it or cut the cost of making it," adds Marvin Hill, who helps Burakoff coordinate cost reduction efforts at Merrimack Valley.

## Motivators: achievement, recognition

In the production of one small item — deposited carbon resistors, for example — 20 separate proposals to cut costs were processed during the past five years. The cumulative savings over that time have amounted to over $553,000.

The product and planning engineers feel the sense of achievement and the recognition they get are the biggest motivators in developing new ways of cutting costs. "Cost reduction is the only program I know of where you can go before the top management and tell them, 'Look, we can save you so much money by doing such and such.' There aren't many places in industry where this is possible. It's a great opportunity," states Leonard J. Winn, a product engineer at the Merrimack Valley Works.

"There's a lot of personal satisfaction involved when you're working on a good case. Not only do we know that our performance is being evaluated—partially, at least — on the basis of our cost reduction



Cost and Price Comparisons—January 1, 1967 with Jan. 1, 1950 Levels

effectiveness, but we also know that there is direct competition between Western manufacturing plants," Mr. Winn points out. "It's a great competitive challenge, a working test of our professional competence."

Winn and other Western Electric product engineers work against a yearly cost reduction savings goal. Each engineering department and each manufacturing location has a similar goal — as does the entire company. Fixing the target — setting the goal — starts with each engineering department which each fall presents its firm plans for cost reduction for the next year and its preliminary views of other possibilities. The department's goal, an amalgam of indi-

*"Presenting a cost reduction proposal to the committee is the kind of challenge an engineer lives for," states Charles W. Higgins, left, of WE's Merrimack Valley Works. "His ideas must meet rigid standards, both technical and economic."*

vidual engineers' targets, is then dovetailed into a plant goal which, in turn, is combined into a company-wide goal. This year's target: $35 million.

Although the formalized engineering cost reduction program is the most significant, it is not the only means by which Western Electric seeks to keep the price level of its products low. The engineer's primary responsibility is planning for production at the lowest possible cost — cost avoidance — and *this* is the most important effort.

Like other manufacturers, Western Electric has an employee suggestion plan which has produced more than half a million suggestions since it was inaugurated in 1944. About one-quarter of these have been adopted. Result: estimated savings of $13 million.

In addition, Western has a group wage incentive plan, which provides a bonus of 15 per cent of the basic wage rate when the work group's efficiency meets the carefully spelled-out standards. As the group's efficiency goes above or falls behind the standard, the incentive factor in their wages rises or is reduced accordingly.

Another manufacturing program is the standard cost system which sets up a yardstick — an objective — for each element of costs. Standard costs tell the first-line supervisor how much his operation should cost, thereby making it possible for him to determine whether he spent more or less than he should have for labor, materials, or other expenses under his control. It also provides a comparison of performance between work groups in any plant.

The effort goes beyond manufacturing. Western Electric's purchasing and transportation organization has a sustained program to reduce costs. The service division has been registering substantial savings in its distribution, installation and equipment engineering activities for many years.

To cite one case: a new solvent polishing process is being developed to restore telephones to their "like-new" appearance which will enable 75 per cent of the plastic parts to be reused, instead of only 45 per cent with the present buffing process. With more than 16 million telephones being restored at the 35 Western Electric distribution centers across the nation, annual savings are estimated at nearly $2 million.

What does it all add up to? Last year, manufacturing cost reduction savings amounted to over $30 million and, over the past decade, $200 million.

## Price level 15% below 1950

The result of this cost reduction effort is that today the price level of Western Electric's products is about 15 per cent below 1950 — despite increases of 104 per cent in wages and a 46 per cent increase in the cost of raw materials.

What does this mean to the Bell System operating companies and their customers? The telephone set itself serves as a good illustration. Since the present design of the standard desk telephone was introduced in 1949, 2,300 separate changes have been made to improve its performance and lower its cost. The result: a better telephone for 25 per cent less than it cost originally.

This, of course, has the effect of helping the Bell System operating companies keep their needs for new capital to the lowest possible level, makes more money available for service improvements, and — in the case of some service offerings — makes it possible to reduce rates to the telephone user.

"This achievement," Western Electric President Paul A. Gorman says, "has helped hold down the cost of telephone service to the public. It was possible chiefly because of cost reduction.

"This policy of passing on in lower prices the economies we have achieved — or will achieve — as a result of our intensive drive to cost reduction has contributed much to telephone progress. It is our membership in the Bell System that makes our pricing philosophy possible, just as it makes possible — just as it dictates — our total commitment to the goals of the Bell System as a whole." □

H. I. Romnes, on February 1, became
chairman of the board and chief executive officer
of the American Telephone and Telegraph Company.
Here are some of the ideas and opinions
he has expressed about the business
in which he's worked 38 years
and the society of which it is a part.
The pervasive theme of his remarks is his emphasis
on quality—in service, in workmanship, and in life.
In today's complex society, he sees management's job as

# A Summons to Excellence

## What is Our business?

Our business, I'm glad to say, faces an uncertain future. Not only do electronic switching and communications satellites offer potentialities we can barely imagine now, but so does the laser with its capacity to transmit — and to store — vast amounts of information in a beam of light. So does the wave guide cable now under development by which we hope to be able to transmit a third of a million simultaneous conversations over a single "pipe." And so, too, do recent developments in Pulse Code Modulation, a system that promises as dramatic economies in short-haul transmission as the waveguide cable does for long haul. . . .

In our business the potentialities of a new technology are a long way from being "topped off." As a matter of fact, if there is one overriding lesson in the history of the telephone, it is that growth and progress depend on a constant probing for new potentialities in communications service.

Our business was born of research and it has grown through research. . . . This is our investment in the future. . . . What its yield will be is beyond precise prediction. But I do know we have no more cherished asset than our capacity to change, to innovate.

*Chamber of Commerce*
*Baltimore, Maryland*
*November 8, 1965*

Surely we can never forget — in applying new technology to our own business practices — that the ultimate test of everything we do is the satisfaction and convenience of the customer. *He* is the one who shouldn't be folded, spindled or mutilated.

*U. S. Independent Telephone Association*
*New York City*
*October 18, 1965*

We number our customers in the millions. . . . But we serve them one at a time.

More and more, it seems to me, the public's opinion of the telephone company will reflect its sense of the personal interest we show in all our dealings. . . . It is because of this desire — the natural, understandable desire for personal attention—that we have made it a precept of our business that, whatever miracles automation might achieve, our customers will always have access to a real, live human being — an employee equipped and trained to be helpful.

*NAWGA Convention*
*Chicago*
*March 7, 1966*

## Managing Change

The management of change in our society is a partnership — a partnership between enterprise and innovation, between invention and investment. Each has obligations to the other — enterprise to support the quest for truth from which all new things come, to run the risk of untried ways; innovation to provide a continuously evolving practical specification for progress.

*Ohio State University*
*Conference of Engineers and Architects*
*Columbus, Ohio*
*April 28, 1961*

. . . a business information system, if it is to be successful cannot be imposed — appliqued — on an organization. Indeed, were you to attempt to do so — and however elegant your design — its purported beneficiaries would almost certainly resist it. And they would be right in doing so.

To the technologist, their resistance might seem like sheer human cussedness, mankind's traditional response to any threat to his accustomed ways. But, more fundamentally, any system that does not grow out of an organization's own experience and that does not match its own definition of its needs and the results it seeks, just can't be a very good system.

Participation isn't just a necessary precondition of acceptance; it is a prerequisite of effective design.

*International Data Processing Conference*
*Chicago, Illinois*
*June 22, 1966*

. . . 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 . . . not to mention its responsiveness to its customers . . . as to require the most comprehensive management consideration. . . . In some organizations, the installation of a business information system has had the effect of drawing the authority for decision-making closer to the top. And in some organizations this may be all to the good. . . . But in other organizations — and I would count the telephone business among them — the need to respond flexibly to the unique needs of each community, each customer, is paramount. The design of a business information system for such a company will be quite different from the company with the accent on centralization. But the need for such a system — and its value — may be no less. Its purpose, however, will be to provide the local manager the context of information he needs to make his own decisions as to how best to serve his customers.

*Industrial Communications Association*
*Pittsburgh, Pennsylvania*
*May 4, 1965*

## The Individual's Role

First in my list of the individual's responsibilities to society is the responsibility to do his job well—assuming, of course, that the job is a useful one. Being merely adequate is not enough. Society will remain static if the standards we set for today's attainment are no higher than yesterday's and tomorrow's no higher than today's. The "pursuit of excellence" may be an over-worked phrase. But it is the root of progress. It is something we owe not only to society but to ourselves.

*Science and Engineering Club*
*Kearny, New Jersey*
*June 28, 1960*

. . . Increased mechanization in shop and office — perhaps paradoxically — is actually increasing the significance of human effort. With automation the investment for which each individual employee is responsible is growing. And what he does with the complex and expensive facilities at his command is coming to have a more critical bearing on our success. The demands of the new technology are changing the composition of our work force, putting greater emphasis on individually acquired skills. . . . The progress we seek cannot spring from an organization chart, however artfully designed; it can only come from people. . . . More and more it will be the man that makes the job rather than the other way around. Personal attributes — initiative, creativity, even that old-fashioned one, responsibility — will be the factors that spell the difference between success and failure in tomorrow's industry.

*Reading and Berks County*
*Chamber of Commerce*
*Reading, Pennsylvania*
*June 6, 1961*

## Our Society and Its Needs

Equal opportunity is a fine phrase. Making it come true is an arduous, sometimes painful process. But there are many good reasons why management needs now to demonstrate not merely good faith but practical initiative in support of this basic American tenet. The good opinion of the world is only one of them. A more compelling one is that prejudice breeds waste, the most tragic kind of waste, the waste of human resources. But in the final analysis there is one reason above all others for giving our best management attention to making equal opportunity come true — and that is because it is right.

*Chamber of Commerce*
*Associated Industries of Arkansas*
*Little Rock, Arkansas*
*November 8, 1961*

Today our country is attacking the twin problems of poverty and discrimination by a strange and sometimes confusing mixture of means, public and private, mandatory and voluntary, Federal and local.

This arena will be the principal testing ground of the vitality of local initiative in the months and years ahead.

I for one have no doubt about the sincerity of our country's commitment to the attack on poverty and discrimination. How long it will take I don't know. But the job will get done one way or another.

How it is done, though, can make a great deal of difference as to whether the balance of decision-making in this country swings toward Washington or swings closer to home.

Business people can have a great deal to do with the outcome.

. . . If enough trained business intelligence is focused on these problems — to help sort out the priorities, to help match objectives to resources realistically — the job is going to get done sooner and better.

*Wisconsin Manufacturers Association*
*Milwaukee, Wisconsin*
*May 17, 1966*

We [in business] need to demonstrate our concern for the larger interests of society through the application of business-trained intelligence to problems that transcend the special interests of business and affect the whole community. There are problems cut to the measure of each of us — hometown problems like schools, slums, traffic and taxes; regional problems like transportation, water resources, industrial development and the like.

. . . To stand aside in the face of these problems is to deny our communities their most needed resource — responsible leadership. It is with poor grace that businessmen decry the growth of big government, the centralization of power and authority in Washington, in the absence of taking up the responsibility themselves, where it belongs — at the local level. If we don't, I'm afraid we won't be able to complain that our responsibility has been taken away. We shall have given it away — and some of our freedom with it.

*American Management Association*
*New York City*
*February 7, 1961*

## Business and Government

. . . It would be unfortunate, it seems to me, if some of the more dramatic encounters of business and government should lead our people to the conclusion that there is a necessary and inevitable conflict between public and private interests.

Should this happen, the American people will have lost sight of that feature of our economy that has made it unique among the nations of the world, that has brought us further, faster than any system of economic organization yet devised and which remains our best hope for growth and progress in the future. I mean the freedom of men and organizations to strive competitively to excel and to derive appropriate rewards for achievement. It is precisely in the pursuit of private aims that we have felt the public interest to be best served.

*Chamber of Commerce*
*Winston-Salem, North Carolina*
*May 17, 1962*

## Business and Youth

I believe the best of youth remains today what it always has been — purposeful and idealistic, ambitious to be of some service in this world. Does business provide scope for this ambition, this idealism? Career choices being made in our schools and colleges will largely turn on the answer to that question. In the face of cynicism with respect to the motives, ethics and standards of business there is no more serious charge on American management today than to convey to our young people that a career in business will challenge the best that is in the best of them.

*Associated Industries of Massachusetts*
*Boston, Massachusetts*
*October 26, 1961*

## Excellence

The potentialities of communications are enormous — and quality is the key to the future. The fastest growing aspect of communications today is not person-to-person but machine-to-machine — data transmission. Data transmission imposes vastly more stringent demands of the capabilities of communications circuits than do voice conversations. At the fantastic speeds at which data traffic will be handled — thousands or even millions of bits per second — an otherwise imperceptible interruption or irregularity in transmission could lead to disastrous distortions in vital statistical information — a missed decimal point, for example. That we are today able to envision a time when data transmission may rival voice traffic is a tribute to the people in our laboratories and factories who have been able to build a new order of quality into the countless components of our communications network and thus achieve a whole new order to capability.

*IRE-EIA Meeting*
*Toronto, Canada*
*November 13, 1962*

. . . it does seem to me that the standards of excellence we in business set for ourselves in this day and age must go beyond the customary measures of efficiency and convenience and profitability and take account of the human qualities on which more and more our performance will be judged.

For all day, every day, the earnestness with which we in business pursue our professed standards of high value at low price are being quietly appraised. The integrity of our business relationships, the craftsmanship of our products, the sincerity of our dedication to service — all are being tested by millions of Americans — one at a time.

On the outcome of this appraisal, not merely the prestige of business but its future freedom and vitality will depend.

*NAWGA Convention*
*Chicago, Illinois*
*March 7, 1966*

. . . business freedom in the sense that I am thinking about it is not the heedless exercise of self-interest. It is a freedom that must be earned. To my mind, earning it requires that we recognize that responsibility to the public interest is an explicit function of business management in our time.

That responsibility calls, first of all, for a renewed initiative in support of industry's basic obligation to the public — enhancing the economic performance of our country and enlarging the opportunities of its people. But it calls as well for a sensitivity to human needs and, in the face of the economic, social and ethical problems that have added complexity to today's management job, it calls for the added imagination to discern and the courage to do what is right. It is a challenge to the character and competence of American business. It is a summons to excellence.

*Chamber of Commerce*
*Winston-Salem, North Carolina*
*May 17, 1962*

# The Promise of Holography

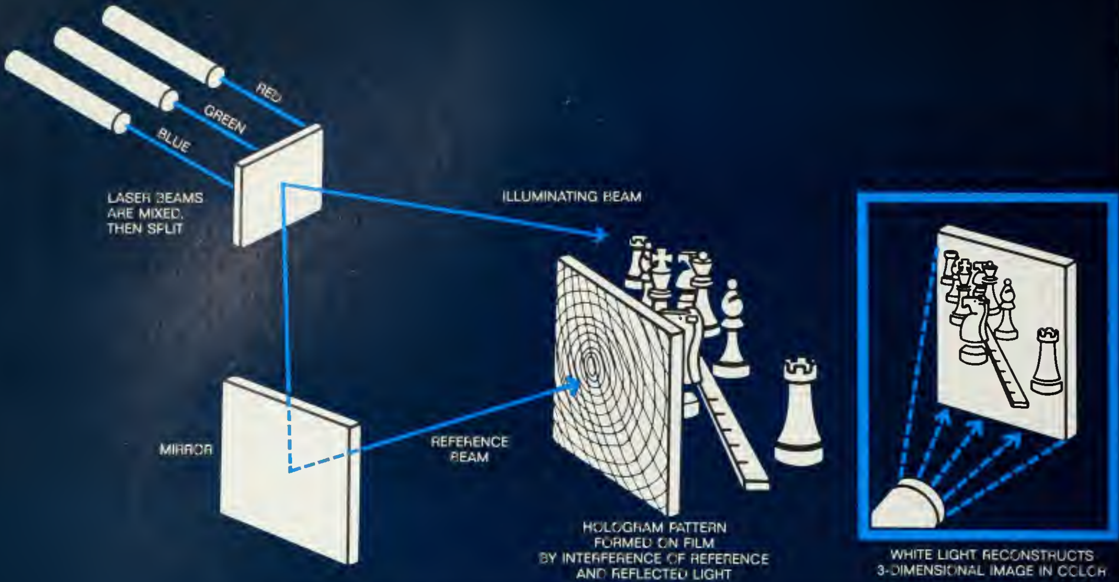
Lasers and "lensless" photography techniques can now produce holograms of three-dimensional, multicolored images that "float" in midair and may revolutionize storage and retrieval of information

For years scientists have been groping for ways to preserve and reproduce objects in three dimensions. The best that have been produced thus far have been stereoscopic devices and cinerama motion pictures — both of which give the impression that you're seeing the object in 3-D — and cumbersome Polaroid glasses that give the effect of three dimensions.

But scientists at Bell Telephone Laboratories and the University of Michigan have developed a method by which three-dimensional, multicolored images can be seen by shining an intense beam of light on a hologram, a photographic plate or a piece of film that records an image of an object illuminated by a laser beam. The realism of a hologram is so great that the image appears to "float" in midair and is practically indistinguishable from the real object itself.

Although its ability to reproduce a three-dimensional image is one of its most important properties,

*The realism of holograms is demonstrated by David Melroy of Bell Labs who holds a Trimline® Touch-Tone® telephone (right) beside a three-dimensional photographic image of the same telephone as it is illuminated on a piece of translucent film.*




*To make a hologram, laser beams are mixed, then split into two beams: an illuminating beam that shines directly onto the object, and a reference beam that's reflected by a mirror onto photographic film. By shining a beam of light onto the film, a three-dimensional multi-color image of the object is reproduced.*

*Three conventional pictures of a single hologram photographic plate demonstrate the ability of a single hologram to show three sides of a subject. When viewed against a yardstick, it is possible to see the left side of the chess figures, the head-on view, and the right side of the figures.*

ooking specks and whirls on the holographic plate (above) record the pattern produced by the interaction of two laser beams. When illu- ed by a beam of light (below), the original subject is recreated in a three isional image which "floats" either before or behind the hologram.

the hologram has other characteristics that make it attractive to scientists and engineers:

- A hologram does not require any lens to produce an image,
- A hologram can produce multicolored images from film emulsions which normally produce only black and white images,
- A hologram can be broken into pieces, yet each piece can still produce the entire image, and
- A single hologram can record information about many different objects.

The potential of the hologram technique is implied in its name which is derived from the Greek roots *holo*, meaning "whole," and *gram*, meaning "writing" or "record." A hologram's capability of storing large volumes of information in a compact area may make it a particularly valuable element in the Bell System's nationwide communications network. For example, Bell Labs scientists are investigating the possibility of applying holography techniques to the storage and retrieval of information for switching, information services, and the transmission of large volumes of visual information.

How is a hologram made? One way to answer this question is to compare how an ordinary photograph is made with the means of making holograms.

When taking a conventional picture, the subject is usually illuminated by sunlight or light from a lamp. An image of the subject is formed by a lens focused on photosensitive film that records the image by responding to the intensity of light reflected from the subject. A black and white photograph, therefore, is made up of black, gray and white tones that correspond to variations in brightness of the subject.

Holography, however, differs in two basic ways: (1) no lens or image-forming device is needed because no focused image is formed on the hologram, and (2) the object must be illuminated by "coherent" light, such as that provided by a laser. The use of coherent light enables special patterns of light waves to be recorded on the film, in addition to variations

*Bell Laboratories' Larry H. Lin (left) and Ken Poole make the multicolored hologram which is seen on the preceding page.*

in brightness. (Coherent light, which contains light waves of nearly a single wavelength, provides a scale for measuring the distance the light has traveled and the direction from which it came.)

A hologram records a visual pattern produced by the interaction of two coherent light waves from the laser: one that is used to illuminate the holographic plate, and the other to illuminate the subject. Light waves that illuminate the subject reflect back to the plate and interact with the first light wave on the hologram. This interaction of light waves produces a combination of lines, specks and whirls which may look like an out-of-focus fingerprint or a smudged or darkened photo negative.

When this combination of smudges is illuminated — either by another laser beam or a beam of light from the sun or a flashlight — the original subject will appear in three dimensions, apparently floating in midair. And if different colors of laser light are used to illuminate the subject, a multicolored hologram will be produced.

The basic principles behind holograms were first described in 1948 by Dennis Gabor of the Imperial College of Science and Technology in London. For many years thereafter, no practical source of coherent light was available and work in holography was limited. In 1960, however, the advent of the first laser sparked renewed interest in holograms. This interest was stimulated mainly by experiments of scientists at the University of Michigan's Institute of Science and Technology.

About two and one-half years ago, Bell Labs scientists at Murray Hill, N. J., recognized holography's capacity to store vast amounts of data on small slides. In 1965, two BTL scientists discovered a way of making two-color hologram images by laser light, and a year ago, members of the electron tube and optic device department teamed up with University of Michigan scientists to create two-color holograms that could be viewed with the light of a high-intensity lamp rather than a laser.

Studies now under way are investigating the possibility of using holograms to make more precise masks for microminiature integrated circuits. Other research work is under way to see if television and Picturephone® systems can transmit three-dimensional images.

But to make a hologram today is a formidable task. To produce the holograms pictured here required three days to align the optical components, five beam splitters, five lenses, 13 mirrors, the hologram plate and subject, and a laser atop a three-ton table designed to avoid shock. (If the object moved as much as two ten-millionths of an inch, the variations would have shown on the hologram and distorted it.)

Whatever its potential may be, holography is now about at the same stage of development as photography was about 130 years ago when Louis Jacques Mande Daguerre, a French artist, exhibited a picture of some small busts, a basket and a painting. Yet the promise of holography may be as great as Daguerre's primitive photographic efforts. ☐

# The Interstate Rate Case

## AT&T's proposed findings emphasize the need for rate of return in the area of 8%

AT&T submitted its proposed findings and conclusions and legal briefs for Phase One of the interstate rate case to the Federal Communications Commission in late March.

In a letter of transmittal, AT&T Vice President F. Mark Garlinghouse reemphasized the need for Bell System earnings "comparable with those of other companies offering competing investment opportunities" so that continuously improving, low-cost communications service may be provided. "By this criterion, our evidence shows," the letter stated, "the Bell System needs a return averaging at least 8% on the total investment in its interstate business."

The letter also dealt with rate of return and three related issues covered in the initial phase of the rate case: accelerated depreciation, rate base items, and separations procedures. "On each of these questions," Mr. Garlinghouse said, "our position reflects the basic responsibilities of our businesss: providing the public an ever-improving, low-cost communications service and maintaining the financial strength and integrity necessary to fulfill that objective in the years ahead."

Following is the text of Mr. Garlinghouse's letter:

**Rate of return**

We believe that to provide excellent and continuously improving communications service at low cost, the Bell System must produce earnings on its share owners' investment that are comparable with those of other companies offering competing investment opportunities. By this criterion, our evidence shows, the Bell System needs a return averaging at least 8% on the total investment in its interstate business.

This need is shown by the testimony of our principal financial officers, experienced in raising the huge amounts of capital necessary to meet the public's need for our services, and it is firmly supported by highly qualified witnesses from the financial community, as well as by leading economists and outstanding university scholars.

In the course of our presentation, Ben S. Gilmer, president (then executive vice president) of AT&T, defined the basic objective of our business as an "ever-improving service" and stressed the importance of continuing technological innovation as the means to that end. But, he pointed out, realizing our full potential for better service through innovation depends on the opportunity to achieve good earnings.

"Earnings prospects that encourage a commitment to the future," Mr Gilmer said, "will help assure continued leadership in the technology of common carrier communication." (Bell Ex. 31, p. 7)

In the view of distinguished economists appearing in our behalf, determination of an appropriate rate of return for our business must give full account to the role of communications as a critical determinant of the nation's ability to meet its economic goals. A minimum rate of return aimed at saving a small fraction of the public's telephone bill would stultify growth and innovation, retard the economies that derive from technological advance and thereby frustrate the public's larger interest over the long term. In short, it would be false economy.

As pointed out by AT&T's vice president and treasurer, John J. Scanlon (Bell Ex. 20), the plain fact is that an investor will not buy AT&T stock if he thinks he can get better performance in another stock, relative risk to his investment considered. And, in assessing risk, the investor does not view the stock of AT&T much differently than he does the stock of other large, well-established American businesses. Thus, if AT&T is not earning a return on its equity in a range comparable to the earnings of other companies, the investor will choose some other investment opportunity.

In order to ascertain the earnings level needed to maintain AT&T stock as a comparable investment alternative, Mr. Scanlon analyzed the earnings on equity of 528 manufacturing companies. The study showed that equity earnings of these companies manifested strong central tendencies of about 10% to 12%. The averages for all companies were even higher. As a futher check, Mr. Scanlon made a similar study of the equity earnings of 128 electric utility companies and found their equity earnings to be reasonably comparable to non-regulated companies. Any differences in business risk between manufacturing companies, telephone companies and electric utilities tended to be equalized by differences in capital structure between the respective industries, so that the investment risk of the equity owner in each case was quite comparable. Finally, in order to allow for possible residual differences of equity risk, Mr. Scanlon said that Bell should be allowed to earn between 10% and 11% on its equity — the lower end of the central range of manufacturing earnings.[1]

To demonstrate the practical significance of the comparable earnings standard, Bell introduced five prominent spokesmen representing all sectors of the financial community who described the manner in which AT&T stock is actually evaluated as an investment opportunity.[2] All of their analyses supported the same result—that AT&T needs a return of 10% to 11% on book equity to be competitive with other investments. This evidence was never challenged. This level of earnings for equity translates to an over-all fair rate of return of at least 8%.

Finally, our need for earnings of at least 8% was examined from the point of view of national economic and defense objectives and desirable regulatory goals. This testimony was presented by men of such stature and reputation that all have been valued advisers to Presidents of the United States.[3] They gave unqualified support to the position that earnings of at least 8% for the Bell System would serve the national interest and be consistent with national policy.

Despite a clear challenge to do so,[4] no witness with practical financial experience came forward to oppose these views. In point of fact, only three witnesses made rate of return recommendations inconsistent with our own and none of the three had any investment or financial experience.

One of the opposition witnesses (Robertson, W. Va. Ex. 1) derived a cost of capital of 7% by using raw earnings-price ratios, a method thoroughly repudiated by the other witnesses, by numerous commissions, and by NARUC. Dr. Robertson admitted that his cost of capital, so derived, could not be applied to the book value of AT&T stock (Tr. 5072). Hence it is useless in this case.

Another opposition witness (Thatcher, FCC Staff Ex. 16) recom-

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[1]Mr. Scanlon's conclusions were corroborated by independent studies prepared by Dr. Walter A. Morton, Professor of Economics and a noted lecturer and author in the field of public utility economics, and by Dr. Irwin Friend, Professor of Economics and Finance, The Wharton School of the University of Pennsylvania.

[2]The five were: F. J. McDiarmid, Vice President of Lincoln National Life Insurance Company; Charles W. Buek, President, United States Trust Company; Gustave L. Levy, Chairman of The Management Committee, Goldman, Sachs & Co., Vice Chairman of The Board of Governors, New York Stock Exchange; John H. Moller; Senior Vice President, Merrill Lynch, Pierce, Fenner & Smith; Adrian M. Massie, former Chairman, Trust Committee of Chemical Bank New York Trust Company.

[3]These witnesses were: Robert R. Nathan, Alexander Sachs, Paul A. McCracken, and Robert A. Lovett.

[4]Mr. Scanlon said: "Doubtless the Commission will hear other evidence as to the rate of return required by the Bell System — some with conclusions differing from those proposed by AT&T. It is to be hoped that the Commission will insist that such testimony be similarly buttressed by the testimony of witnesses of comparable investment competence, stature and responsibility to those presented by the Company." (Bell Ex. 20, p. 68).

mended a return of about 7%. But he conceded many errors, some minor but some major. He made no allowance for flotation costs but admitted the he should have done so. He did not give effect to rights offerings and vacillated on whether he should have,[5] although the other staff witness, Dr. Gordon, was clear that the value of rights must be considered in finding cost of capital. Clearly, Dr. Thatcher's testimony lacks credibility, and if his figures are adjusted for his errors, his rate of return would be at least 8%.

The third opposition witness (Gordon, FCC Staff Ex. 17, p. 23) stated flatly that, if the Commission accepts the existing capital structure and rate of new investment, then the Commission should allow AT&T a rate of return of 8.25%. He then argued that the Bell System's financial policies could be drastically altered to reduce its cost of capital.

Dr. Gordon presented a complex mathematical model which included a formula designed to predict the price of AT&T stock under various assumed investment, financing and earnings rates. His formula does not of itself produce a cost of capital; it merely produces a market price. Using this formula, he calculates what the market price would be at different rates of return and different rates of growth. He then selects as the cost of capital the lowest rate of return which would, granting his assumptions, produce a maximum market price at the desired rate of growth. He computed that, at a 7% rate of return and with a $2 for $1 debt-equity financing policy, AT&T stock would reach a maximum price of $73.76 if management invested at the 8% growth rate he assumed to be proper. It was his contention that any higher or lower growth rate would result in a lower stock price. He admitted that the validity of his model — and his conclusions — depended on whether the model produced a maximum price of the stock. His assumptions, that the Bell System could prudently carry its debt ratio to 50% and that the market could absorb at reasonable cost the volume of new debt required by his policy, were the products not of his model but of his unsupported judgments in an area where he claims no expertise.

As it turned out, Dr. Gordon's model did not produce a maximum price of the stock. Accordingly, by his own admission it cannot be used to determine the cost of capital.[6]

On February 1, two weeks before the record was closed in this phase of the case, Dr. Gordon came in with a new model, based on new and questionable assumptions and even more heavily reliant on his unsupported judgments. His new model still had many infirmities, and it indicated a return requirement of 7.44% (Tr. 9935-36), which he "adjusted" to 7.25%.

Even though one might speculate on whether future mathematical models could be helpful to rate of return determination, at this time and on this record Dr. Gordon's approach — with the collapse of his first model and the numerous deficiencies in his second — can hardly be regarded as a serious substitute for the expert testimony of the witnesses presented by the Bell System. In short, Dr. Gordon's models simply cannot be relied upon in this case.

Finally, it should be noted that Dr. Gordon readily conceded that if Bell's present financial policies are "within the limits of prudence of sound financial management," AT&T should be allowed to earn more than 8% (FCC Staff, Ex. 17, p. 23; Tr. 9840).

Thus there is no real issue on rate

[5]Dr. Thatcher frankly conceded he had erred in failing to consider the value of stock rights in computing his cost of equity capital (Tr. 4711), an error which, when adjustment is made, would bring his cost of equity to the same level as that recommended by Bell witness Friend (Bell Ex. 18). In a later appearance, Dr. Thatcher retracted his confession of error (FCC Staff Ex. 30), but he could not explain his retraction and finally demonstrated his lack of understanding by asking Bell Counsel to explain how stock rights should be considered (Tr. 9603).

[6]Dr. Gordon said: "If price rises indefinitely with the investment rate as portrayed in the graph on page 5503, my analysis does not yield a cost of capital figure for AT&T." (FCC Staff Ex. 17A, p. 9) Later he said: "I agree that the estimating technique Dr. Tukey (Bell's witness) proposed is more accurate than my simpler method, and therefore, as my model stands, share price does rise indefinitely with the investment rate for a 7% rate of return." (FCC Staff Ex. 35, p. B). Thus, his mathematical error means that by his own statement his model cannot be used to find the cost of capital.

of return; the record will not support a finding lower than 8%. The only remaining question relates to the prudence of the Bell System's financial policy of maintaining debt ratio in the 30% to 40% range.

The reasons for Bell's policies regarding debt ratio were fully developed in the record. Mr. Scanlon testified that the development of the Bell System's capital structure has been the result of careful and informed attention to the capital market month by month and year by year. Clearly the record demonstrates that Bell's financial policies were developed over the years by an informed, responsible management and that these policies are powerfully supported by the competent testimony of leaders in the financial world.

### Accelerated depreciation

Since the issue in this phase of the case is limited to the relevance of accelerated depreciation to rate of return,[7] our brief places emphasis upon demonstrating that no adjustment in Bell's allowed rate of return is warranted by reason of Bell's non-use of accelerated depreciation.

The Bell System's decision not to use accelerated depreciation was reached after careful consideration by Bell's officers and directors (see Stott, Bell Ex. 38 and Jones, Bell Ex. 37), who consider it prudent for the Bell System companies to use straight-line depreciation for tax purposes, as they must for book purposes. In practical effect, the only choice Respondents have is between straight-line tax depreciation and accelerated tax depreciation with "flow through" of the reductions in tax payments. The position of the opposition witnesses is based on setting rates as if Bell had adopted accelerated tax depreciation with "flow through."

"Flow through" is a step back toward the concept of retirement accounting. It ignores a current cost just as retirement accounting ignored a current cost. Years ago, it was asserted under retirement accounting that depreciation reserves need not be accrued, because, with continued plant growth, retirement charges would never exceed accruals and the large reserves created by accruing full depreciation would be unnecessary. This concept is now universally discredited, and it should not be permitted to make its partial reappearance under the form of tax "flow through."

As Mr. A. L. Stott, AT&T vice president and comptroller, pointed out, depreciation deductions for tax purposes arise out of the investment of capital by investors. The theory of the opposition witnesses would involve eroding the value of the investment by prematurely taking tax deductions attaching to the property without recognition of the cost involved.

Even if we were to assume that this Commission might have a different viewpoint about accelerated depreciation, it would be impossible on this record to find that the Bell System's non-use of accelerated depreciation is the result of Bell management's imprudence.[8]

In support of our position that no adjustment in Bell's allowed rate of return is warranted by reason of Bell's non-use of accelerated depreciation, we show that the use of accelerated depreciation could not provide a source of interest-free capital, thereby reducing the amount of capital which Bell must raise in the future, because, for very practical reasons, Bell could not "normalize" the tax deferrals resulting from accelerated depreciation. Without "normalization," there would be no fund or reserve available

[7] It is important to note that there is not before the Commission for decision at this time any other question regarding accelerated depreciation such as whether a portion of Bell's tax expense should be disallowed (a) directly on the assumption Bell should have taken accelerated depreciation, or (b) indirectly on the grounds that Bell's earnings should be assumed to be higher than they are because potential tax deferrals resulting from accelerated depreciation should be assumed to "flow through" to net income.

[8] One of the opposition witnesses who strongly urged "flow through," agreed that whether a company should or should not use accelerated depreciation is a question on which reasonable men could differ (Van Scoyoc, Tr. 9313A).

for investment in telephone plant.

Hence, the fact that tax deferrals resulting from accelerated depreciation with reserve accounting can provide some businesses with funds which can be used to promote national economic growth can not in any way affect Bell's required rate of return.

No witness in this case has said that Bell's rate of return should be adjusted because of Bell's non-use of accelerated depreciation. And, of course, no witness has said how much any such adjustment should be.

The Commission staff urged that the issue of accelerated depreciation be included in Phase 1 to the limited extent of its relevance to rate of return. So it may well be that the staff will present, ex *parte,* some other argument on this point which has not occurred to Respondents. If this should happen, we believe due process requires that we be informed of the staff's argument and be given an opportunity to meet it or to rebut it.

**The rate base items**

No party to this case questions that Bell must have cash with which to do business, that it must have on hand material and supplies, and that to meet the public's requirements it must always have substantial amounts of plant under construction. And as to material and supplies and plant under construction, we can find no challenge in the record as to the reasonableness of the amounts Bell had on hand during 1965 or 1966.

What then are the issues? As we see it, the principal questions to be resolved are these:

(a) *Have all the amounts claimed by Bell for these three rate base items been supplied by the investors?*

Our testimony has amply demonstrated that the amounts claimed in the rate base have all been supplied by investors and that all amounts not supplied by investors have been excluded. Two separate studies (Wentworth, Bell Ex. 3 and Mason, Bell Ex. 33) supported this testimony. The validity of these analyses was not seriously challenged in this record.

(b) *Is the amount of cash held by Bell and claimed in the rate base reasonable?*

Succinctly, Bell's policy is this: For prudent management, enough cash should be held on hand[9] so that the total of Bell's current assets (consisting mainly of cash, material and supplies, and accounts receivable) should be at least equal to its current liabilities. The reasonableness of this one to one ratio was supported by evidence showing the practices in other businesses (O'Connor, Bell Ex. 32), most of which maintain ratios substantially higher than one to one.

The reasonableness of Bell's position was further supported by a thorough explanation of the importance of maintaining at all times adequate liquid assets to cover fully Bell's tax liabilities. The legal hazards of pursuing any different course were spelled out in an opinion of the Davis Polk law firm of New York (Bell Ex. 43, Att. A).

(c) *Should plant under construction be disallowed because either (1) the plant is not yet revenue producing, or (2) the investors are not entitled to a full rate of return of 8% inasmuch as Bell capitalizes interest during construction at 5%?*

The allowance of the amount claimed for plant under construction is required in fairness and equity. Investors have put up the money. It is being used prudently to build new plant for expansion and modernization. And investors don't accept a lower return while plant is being built.

[9]Actually, most of the cash is placed in temporary short-term investments until needed in the business, and the interest received is credited to revenues, thereby reducing the revenue requirements to be obtained from customers. Central investment of these funds results in the best economies and efficiencies.

To disallow plant under construction is the equivalent of saying to the investor "we will not in fact allow you the full rate of return we have otherwise found reasonable." In short, the financial facts of life require that investors be paid a full return on their investment regardless of whether regulatory authorities exclude a portion of that investment.

The suggestion that the investor is entitled to no more than the interest capitalized during construction is superficial. This Commission has allowed Western Union a full return on plant under construction where no interest was charged during construction. (34 F.C.C. 217, 285-286). If investors in Western Union are entitled to a full return on plant under construction, then investors in AT&T are likewise entitled to a full return.

Since the 5 percent interest charged construction is credited to income, the effect of Bell's request is that it be allowed to earn the difference between 5 percent interest charged construction and a full 8 percent return on the amount of investors' money devoted to construction. Fairness supports the request.

**Financial risk and management discretion**

It will be noted with respect to three of the major issues — rate of return, accelerated depreciation, and the rate base items — that a recurrent theme in the differences between Bell's witnesses and the opposition witnesses pertains to the degree of financial risk which the Bell System should assume. As we see it the opposition witnesses are saying this:

(a) Bell should go further into debt; your policy of 30% to 40% is too conservative; you should go to a 50% debt ratio, or even higher, and if you did, somehow or other you could get along with a lower rate of return.

(b) Bell should take accelerated depreciation and "flow through" the tax deferrals to net income; the deferred tax liability probably will never have to be paid because future tax deferrals will be there to offset the liabilities; so again you are too conservative.

(c) Bell is too conservative in keeping more cash on hand than it needs; if you kept less cash, your rate base would be less.

This central theme, which runs through the opposition approach in this case, adds up to an advocacy of financial brinkmanship not in keeping with the longer term basic goals of both this Commission and the Bell System: to assure the nation an adequate and ever improving communications system. Neither the Commission nor management should countenance financial shortcuts which could in the long run frustrate these goals.

No one can know with certainty today whether Bell's future ability to serve would in fact be impaired by assuming the greater risks recommended by the opposition. So the question of how much financial risk should be assumed today obviously becomes a matter of judgment. But whose judgment?

Clearly, management must make the first judgment. The Commission has a right and duty to review that judgment. But the Commission should not and legally it cannot substitute its judgment for that of management unless the record shows that management has abused its discretion or has been imprudent. On this record such a finding could not be made.

Even if this Commission felt strongly that Bell should assume greater risks, it should be hesitant to force such risks on management. (See testimony of Lovett, Bell Ex. 44.)[10] Regulatory history is full of examples of utilities

[10] In response to a question about future risks from Commissioner Cox, Robert A. Lovett, noted banker and former Secretary of Defense, said: "I am not saying, sir, that it is my view that the future is dark. I am only saying in a company that is so fully charged with the national interest and with national security, the rule there should be to hope for the best while you prepare for the worst. That is my position. I think you have to be more prudent in this than in almost any other business." (Tr. 7952).

[11] In its report following the long investigation of the late 1930's, this Commission commented favorably on the Bell System's conservative debt ratio in contrast to certain other public utility systems having a much higher ratio of fixed income securities. (*Report of Telephone Investigation*, H.R. Doc. No. 340, 76th Cong., 1st Sess., 449-50, 593 (1939).)

which have failed because they assumed too much financial risk. Legislative bodies have granted commissions wide powers to prevent utilities from incurring financial risks that might jeopardize their ability to serve. It would be ironic for regulatory authority over rates to be used to force upon a utility management the assumption of greater risks than the management thought wise.[11]

**Separations**

A separate brief submitted herewith by Respondents fully discusses this complex and technical issue. In summary, there are before the Commission three principal recommendations: those of Bell, of NARUC, and of USITA. The recommendations relate to two classes of plant: Interexchange circuit plant and subscriber plant (subscriber lines and station equipment).

With respect to interexchange circuit plant, Bell recommends discontinuance of the so-called Modified Phoenix Plan, first adopted in 1956. NARUC, although with dissenting members, favors retention of the plan. Elimination of Modified Phoenix, together with elimination of certain other averaging techniques, would transfer from interstate to intrastate about $176,000,000 of revenue requirements. In other words, if this were the only change, Bell's interstate return would be increased.

Modified Phoenix involves a process of averaging the investment and related expenses of Long Lines interexchange circuits with those of the associated Bell companies. Since Long Lines circuits are of greater average length, and since longer circuits generally have a lower investment per mile than shorter circuits, lower unit costs are assigned to Associated Company circuits than in fact apply. Thus, Modified Phoenix results in increasing the investment assigned to interstate circuits and decreasing the investment assigned to intrastate circuits.

Since many of the circuits thus averaged could be directly assigned to interstate or intrastate, the averaging process tends to do violence to the principle of use, which should govern all separations procedures. While this weakness has always been inherent to a degree in the Modified Phoenix Plan, the problem has grown worse in recent years because of technological developments and rapid growth. We believe that long term soundness of the separations procedures calls for elimination of Modified Phoenix.

With respect to subscriber plant, the present separations procedures recognize that the worth — or value — of its use for long distance interstate calls is greater than the worth of its use for short haul intrastate toll or local calls and that, accordingly, in determining how much of the subscriber plant should be assigned to interstate, the greater value of this interstate use should be recognized. The new plan proposed by Bell and supported by NARUC would provide a more accurate, and we believe more reasonable, measure of that worth component.

The effect of Bell's subscriber plant proposal would be to transfer from intrastate to interstate about $282,000,000 of revenue requirements. Considered together with elimination of Modified Phoenix, the effect of the total Bell proposal would be to transfer from intrastate to interstate a net amount of about $106,000,000 in revenue requirements. This would decrease interstate rate of return by about 0.65 percent.

We believe NARUC's proposal to change only the subscriber plant methods is not only unsound in that it fails to eliminate Modified Phoenix, but is clearly impractical under present circumstances. NARUC's proposal would transfer from intrastate to interstate about $282,000,000 of annual revenue requirements. This would necessitate a substantial increase in Bell's interstate rates.

USITA's proposals would require an even greater increase in interstate rates because they would transfer from intrastate to interstate about $525,000,000 of revenue requirements. Western Union's proposals would transfer nearly $500,000,000 of revenue requirements.

Under either the Bell or the USITA exchange plan the independent telephone companies would receive additional amounts in settlements with the Bell companies (assuming settlements with the independents follow the separations procedures). Under Bell's plan about $30,000,000 would go to the independent companies leaving $76,000,000 which would be subtracted from Bell's intrastate revenue requirements. Under the USITA exchange plan, however, about $71,000,000 would go to the independent companies.

We believe that the Bell System's plan is sounder in principle than any of the other proposals. We recommend that it be accepted and applied uniformly in all jurisdictions.

**Conclusion**

It should be noted, as our brief points out, that for the year 1966, our return on net investment for interstate service was 8.19 percent, as recorded, and 8.01 percent, as adjusted for known changes. These results are within the reasonable range of earnings supported by the evidence.

This letter has of necessity dealt only with the high points of our case. We urge a full and careful reading of our briefs and proposed findings. ☐

# The All-Purpose Picture Network

Behind every TV tube is an army of actors, directors, writers, sponsors, athletes, cameramen, and technicians practicing disciplines ranging from hairstyling to acoustical engineering. The efforts of these specialists produce the pictures that the TV cameras capture. Moving this output of images all over America is, however, the job of an almost equally large and diverse crew: The men who plan and man the Bell System's nationwide transmission network.

*Behind men who manage TV transmission system is map of nationwide network that can be custom-tailored to each broadcaster's minute-by-minute requirement. At New York switching center (right) technicians monitor picture quality. Similar centers hum in Atlanta, Chicago, Los Angeles.*


CBS TELEVISION

# The All-Purpose Picture Network

"Go out in the street and ask ten people what it takes to put one of those pictures on their TV tube. They think you point the camera and, bang, they get the picture. Nobody realizes what it takes to keep that flow of pictures coming in. Of course, if we do our job right, maybe we *should* be the invisible men."

Dick Kerr pauses. He's a wiry Missourian who was operations manager of an independent telephone company before he was old enough to vote. Later he ran a Signal Corps station in the Army. Now he heads a team of salesmen handling fast-breaking demands for TV transmission facilities. His bailiwick includes specialized TV networks and miscellaneous closed-circuit and educational television transmission requests that come into the New York office of AT&T's Long Lines Department. Also in this office are the men who handle requests for transmission from NBC, CBS and ABC — plus the vital 'facilities' organization that keeps an up-to-the-minute inventory of all TV transmission channels and designs networks to customers' specifications.

"How about the State of the Union message in January?" asks Dick Vitzthum, an account manager on Dick Kerr's staff who was handling the National Educational Television account. "I was sitting at home on Saturday afternoon when I heard that the President would give the talk on Tuesday. I told my wife, 'Sweetheart, I'll see you when it's over,' and headed for the office. Saturday afternoon we got the plant and engineering men together. Sunday we made the plan. Monday, the facilities people scoured the country for available circuits, which wasn't easy because everybody and his uncle wanted to transmit that event. We handled NETV's requirement to broadcast the program to 70 stations. Then, we tied in 10 live locations all over the U. S. after the speech so experts, such as Arthur Schlesinger and Walter Heller, could analyze the President's message. We bounced from one speaker to another, back and forth.

"But it worked. *The Times* complimented us when it reviewed the show." Vitzthum shows a clipping from Jack Gould's column in *The New York Times* of January 11: " '. . . *President Johnson's . . . was the first State of the Union message to be carried live on four national television networks. . . . The switching of the program from city to city ran off faultlessly, a testament to the technical efficiency of the American Telephone and Telegraph Company . . .*' "

Bill Cook, who handles NBC for Long Lines, breaks in. "The way Vitzthum here has been showing that dog-eared clipping around, you'd think he just got a rave review for a great perfomance in Hamlet."

## Behind the picture: planning, purpose

The Long Lines network managers, and most of the other people associated with TV transmission, live in a climate of crisis. In return for being at the mercy of events, they have the satisfaction of being part of those events. Whether it's a tragedy at Cape Kennedy or a Pope's visit to New York City, they must find a way to get the picture from its point of origin to television stations across the country. Putting the Bell System's TV switching network to real-time, on-line use takes the efforts of craftsmen, engineers and planners. While craftsmen and engineers may often be caught in the hectic "right-now" atmosphere, planners have a different perspective.

"Here's something that may surprise you: From our point of view, there are no networks as such," says Jim Griffin, who has the job of planning future TV transmission facilities.

"Physically, there's just one nationwide network: that of the Bell System. Imagine a map of the United States with an enormous spider web spun across it. This web is our network. Into it we can weave any broadcaster's geographical coverage.

"Take a typical Sunday during the football season, for example. One minute CBS has circuitry taking an NFL game all over the country. At an appointed instant in time, we dissolve that hookup into 23 regional pieces, so local stations can show local or regional commercials: snow tires in Maine, swimsuits in southern California, budget air fares in New York. Sixty seconds later, we put the whole thing back together and the game goes on. To me, the whole transmission system is a kind of harpsichord on which we can play anybody's favorite tune."

Leaning forward and folding his big hands before him on the desk, Jim says, "We've got to have the capacity. Who else could be expected to have 600,000 channel miles of communications circuits: 350,000 miles of voice and data channels; 125,000 miles of TV-carrying capacity; and another 125,000 miles of protection' channels, also TV-grade."


## Protection circuits provide reliability

The idea of protection capacity is expanded by Bob Miller, who helps manage the big Long Lines switching center at 32 Avenue of the Americas. Here, and at similar locations in Atlanta, Chicago and Los Angeles, the actual switches are thrown that make and dissolve the national TV circuits.

"The word 'protection' means what it says," Miller says, his voice hardening a little with recollected emergencies. "We need reliability in the face of floods, hurricanes — even rockslides on the mountains where our microwave towers sit."

Miles McCosker, who works on Miller's staff — around the clock when necessary — adds, "We also use the protection capacity to meet big demands like those football Sundays. In addition to CBS, NBC televises the whole American Football League. And either one of them may want to televise several games of regional interest, which means we create subnetworks and then split them into those separate commercial segments. Meanwhile, all the non-football stations want, deserve and get business as usual."

Bob Miller cuts in. "Of course, there's one other side to protection, just to finish the story. A nationwide one-minute commercial in, say, the Packers-Colts game costs about $70,000 a minute. Put yourself in the place of a TV vice president if one of our men in the sales group had to go to him and say we lost his commercial. That's another reason why, if one path is blocked, we've got to have another way to go, even if it means sending the picture from New York to Washington by way of Chicago.

"The network we have — with its 'protection'

*This switch determines route TV image will take. Behind it lies miles of microwave circuitry, including unmanned towers that change picture's path at buttons' bidding.*


## "Now, live, from Los Angeles, we bring you..."

*Los Angeles Open golf championship is typical of year-round right-now sports action expected by U. S. TV viewers. Commercial TV network's cameras record event, pipe pictures to its truck. Then telephone company mobile unit beams it to nearest switching center, thence to local stations around country.*



capacity — makes it possible for us do just about anything a broadcaster wants. We can take an alternate route when there's trouble, meet suddenly quintupled demands, and always go by the most economical path under the given circumstances. This is the base that is built on when Jim Griffin and his people plan future growth — both for the interstate hookups that we handle at Long Lines, and the local facilities built and maintained by the Bell System operating companies."

## Local phone companies essential

Local Bell System companies generally pick up the picture at the scene of the action and transmit it to the Long Lines Department for national distribution. The New York Telephone Company, for example, lined the Pope's route from John F. Kennedy Airport to Manhattan with portable microwave towers to keep the Pontiff in constant view. "Once in the city," Dick Vitzthum recalls, "The New York Tel people put the pictures into the coaxial cables they maintain all over the city. They cover the big hotels, the United Nations — everywhere the action is likely to be. Of course, this means keeping all the channels tested and ready, even when there is no action."

On the average, the Long Lines office in New York handles 300 orders a day and, when President Kennedy was assassinated, a record 1200 were handled. Pooling their reminiscences, the Long Lines account managers agree that a week in September, 1966 was typical of the way orders for service sometimes pile up even under "normal" circumstances. All the national TV networks were doing business as usual. And then there were a few specials: A space shot from Cape Kennedy; a closed-circuit show from Detroit that permitted Chrysler's Dodge division to unveil a new line of trucks to dealers in a few dozen cities; a New York State network for two political conventions; educational hookups in a number of towns; a special closed-circuit system for Republican fund-raising dinners; and on Saturday night, Miss

America "live" from Atlantic City competing with a special pro football game.

"The trend is obvious," Dick Kerr concludes. "Besides all the network shows originating in studios and on film, which will continue, the big growth areas are closed-circuit TV, educational TV, and more and direct telecasts from remote locations."

## From systems, social implications

A man who agrees with these estimates is Dick James, engineering manager—video, at AT&T's headquarters. On the subject of remote TV pickups, James notes that it's expensive to engineer a system that can transmit a picture from anywhere at any time. "Take the Pope's visit. To engineer a system that could handle that peculiar demand, you'd be committing facilities to an event that has occurred once in 1,967 years.

"Of course, we handle part of this demand with temporary and mobile facilities. But there's a constant demand for more of these. Probably nobody but the Bell System could be expected — or could afford — to maintain an instant capability to meet almost any unforeseen demand for transmission facilities. We accept that obligation and it is expected of us. The costs of this, though, are enormous.

"We have to have coaxial cable all over New York City — just to be ready for the occasional Pope's visit, or the visit of a head of state to the UN, or a ticker-tape parade, or a political rally of national interest.

"In Washington this situation is even clearer. We have to maintain 'plug-in' facilities for TV transmission all along Pennsylvania Avenue. Every four years, at inauguration time, the demand for facilities peaks. Except for an occasional parade or other public event, this 'buried plant' doesn't get much use.

"This 'standby capacity' — including all the cables and mobile units and so on — means that a substantial part of the plant is used only sporadically by the broadcasters. This is one reason we are constantly looking for opportunities to use our plant in other branches of the television industry."

Leaning back in his chair, James folds his hands behind his head and swivels toward a window that overlooks downtown Manhattan. After a pause, he outlines the broader perspective: "There are really four television businesses we're involved in, and as you go down the list the social, political, technical and personal implications grow greater.

"First there is network television, which is a one-way street — one link between an event and the station. Very precise engineering required, but the words and pictures all go in one direction . . .

"Then there's CATV, community antenna television. As a common carrier, we lease lines to the CATV people to transmit pictures from their receiving stations into the homes of their subscribers, or they use our poles for their own lines. This demand could really grow — when and if the legal disputes among CATV people, broadcasters and regulatory commissions are settled. We have to be ready with plans and equipment. Meantime, it's a very fluid situation.

"Next there's CCTV, closed-circuit television. This is the third TV business where we provide service. It's growing fast, both in number of installations and in the size of them. Xerox, for instance, just recently asked us to set up a New York-to-Los Angeles transmission link for an exclusive corporate press conference in the two cities. IBM has also been a leader in this area and we ourselves are using television to an increasing extent for conferences, instruction, etc.

"Examples of closed-circuit TV could be multiplied, and the list of companies using these facilities

*Beginning at remote pickup point, Bell technicians monitor signals. New device (above) shows each switching center quality of signal received, pinpoints trouble fast.*

gets longer every day. Each of their 'networks' is small compared to CBS, NBC or ABC, but there are hundreds of them — hundreds of additional networks stitched into our system, each one subject to change. 'Take out this meeting room in Atlanta. Add such-and-such hotel ballroom in Denver for next Tuesday's new product introduction.'

## ETV: biggest growth potential

"This is a growth business, an enormous one, but even this is overshadowed by number four: educational television. Here's where the technical requirements *and* the social implications are greatest.

"To take the technical side first, the problems are twofold. First, there's picture quality. If a group of medical students in Boston is watching a cornea transplant in Dallas, they have to see details far beyond those required by laymen. And, in many cases, ETV requires a two-way street. Students may want to question the teacher, which means additional circuit capacity to provide this playback from the audience. Again, though, the technical problems are being mastered. There may be some new educational tools developed — but the promise of ETV goes well beyond mechanical marvels. The big hope is social, personal, human.

"The solutions proposed for our most pressing social problems are quite varied depending on whom you talk to. Most people agree, however, that good education for all is one of the things that must be accomplished somehow if we are to make any progress in this area. ETV seems to be one of the educational tools that may be useful here."

Turning back to his papers, James flips some pages at random. "That's what all these charts and theories on how to get more 'broadband capacity' come down to. ETV can put more teachers, better teachers, new and better teaching techniques, in front of more kids, more often, and at less cost. Our TV network gives us the base to build on toward these goals. When the educators are ready, we'll be ready." □

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Berne Karlin

# Way-Out Ways to Communicate

**by Dr. John R. Pierce**

As a longtime reader of science fiction, I've compared today's world with the predictions writers in the past have made about it. Somehow, prophecies and reality don't jibe.

What went wrong when past prophets tried to take science and technology into account in picturing the future?

In looking into the future, Aldous Huxley, for example, saw man overwhelmed by machines and by a social structure which seems to point clearly to a civilization of more compact and crowded cities, and to a domination of every aspect of man's life by technology.

But, looking at contemporary American life, we find that science, technology, and man himself have played a nasty trick on such prophecies. We can see that sprawling suburbia and a wandering population are chief characteristics of the nonstagnant part of our society.

What prophets of utopias and anti-utopias lacked, partly, was a foreknowledge of unpredictable inventions. For example, the transistor and the vacuum tube have both had a profound effect on our civilization, as well as the laser, the maser, plastics, antibiotics, and a host of other unanticipated, and unanticipatable, discoveries and inventions which, at their inception, seemed mere toys of civilization. Consider the telephone, automobile, airplane and radio and television, all of which at first showed little promise of revolutionary impact.

In H. G. Wells' 1899 story, "When the Sleeper Wakes," the city grew dense and glass-enclosed, and the life of the average man was reduced to a drudgery of machine-tending and a cubbyhole off-the-job existence. The individual was helpless. Yet today we live in a world in which one individual created, in information theory, a field of study which permeates both sides of the Iron Curtain. Three other individuals, in inventing the transistor, laid the basis for a new industry in Japan and Hong Kong, as well as in the United States.

### No anthill-dwellers we

Today we see something entirely different from the domed and collectivized anthills that Wells predicted in the Nineties. Science and technology may have equipped men with means for controlling and binding other men; but — and it's a big but — they have also provided a refuge in this world for the individual.

Three great freeing influences have been the automobile, the telephone and electric power. When I was young, one could go conveniently as far as the streetcar ran. One vacationed as far from a railway station as public transportation took him.

Today, everything is different. The individual who wants to can escape into the countryside and live there very comfortably with the aid of an electric pump, bottled gas, oil heat and a septic tank. He can, if he desires, do a great deal of his shopping and socializing by phone.

For the rest, supermarkets and other stores have followed the drift of population away from the cities. And industry itself has had to solve traffic and labor problems via moves out of town.

And yet, people so spread out need not live in an isolated provincialism. However far they escape from former centers of population, television programs, political broadcasts, and press service dispatches follow them. The collectivizing influences of technology spread by wire and wireless over the whole country.

One might miss in this sprawl of civilization the play, the orchestra, the enlightened individual. But human contact is in part taken care of by the telephone and automobile, for one no longer boggles at the idea of calling friends or relatives across a state or across a continent, or at driving 50

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*Dr. Pierce is executive director of research at Bell Telephone Laboratories and author of eight books and scores of scientific articles.*

miles to see a friend. Indeed, human relationships are easier than ever between people with common interests, however far apart they may live. rather than the old confinement to the immediate neighborhood.

But what of other intellectual and physical aspects of life?

Unlike the newspaper, and more than the journal, the book is the medium of expression of the talented individual. In a drugstore in a small city near where I live, I can find a better variety in paperbacks than was available among the books of the Carnegie Library in a town of similar size in which I lived years ago. A million paperbacks are sold in America every day through 95,000 mass outlets.

The variety which has come into music through long-playing records is even greater. The average man can and does purchase, for a reasonable price, fine recordings of more different compositions than either the Emperor or Prince Esterhazy had access to in Haydn's day. Or, he can hear these recordings played over a number of FM stations.

All of the technological means of collectivizing people which were foreseen at the beginning of the century have increased in strength. In their political and nationalistic manifestations, these means have brought men closer together within nations, and yet nations have been driven somewhat further apart through national rivalry.

This is the present as I see it. What of the future?

### Prophets grow warier

I think we will have more of the same. But here I run a great risk, for that is what H. G. Wells said in the Nineties. And that is how he erred.

I, too, may be overlooking very important and revolutionary things not yet discovered or invented—a risk unavoidable in prophecy. Ignoring the unknown, however, let's consider the foreseeabie advances in the art of communication.

The importance of relatively cheaper communication need not be labored. Reduced rates have led to worthwhile personal conversations with distant children and relatives, and have greatly increased the amount of such communication. This lowered cost makes it more practical as well as more convenient to communicate rather than to travel, and this may save endless wear and tear on the man of the future. But it is not merely cheapening which will expand the role communication plays in our lives.

The linking of voice and data is bound to become more common. Today, in business conversations, we frequently write down information. Sometimes we dictate such material over a telephone. This is a primitive, fallible and exasperating resort. In the future, I am sure it will be common to intersperse typewritten material with spoken remarks, all carried over the same circuit. And this can extend into the home, in making reservations, in purchasing advertised goods, in the control of household devices, and in many other ways.

Finally, as communication becomes less specialized it will come to include computers as well as human beings.

Wrong-minded early prophets tended to think of the computer as being like a man, only more so. So we might once have thought of an automobile as an imitation of a horse, an airplane as an imitation of a bird. A horse is wonderful, and an automobile is wonderful, but they are wonderful in different ways. The horse excels in flexibility, self-sufficiency and intelligence; the automobile could not exist profitably without our elaborate system of highways. However, the automobile is wonderful in speed and endurance.

While a computer has played a good game of checkers, it has not played a good game of chess, nor has it proven theorems in competition with trained mathematicians. The computer has not excelled at old tasks. It has opened up the possibility of new tasks, and it has done new and surprising things that are very pertinent to the future.

Some of these things are keeping account, in one primitive and limited but accurate and very capacious mind, of the whole of some knotty problem which was formerly spread ineffectively among a host of human beings and a plethora of records. Thus, the computer can do a superb job in payroll, in accounting, in inventory control, and in reservations services.

And a computer can aid a human being in carrying out fatiguing chores. Once a group of entries has been reduced to a machine-readable form, it is no trouble for a computer to arrange them in a variety of indexes, such as alphabetically, or according to key words in the title.

### Computers to talk, sing?

Computers have been used to generate articulate speech from a sequence of phonetic symbols. While the quality is not yet good, it is sure to be improved. In the future, it will be possible to query a computer by means of a sequence of letters or numbers and receive a spoken answer without the crude and complicated expedient of tape-recorded messages.

The computer has been pushed beyond this difficult process of generating articulate speech, to the generation of musical sounds. Here its versatility is without limit. In principle, the computer can generate any sound in existence. Through the computer, the composer will be given something more powerful than any orchestra which now exists, and more accessible than the orchestra which was at Haydn's beck and call. And the computer will certainly be available to the architect as a means for exploring the visual and structural consequences of various designs. As an editing and reproducing device, the computer could open more opportunities for publication to the talented writer.

### Every phone a data-maker

Advances are bound to make computers more widely available for teaching in schools. But, beyond that, people will use computers from their homes—ordering, making reservations or seeking information. This may extend to banking as well as to other business transactions, so that nothing need go through the mail except actual goods. A combination of voice and punching buttons will do the rest.

With this sketch of the possible, of the realizable, in mind, I now ask whether this is a happy vision of the future. To me, the vision is exciting and desirable indeed.

In the future, government and business will be larger, life will be more complex. This is the price we must pay for technological well-being.

But complexity will no longer mean centralization. Electrical communication, the computer as a recordkeeper, and rapid and flexible means of communication will make possible a civilization which can be highly amalgamated without being centralized.

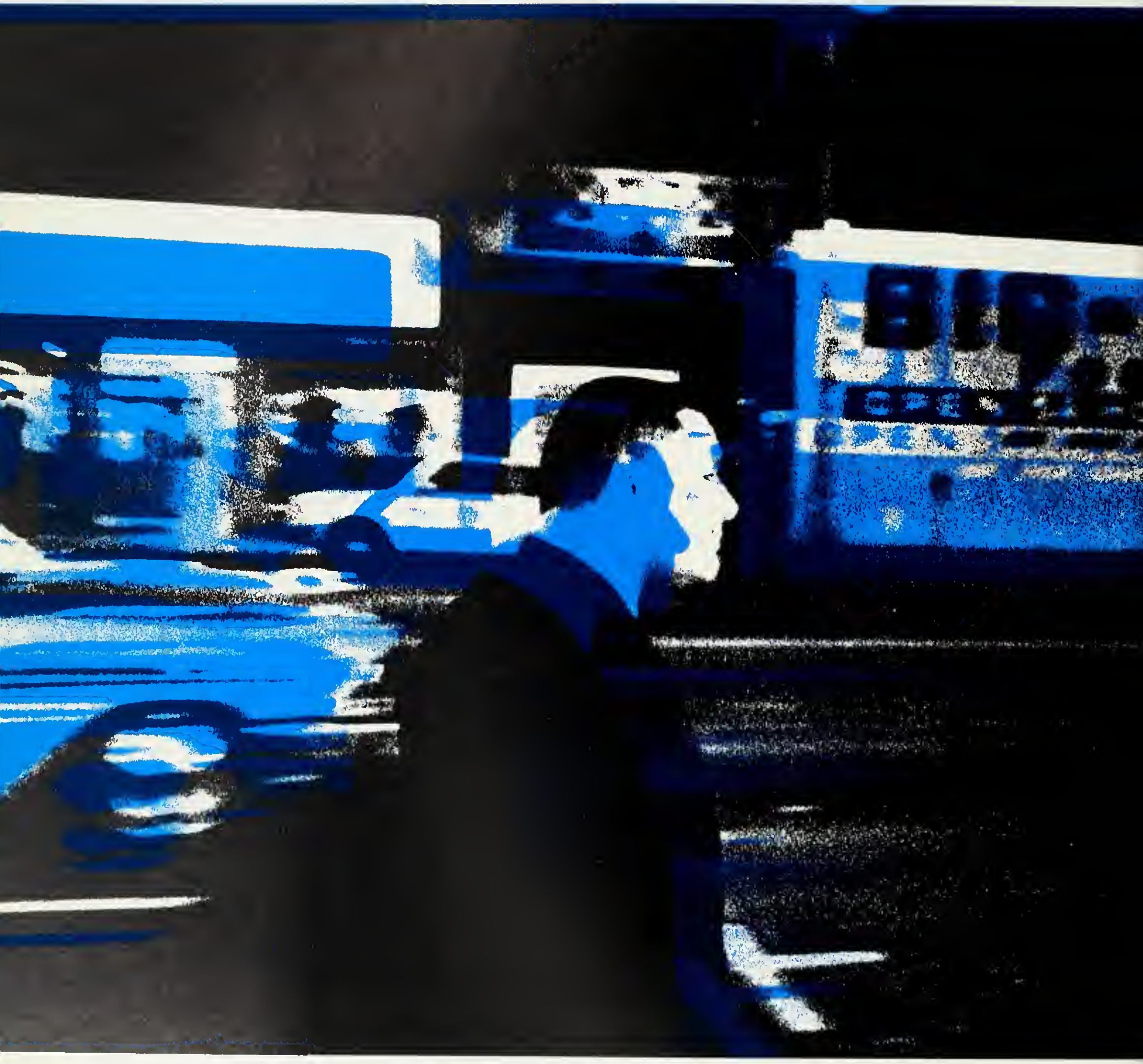
And within this structure for those who have something of intellectual importance to offer, the options will be greater. The computer will take over "mental" routine as the machine has supplanted physical effort.

### For artists: new frontiers

What will happen to the arts as society is increasingly interwoven and decentralized? I cannot believe that live, professional theater and opera can be maintained except as an input to television. Easier transportation may increase rather than diminish highly qualified touring artists and small groups, such as string quartets. And good art, in sight and sound, will become more widely available than before through improved recordings.

Thus, I can see a very bright future consistent with technology. In that future, technology, both through prosperity it can create and through the communication and travel it can afford, could erase those differences associated with region and race which have been little affected by exhortation and social action. Yet the same technology could, in a society without provincialism, give the individual a greatly increased range of climate and geography. It could provide new opportunities for creation, communication and self-expression.

Technology could bring these benefits, but will it? ☐



# A Man and His City

Ray Garcia has known bitter days, but he is not a bitter man.

He is, in fact, an upbeat man in a downbeat time, a believer in the midst of apathy, a quiet but strong voice where the voices often shout, and a lover of a city reviled by some and sniggered at by others.

At the same time, he remains a realist. The sorrows that have visited him and his friends temper his view of the future. He hopes, but not too much.

The city he loves is troubled Los Angeles, and the bitter days came in his part of Los Angeles — the poverty-haunted complex of communities and peoples, predominantly Mexican-American, known loosely as "East Los Angeles."

East Los Angeles, where the average educational level falls just below that of next-door Watts, has been home to Ray for most of his 30 years. His family moved there from a higher rent district to the west when Ray was four. His parents hoped that reducing living costs would buy better medical care for Ray's older brother, ill with a respiratory disease. (Not long after the move, the boy died.)

It was in East Los Angeles that Ray, in pre-teen days, played hard through long summer evenings with as many as 30 kids from the same block. It was here that later he roamed the streets with a juvenile gang that was destined to produce its share of convicts and dope addicts.

It was here that he dropped out of high school at 16, then came back for night study that brought him a diploma and two years of college work majoring in sociology.

It was here that he met Corinne, his steady girl at 14 and his wife at 20 and, in Ray's words, "the strongest and best influence in my life." It was here that Ray and Corinne welcomed the births of four sons, and faced the death of one, a victim of leukemia at the age of seven months.

It is here that Ray, now a communications consultant for the Pacific Telephone and Telegraph Company, chooses to live with his family and, in every hour he can find, works to improve the quality of life in the community.

Topping the list of projects in which he's been a leader: the founding of a new boys' club in a neighborhood where none existed before, and the distribution to places of greatest need of 5,000 books contributed by telephone company people.

Modest to a fault, Ray Garcia nevertheless expresses without hesitation his ideas, based on his own experience, on the involvement of business and the individual in the problems of the city. This account of these ideas, plus some of the satisfactions and frustrations in his life, may suggest some answers and raise some new questions for other people as they wrestle with problems of urban society. . . .

# A Man and His City

**by Ray Garcia**

*as told to Robert L. Varner*

When we first put the windows in the back wall at the new Salesian Boys' Club — and there are a lot of them; the wall is almost all glass — they all were broken out in a matter of days. Fortunately, one of the club board members owns a glass company and was willing to contribute new glass.

The second time we put the windows in they lasted about a week. The third time they lasted a month or more. Finally, this time, they've been in for many months and although some are cracked they haven't been knocked out altogether. I'm confident the windows are going to stay in. The kids gradually are getting used to playing and living where all this glass lets in the sun. Gradually they're learning a new respect for property.

To me, those windows say something about the problems of East Los Angeles or all of Los Angeles or any city. The problems can't be licked quickly or easily. The people concerned need great patience and perseverance and understanding. But the problems can be licked.

The one most significant change in East Los Angeles since my boyhood days here, as I see it, is the feeling generally that we can improve the quality of our lives. It's a feeling that we don't have to consider ourselves different from anybody else — that, if we really want to, we can climb over any obstacle that may be placed in our way.

When I was very young the attitude was more passive. The attitude was, "Well, we are Mexicans and most Mexicans always have lived in poverty and

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*Mr. Garcia is a Pacific Telephone and Telegraph Company communications consultant. Mr. Varner is employee information supervisor with AT&T.*

always will, so there's no point in struggling." This has changed. Actual living conditions in East Los Angeles haven't changed too much, but the attitude has. People are trying harder; their aspirations are higher; they have more hope.

Tied in with this is the fact that the poor people of the area are gaining a more effective voice in some of the programs for community betterment.

I don't think you can put a poor person with limited education in a very responsible position administering a program right off the bat. He can come in as an aide, however — and this is being done in many instances — and gradually gain the experience and training necessary in order to be able to take an administrative role.

And, whether they work as aides or not, the people of the community speak up more in the planning of the programs. They don't dictate what goes on, but they have something to say about it.

So there is hope.

There is also despair, I know, for many individuals. Of the 12 fellows I knew best as I grew up, only two have been steadily employed the last 10 years.

Louis, for instance, was a very handsome young man, an athlete, who started using dope while in junior high school. He is still a dope addict and I understand has since gotten his wife hooked also. One day last year when I was working with the library at the Variety Boys' Club, which we both attended as kids, I met Louis standing across the street from the club. He was trying to sneak a look at his son, who now attends the club, but didn't have the courage to come any closer because of his condition.

Another friend, Victor, started using dope when he was about 15, and has been in and out of jail since that time. He married my wife's closest friend and for a while seemed to be doing very well. But then he went back to dope and the situation deteriorated, there was no food for their three children, and the family had to go on relief. Victor is in prison now, and by chance was arrested the last time by a police officer who also was a boyhood friend of ours.

And there are others. I consider these men my brothers, and because of them and other experiences I have had, I can never entertain any lightheaded or falsely optimistic outlook on life.

I have been very lucky in many ways — far more fortunate than many of my friends.

I was lucky, first of all, to learn the meaning and the value of working very hard from my father's background. As a cowboy in Mexico at the age of 12, he rode the range caring for the cattle from sun-up to sun-down, while my grandfather collected my father's pay from the Mormon rancher. This was the way my father contributed to their family.

He crossed the river to El Paso at the age of 16, thinking my grandfather would join him. My grandfather never did, although just before he died he traveled to Los Angeles to apologize to my father for having treated him as he did and to tell him he truly loved him as a son. In El Paso, where my father stayed for three years, over the western states, and finally in Los Angeles, he continued to work very hard, as a mason apprentice, a farm laborer, and at many other jobs. He still works hard today.

He told me the stories of how he worked as a boy, not in a bragging way but because I wanted to know. To me the stories said that if you have a job to do, and you really want to do it, you can.

I was fortunate also in that certain teachers and other older people took an interest in me. Mrs. Green, for instance, encouraged me in my art work in grade school days. She would put up as many as 10 of my pictures of trees on the bulletin board at the same time. Some years later a really fine teacher, Mrs. Crane, helped arrange for me to attend night school when I was still in my teens, although technically it was for adults only.

I was lucky, more than 10 years ago, to get a job with the Pacific Telephone Company, with its infinite variety of opportunity. It was good to start as a lineman, where, as had been the case for my father, I had to work very hard. This kind of experience adds extra drive for any job you may move into later.

My two years of Army experience worked to my benefit also. I was able to prove to myself that I had the abilities I had felt were mine — the abilities to write, to speak, to teach, to counsel. Army public information and NCO academy work gave me these opportunities.

The greatest personal influence came from Corinne. She set a beautiful example for me. She was just exactly the opposite of what I thought I was as a teen-ager. I drank and she didn't drink. I smoked and she didn't smoke. I didn't study and she studied. I finally decided that if she was really going to be my steady and we were going to get married some day, I would have to be a better guy because she deserved something better.

Before we were married she helped me see the quality our lives could have — she urged me to finish high school and go on to college — and since we've been married she's given me help all the way.

I had, and still have, strong faith in God. I once worked in a warehouse with six other fellows, all of whom were taking dope. At times they did their best to get me to try it "just once." I feel God helped me steer clear.

Those of us who are concerned with the problems of the city will need to work hard; we'll need faith; and certainly we can use a little luck if we're to deal with the problems.

In East Los Angeles, as in other cities, we face problems of employment, housing, and education, with education the greatest problem of all.

The employment situation has improved some. At one time prejudice blocked employment to a degree, but this is not really a factor today. There is some unemployment, but most people here are able to get jobs, and many hang on to them for long periods of time.

The bad feature, however, is that because of their lack of education, they generally are not able to progress to any position of responsibility. Many times they don't want responsibility because they feel inadequate, again as a result of the educational lack. If you are loading boxcars, as an example, you don't want to be a checker who sees that the orders are correct because your reading isn't good enough or your math isn't good enough and you're afraid of making errors in counting.

This means that the average family income in East

Los Angeles is low — on the order of the poverty mean, actually.

About 85 per cent of the housing is owned by absentee landlords. And about the same percentage is old, by California standards. Many of the single dwellings have given way to multi-unit low-rent housing projects, but a great number of the small, individual houses remain.

A lot of these are sub-standard, but they could be restored, rather than torn down. I think a slum is a slum by definition and partly because of the fact the people living in the homes often don't really know what they are living in. They are too close to them to see the beauty in the old homes.

I especially like the gingerbread on the small Victorian homes which are all over the place. These homes have style and character. I would like to see a program under which the fundamentals of architecture could be taught to the children in the area so that they would have an appreciation of the homes they live in and perhaps a desire to make them as they were when brand-new.

Along with this could go courses in remodeling and restoration — the practical steps to be taken in rented dwellings as well as those individually owned.


A related idea: an art class could paint these houses as an assignment, not as they are now but as they appear in the mind's eye, after restoration. An art show of paintings of this kind for all the residents of the area would give further impetus to restoration. A resident could be given the painting of his home as a reminder of what might be done.

Race relations pose no particular problem within East Los Angeles. Roughly 65 per cent of the people here are Mexican-American, some 20 per cent are of oriental background, mostly Japanese, some 10 per cent are Negro, with the balance a mixture, mostly of European extraction.

People here generally are indifferent to race or color. If you live here, you belong here, and you're accepted. The only time I notice any distinction is when people try to define what I am. Those outside East Los Angeles, particularly, don't seem to feel comfortable just saying, "Ray Garcia is going to be here." They usually add, "By the way, he's that Mexican-American fellow I've been telling you about."

Most Mexican-Americans never doubt that they are Americans first, even though Spanish may be spoken in the home and there is pride in the Mexican heritage.

As in many other cities, the roots of most of our other problems in East Los Angeles reach back to the one big problem of education. The Mexican-American population here averages between eight and nine years of school completed, as compared to the Los Angeles Negro average of 10 years, and an average for the city as a whole of 12 years. The educational area is one in which the telephone company, with its pool of brainpower, has contributed and must continue to contribute, as should all business.

Sometimes people question the wisdom of business action in such a field. I feel, as a student of sociology and a member of the business community, that the two worlds need not be at odds at all. The one leads to greater sensitivity to human need and the other to workable, practical approaches to meet the need. Society requires both, and in some kind of reasonable balance and creative league.

A couple of years ago, when I was serving as chairman of the Pacific telephone community relations team in my home area, the Boyle Heights community of East Los Angeles, we dug pretty deeply into this question of education and other questions of concern. We visited much of the area and talked with many people, researching what the problems were from the point of view of the customer — telephone service problems and broader problems as well.

We talked at length with teachers, among others, and the consensus was that the reason the educational level was so low and there were so many dropouts was that the kids never learned to read well. They were never encouraged to read in the home. There was no environment in which they could see books, admire books, learn to like books, feel comfortable with books.

They would do some reading in grammar school and in junior high school, but they would never really read well. By the time a youngster got to high school he was in bad shape, because he couldn't understand what he was reading. He would try to fake it, and eventually the teachers would discover he was faking.

This inability to understand what he was reading smothered the learning process and confused the student to the point where he no longer wanted to attend school and out he would go. It was much easier to go to work digging a ditch or doing something else where little or no education was needed than to try to make a fresh start at learning to read. He now was too far behind.

With this need as our base, we have provided books in the places where the youngsters congregate. They weren't going to libraries, which often are miles from their homes, so we took libraries to them. Telephone company people contributed the books in response to our drive — about 5,000 books in all.

The team gave almost 1,000 books to the Variety Boys' Club, which tripled the size of their library and brought it up to date.

About 300 books, including some sets of encyclopedias, went to the Youth Opportunity Board of Greater Los Angeles, which is a Federal program for teaching dropouts and getting them back into school. It had no library at all until we gave them a start.

We helped the Halfway House start a library. This is a temporary residence, during a brief adjustment period, for former dope addicts who have just been released from jail.

The library at the Salesian Boys' Club was a telephone company project from the beginning, and about 2,000 books have recently been delivered and are being categorized and shelved there.

Getting books into these and other places where the kids can feel comfortable with them will help a great deal, but much more needs to be done.

Our community relations team wanted to take two other steps in the educational area. One step would have motivated the youngsters through some kind of inexpensive slide-film presentation concentrating on East Los Angeles people who now have good jobs with the telephone company or other businesses. This could show the youngsters that there is opportunity for them if they work for it.

The other, and more fundamental, step would have provided individual tutoring to youngsters who needed it in reading or other subjects. People in business represent a great variety of expertise — just about anything the kids would require — and quite a number of telephone people, in fact, have volunteered to help in such a program.

We somehow have failed, however, at least so far, to get the motivation and tutoring programs off the ground. Perhaps we will make the grade yet.

So long as a real need is being met intelligently, business should not be reluctant, as I see it, to get into fields that may at first blush seem new or strange or where there may be the fear of stepping on somebody else's toes. The tutoring program, for example, would be welcomed, not only by the youngsters but by the school system if planned cooperatively.

Such programs are needed in the best interests of the community *and* business. I don't know a single boy in East Los Angeles who considers a businessman an idol. The idols are ballplayers, teachers, priests, social workers. Except for the ballplayers, these figures personally know and care about the boys as individuals and are known in the community.

Certainly we're not interested in being idolized. But being known for genuine concern about people is something else again.

Digging beneath the surface as a company, gaining true understanding of a basic problem such as education, and then acting on this understanding will, in the long run, not only help others individually, but also will improve employee recruiting prospects and will upgrade the community generally.

All of the problem-solving should not be left to government. To do this would be ducking individual and corporate citizenship responsibilities.

When families with moderately good incomes choose to stay in East Los Angeles I feel they can, in a small way, help improve the appearance and the environment of their neighborhood by what they do with their homes.

On the other hand, when people who can afford to make some improvements move away instead, they leave a vacuum. The vacuum usually is filled by people of lesser means so that there is a continuing process of deterioration in the housing.

But, even so, you don't have to live in East Los Angeles in order to be of some help here, particularly in something like tutoring. If someone comes in from outside and immediately offers too much advice, there is resentment, but if the outsider's attitude is right and he can give genuine help, he will be accepted.

Los Angeles, sprawling though it may be, is, after all, one city. I don't want to sound corny, but I love my city. Books and articles recently have dealt with Los Angeles as a psychologically unsound place in which to live. Our smog gets plenty of attention. The riots have been analyzed in print again and again. It's almost as though people are saying, when they know anyone will visit Los Angeles, "Oh, he's going where the riots were."

I don't minimize the problems underlying the riots. I know our city faces monumental problems. But there are voices I call "silent people" who speak for Los Angeles at such a time. These silent people are statues erected by our citizens over the years because they represent some truths we believe in.

For instance, a bust of Abraham Lincoln at the county courthouse speaks for justice.

A monument on Bunker Hill depicting a victory of Mormon soldiers during the early growing pains of our city speaks of our heritage, which is a rich and varied heritage, San Francisco to the contrary — not exclusively a Mexican heritage by any means.

In Forest Lawn, where our baby boy, Paris, is buried, there are statues of two little girls that speak of hope. The one called the duck baby reminds me of the poem that talks of a child looking up, holding wonderment in his hands like a cup.

With all of our problems in Los Angeles, we do look up, we do hold wonderment like a cup.

The people I am concerned with are truly interested in solving their own problems. This is the most important thing to remember, I feel. They have much to contribute to our society, and if they can know opportunity, we all will gain. □

# BELL reports

## Telpak, WATS rates revised

New rates for bulk communications services will become effective May 1 under tariffs that AT&T recently filed with the Federal Communications Commission. AT&T has proposed the elimination of Telpak A and B, bulk communications services of 12 and 24 channels respectively, revised private-line telephone rates, increased private-line telegraph rates and rates for teletypewriter equipment installed on customer's premises, and introduced a new service for high-speed data and facsimile transmission. AT&T also submitted proposed increases in Telpak C and D rates, bulk communications offerings of 60 and 240 channels.

In another service change, Interstate Wide Area Telephone Service (WATS), which offers long distance calling at fixed monthly rates for either full-time or measured-time service, has been expanded to include inward service. At the same time, the minimum number of hours of measured-time WATS has been cut from 15 to 10 per month, with the minimum charge reduced proportionately. Rates for additional hours of calling have been reduced by five to nine per cent.

## Accurate synthetic speech produced

Accurate synthetic speech is now being produced with the aid of a computer-generated model of the vocal tract developed by Dr. Cecil H. Coker of Bell Laboratories and Professor O. Fujimura of the University of Tokyo.

The model, stored in a computer, is actually a geometric description of vocal tract areas as they are shaped to produce various sounds. When synthesizing speech, a researcher can see an outline of the vocal tract displayed on an oscilloscope and, at the same time, hear the sound which corresponds to the displayed shape. By making adjustments at the computer console, the researcher can change the shape and sound simultaneously. Thus, synthetic speech can be improved with both visual and aural aids.

This research is being conducted to obtain basic information about speech sounds which may be useful in devising a more efficient means of encoding speech signals and transmitting them over communications lines. It also may help in the development of a practical speaking machine for "reading out" data stored in, or generated by, computers.

## International rates cut

A telephone call to the United Kingdom now costs one-tenth of what it cost 40 years ago when overseas service was inaugurated.

New station-to-station rates that went into effect in February now enable customers to call Europe at costs 25 to 37 per cent lower than the former $12 person-to-person rate for a three-minute call. Rates for time beyond the initial three-minute period have also been cut. The changes will produce annual savings of $6.9 million for U. S. customers.

AT&T has also instituted new rates that will save U. S. and Canadian telephone users an estimated $2 million annually. Reductions in three-minute rates range from five cents to $1.10.

### Business seminar opens

A second Bell System Business Communications Seminar will open in New York City this spring. Patterned after a similar facility in Chicago, the seminar is designed to give executives — representing all segments of business, industry and government service — an insight into the ways modern communications can contribute more effectively to corporate planning, growth and profit. One- and two-day seminar sessions inspect the implications of communications in relation to the information explosion.

### Improve synthetic quartz growing

An improved method of growing man-made quartz crystals, to replace natural quartz crystals in all communications devices, has been developed by Albert A. Ballman and Robert A. Laudise of Bell Laboratories and David W. Rudd of Western Electric.

The new method produces synthetic quartz crystals that control frequencies with the same stability and precision as natural quartz crystals. Synthetic quartz crystals grown by the new method will also produce substantial savings.

### New technical education center

A new Bell System Technical Education Center will be opened this fall in Lisle, Illinois near Bell Laboratories' recently completed Indian Hill facility. The center is an extension of the Bell System's program of continuing education for employees on scientific and technical assignments. Unique in the field of continuing engineering education, the center will provide "tailor-made" instruction and assistance for all employee levels of Bell System engineering organizations.

One of the major assignments of the center will be to help newly employed engineering graduates to become communications engineers. Other courses will assist engineers in keeping up to date with changes in technology.

The education center will also train instructors who will take the continuing education program into the individual telephone companies.

### Two laboratories completed, manufacturing plant under construction

Bell Telephone Laboratories recently completed two new research and development centers in Holmdel, N. J. and Indian Hill, Ill.

Designed by the late Eero Saarinen for the utmost flexibility, the Holmdel laboratory deals with customers' telephone equipment, transmission equipment, data communications, and communications science studies.

The Indian Hill Laboratory, near Chicago and Western Electric's Hawthorne Works, is devoted to development of the electronic switching systems that ultimately will replace the electromechanical systems now in the nation's communications network.

Meanwhile, Western Electric is expanding its production facilities in the Southwest. The new Phoenix, Arizona plant, which will manufacture wire and cable products for Bell companies, will become WE's 15th major manufacturing facility when it opens late this year.

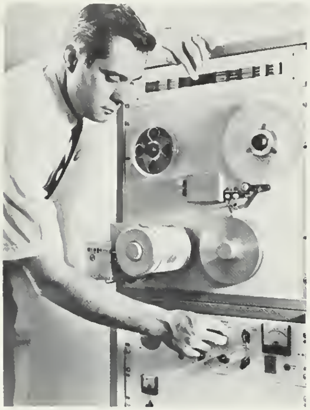
Initially, the Phoenix plant will produce up to 42 billion conductor feet of cable a year, and will ultimately have an annual capacity of approximately 70 BCF. When fully operational, the plant will employ nearly 1,000 persons, most of whom will be recruited locally. Training of new machinists is already in progress.

*Bell Labs' new Indian Hill laboratory in Illinois*

## New sound spectrograph developed

A faster, more accurate, and more versatile sound spectrograph — a device that produces a printed diagram of the frequencies and amplitudes of sound — has been designed by A. J. Presti, of Bell Telephone Laboratories.

The new spectrograph can make spectrograms directly from standard mylar magnetic recording tape in 80 seconds. Earlier models produced a spectrogram in five minutes and required the intermediate step of transferring the taped information to plated drums or metal loops. Use of the standard tape has resulted in better fidelity and lower background noise.



Sound spectrographs — conceived at Bell Labs more than 20 years ago — have long been valuable for a variety of research projects. They have been used to analyze speech, diagnose diseased hearts or malfunctioning jet engines, investigate noise to improve soundproofing, provide better communications equipment, and identify voices, aircraft, ships or submarines.

## Excitonic molecule found

The first experimental observation of the excitonic molecule has been made at Bell Telephone Laboratories.

The excitonic molecule, which was found in silicon, is made of two electrons and two positively charged entities that solid-state physicists refer to as "holes." Holes are unoccupied energy levels that electrons could fill. Unlike ordinary molecules in which two or more atoms combine, the excitonic molecule is a stable complex of two pairs of electrons and holes.

## Science aids widely accepted

The Bell System's Aids to High School Science program has received a strong vote of confidence from physics educators, according to a recent study of use and effectiveness. The study indicated that U. S. high school physics teachers have accepted both the approach and the material used in the five demonstration units designed for classroom use, and the four experiments for students of outstanding ability and interest. Subjects range from wave behavior and magnetism to crystals.

The study found that two-thirds of the physics teachers tested are using some science aids materials. It also indicated that the teaching level of the material appears to be well matched to educators' requirements, and that continued development of similar teaching aids is desired by virtually all educators who have used units in the program. The teachers also endorsed the planning and execution of presentation meetings with Bell System representatives.

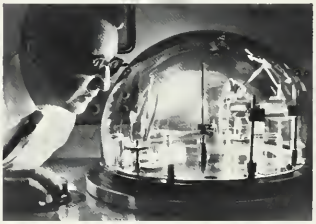
## Intelstat II is 100th

Bell Laboratories and Western Electric recently celebrated the 100th launch from Cape Kennedy of a satellite steered into orbit by a BTL-WE guidance system. This occurred with the launch of the new Pacific satellite, Intelstat II, on January 11. The occasion, which was marked by ceremonies at Cape Kennedy, was also the 10th anniversary of the Bell System guidance facility at the Cape.

The BTL-WE guidance system was used to steer the satellite into a transfer orbit from which it was later placed in a synchronous equatorial orbit by the firing of the satellite's apogee motor. The successful guidance of Intelstat II increases the Bell System's record of successes in space orbits to more than 260.

## Silicon transistor improved

Silicon transistors able to amplify at higher frequencies than any presently in use have been developed by Dr. Rudolf Schmidt of Bell Laboratories. Improved fabrication techniques, allowing the internal dimensions of the transistors to be reduced, are responsible for their ability to operate at higher frequencies without developing short circuits.



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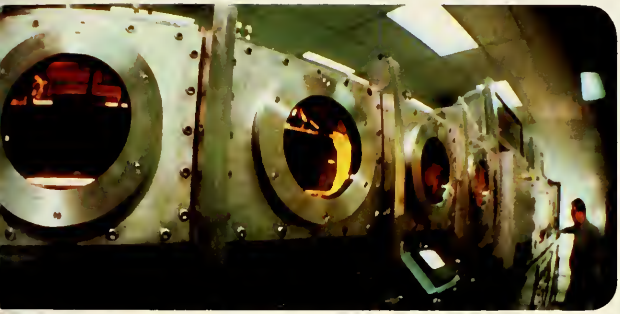
# BELL

telephone magazine



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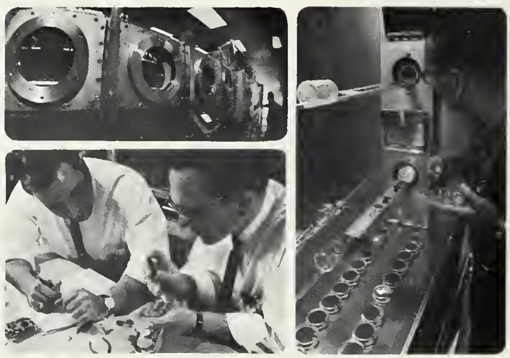

**ON THE COVER** – New manufacturing methods are exemplified in the continuous line vacuum processor, upper left, which makes thin film circuit plates, and in a new furnace which diffuses impurities into silicon crystal. Lower left, Western Electric Engineer Frank Minardi and Bell Laboratories' Bob Moore pool skills to get integrated circuits into production for Touch Tone® Trimline® phones. See Page 1B.

## CONTENTS

To help students keep pace with the knowledge explosion—
while freeing teachers for more individual instruction—
modern communications is helping to provide

# New Tools for Education

**By Tom Mahoney**

In a first-grade classroom in Westchester County, N. Y., a young student sits at a computer console for an exercise in letter identification. In Grand Rapids, Michigan, engineering students follow diagrams projected on a large screen as their professor lectures from 90 miles away. And a doctor in Green Bay dials a University of Wisconsin telephone to obtain up-to-date information on the problems of delivering twins.

In capsule form, these are some of the present uses of new educational tools that will play an increasingly important role in the future. These and many other new educational techniques are being explored by public and private schools, colleges and universities and businesses of almost every description in an effort to meet the current challenges of education.

While an absolutely up-to-the-minute portrait of this educational ferment cannot be drawn — reality won't sit still long enough — it is possible to recognize some of the main problems to be solved, and the major trends emerging as educators, businessmen, government officials and parents seek solutions.

On the problem side, the so-called explosions in population and information have given America's teachers the task of teaching more knowledge to more students than ever before in history. Next there is the problem of quality. Schools have a new mathematics, a new chemistry, a new physics, a new biology and are about to have a new history. All these disciplines require more teaching of teachers, as well as speeded-up and "enriched" schedules for youngsters.

Compounding the problem is the fact that pupils are increasing at a faster rate than teachers at every level. We now have about 2,350,000 primary and secondary school teachers and will need two million more by 1975. At the college level, an anticipated 50 per cent increase in enrollment in the next decade calls for a significant increase in faculty.

Finally, there's the problem of costs. With an outlay of roughly $48 billion this year, education on the national level has become an industry second only to defense in cost. In most communities more than half of the dollars collected through local taxes are spent on education.

Fortunately, an "explosion" in educational tech-

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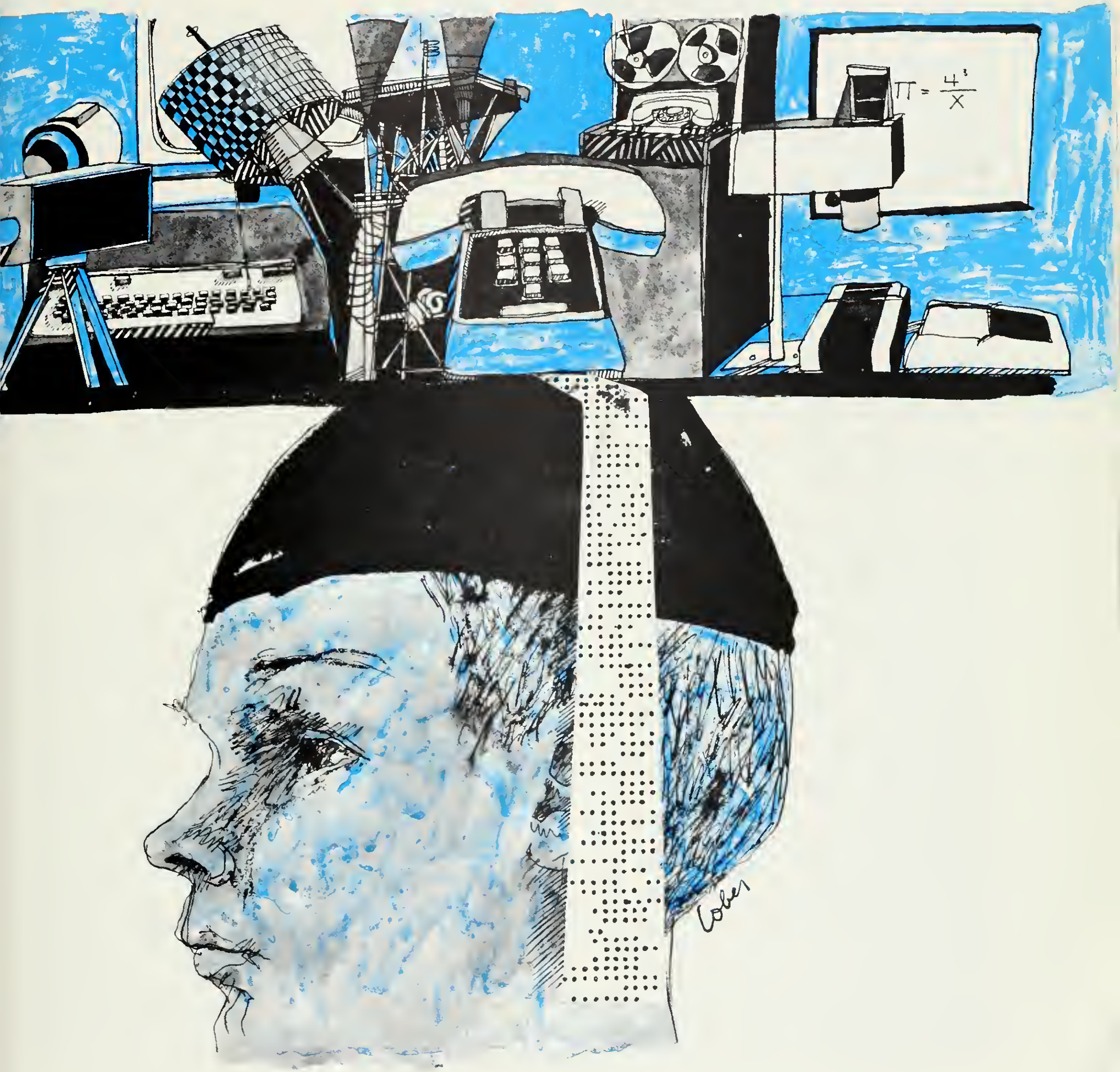
*A long-time freelance writer of books and magazine articles — principally in the fields of science, business and education — Tom Mahoney also has served on the staffs of both Fortune and Look.*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nology — in part based on the expanded use of communications — promises to help schools stretch their teaching talents to meet the rising tide of students. "Schools have to admit that the electronic age is here," said Harold Howe, U. S. Commissioner of Education, "and that there are many ways of communicating and of handling information."

Basically, the aim of the new educational technology is twofold: (1) To make resources go farther; in other words, increase the effectiveness of existing teachers, libraries and experts in various fields; and (2) To improve the quality of the educational experience; educators have already found that the new teaching aids linked by communications often can get more across to more students — more vividly and with deeper retention — in less time.

## Committee urges innovation

A broad-scale program that emphasizes the multisensory nature of the learning process was outlined a few months ago by the Committee for Economic Development's subcommittee on efficiency and innovation in education. A well-equipped system, the subcommittee said, should consist of centralized tape libraries from which schools could select, for example, an entire course of instruction or specialized lectures prepared by great teachers in specific areas; electronic teaching aids like those used in language instruction; programmed learning systems for detailed, repetitive instruction; and scanning devices linked to libraries and offices.

The subcommittee also recommended closed-circuit television systems and individual video tape players to enable each classroom to use top-quality course materials, as well as a flexible educational TV network to bring a variety of instruction to the classroom. In addition, the sub-committee recommended the use of computers for cataloguing and retrieving information, grading examinations and other administrative functions.

While the fulfillment of the possibilities outlined by the CED subcommittee may take some time to achieve, piecemeal parts of the system exist now. Television, for example, is being used in a variety of ways, and lectures and discussions among teachers and students in widely separated areas — linked together by the Bell System's Tele-Lecture service — are being conducted with increasing frequency.

## Computer-assists accelerate

The newest growth area of educational technology, however, is in the application of computers. At Yorktown Heights, N. Y., for example, the U. S. Office of Education is supporting a center "for the demonstration of Computer Assisted Instruction (CAI) and other educational media." At the center, Bell System facilities connect one control console with a computer at Johns Hopkins University in Baltimore, and a second console — with a viewing screen, a slide projector and tape recorder — to a nearby computer laboratory.

With this equipment, elementary school children are learning letters and beginning to read. The "new mathematics," including the concept of numerical "sets," also is taught there.

Dr. C. Alan Riedesel and Marilyn N. Suydam of Penn State University describe CAI as "a feasible tool" that offers "greater potential than previous innovations, such as sound film, television, radio, filmstrips and conventional programmed instruction."

The Yorktown Heights complex is also used for demonstrating problems in economics for sixth grade students. With the computer, children can "manage" a toy store and toy factory, or deal with the problems of an Affairs Officer of the Agency for International Development in Sierra Leone. In an economics project, the computer asks students to "imagine that you have just been made Ruler of Lagash, a City-State of Sumer, in the year 3500 B.C. Twice yearly your humble Steward, Urbaba, will report to you on the economic condition of the kingdom. Guided by these reports, you will decide the use of your grain and other resources, trying to keep your population stable and well fed." The computer states that Urbaba reports that the grain is harvested and stored, and asks how much to feed the people and how much to plant for the next crop. For 36 simulated years, there are twice-yearly reports, and sometimes additional bulletins of disaster, such as: "3,815 bushels of grain have rotted," or "507 bushels of grain have been eaten by rats."

Instead of feeding his people, one young king planted all his grain and the exercise ended when the computer responded: "Your population has decreased to zero. Do not go on. Call the teacher." Nearly all of the boy- and girl-rulers, however, manage Lagash's affairs well enough to win from the computer this accolade: "You have done well. The Gods are pleased. Goodby."

Students who participate in the economic exercises with the computer learn as much as those who study economics under a good teacher in a conventional classroom, but in about half the time.

"Insofar as our experience goes," Dr. Richard L. Wing who directs the Yorktown program reports, "computer-based games . . . seem more effective than conventional methods when the time investment of the student is taken into consideration."

Similar studies of CAI and related technology are in progress at schools and research centers across the country. In Palo Alto, California, fourth, fifth and sixth graders drill in math and spelling by using Bell System teletypewriters to communicate with a computer at Stanford University. The success of this experimental program has resulted in the first use of a computer for regular teaching in an American elementary school. The program is being broadened to include some 150 first-graders who receive half an hour of instruction daily in reading and math by a computer. This system provides teaching material, keeps track of pupils' scores, and analyzes the results for the teacher and staff. Modifications in the program for individual students may be made as they seem desirable. The teacher is also freed from the tedious drilling of pupils, and has more time available for individual instruction. Thus, rather than automation resulting in impersonalizing education, as some have feared, the new technology actually increases the opportunity to tailor the educational process to individual needs.

Computer uses in education are not confined to teaching situations. Even burgeoning administrative problems posed by the student boom bid for their share of computer-and-communications relief. One example is at Indiana University where students register for classes by telephone. Instead of going to the field house and standing in lines for hours, a student takes three minutes to phone the registrar's office and submit a list of the classes he wants to attend. His requests are fed into a computer, which keep an up-to-the-minute record of enrollment in each course.

## New libraries needed

With both the body of knowledge and student populations expanding so fast, libraries are becoming more important in schools, and the pressure on them increases. As new techniques are employed to make libraries go further, sharing the new media on as wide a basis as possible also comes in for consideration. Access to audio tapes, as well as teletypewriter transmission of book and article reprints over the existing information network is being adopted on a wide scale by college, public and specialized library systems.

At the University of Virginia Library, for instance, a teletypewriter works in conjunction with a computer to provide immediate reference by other college libraries in Virginia. And in Maryland and Indiana, local public libraries are connected together by communications facilities to increase the average 4,000-volume small library's resources to about four million volumes that are available throughout the state. In the area of specialized libraries, the National Library of Medicine is using a computer to speed publication of its index of medical articles used by

all medical schools throughout the country.

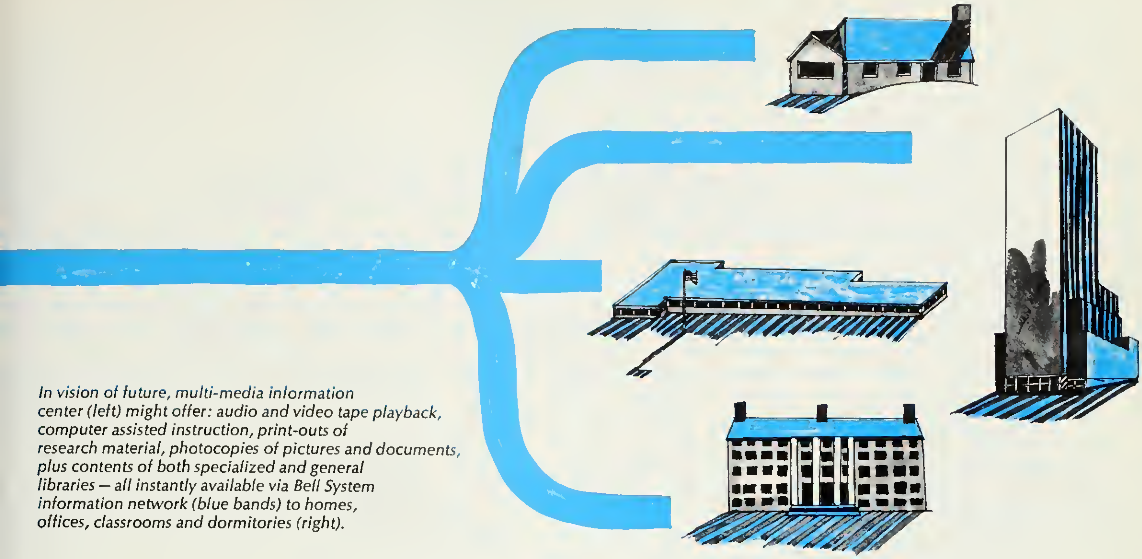
On the national scale, EDUCOM—formally known as Interuniversity Communications Council—is working toward the goal of a nationwide library system. An organization of 62 institutions, EDUCOM believes that an "electronic multimedia information network ultimately must make material in many forms almost instantly available to scholars wherever on the continent they may be."

In all these cases, the communications facilities involved can be used in many ways, such as arranging for inter-library loans of books, films and other materials; confirming research efforts; helping to find alternate sources for needed material; and speeding up orders for photo duplicating.

Microfilm and the newer microfiches and micro-images enable libraries to house much data in tiny space. The latter, for example, can shrink a 1,245-page Bible into a 2-inch square.

Beyond the kind of facilities envisioned lies what Michel Beilis of AT&T calls the "eventual multi-media information center composed of regional, state and national systems." A former university teacher and administrator himself, Mr. Beilis is now the Bell System's national coordinator for education in AT&T's Marketing Department. He foresees the day when "the Battle of Britain — complete with taped Churchill speeches, filmclips of London on fire, and an analysis of the event by historians — will be, as it were, deliverable to anybody anywhere who wants to study it, whether in a classroom, a dormitory or even in his own home.

"The instrumentalities already exist to transmit the contents of books, tapes and films over the existing information network. To go from local to regional to state to national requires only what everything worthwhile requires: planning, purpose, patience, dedication — and, of course, money," Mr. Beilis maintains.



*In vision of future, multi-media information center (left) might offer: audio and video tape playback, computer assisted instruction, print-outs of research material, photocopies of pictures and documents, plus contents of both specialized and general libraries — all instantly available via Bell System information network (blue bands) to homes, offices, classrooms and dormitories (right).*

Before the full benefits of a new educational technology can be obtained, some problems remain to be solved. While the technical side seems feasible, human and legal questions remain.

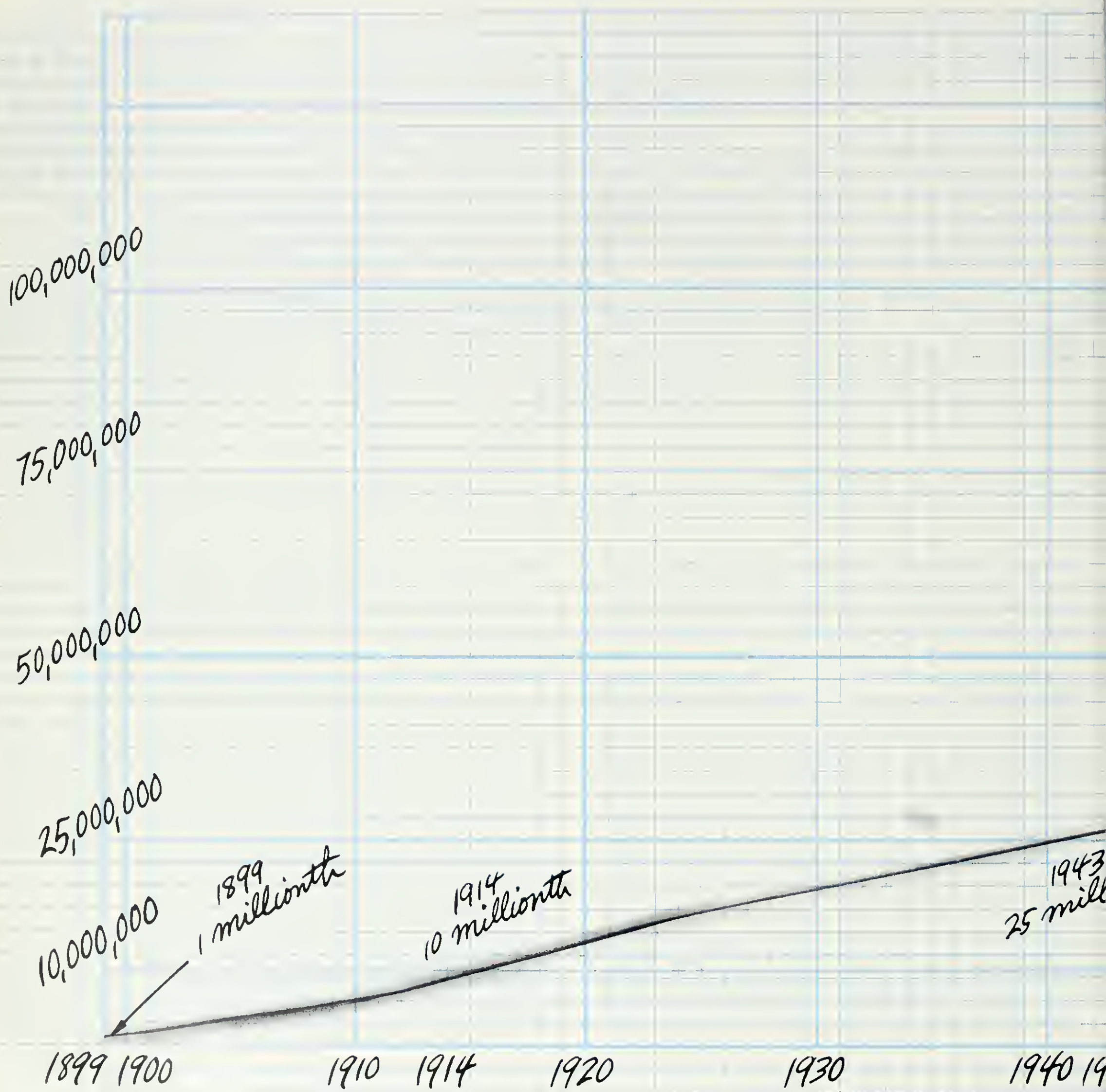
For one thing, the new developments are coming so fast that it is becoming increasingly difficult for teachers to keep pace with the new technology. At the same time the new technology is bringing new roles for teachers, librarians and libraries.

"A teacher who only dispenses information can be dispensed with," says Harold Gores, president of Educational Facilities Laboratories, a non-profit corporation established by the Ford Foundation. "From now on, things should be taught by machines and the teacher raised to the level of meaning." The teacher, adds William C. Harley of the National Association of Educational Broadcasters," will cease to be a source of inadequate and often outdated information and will become a guide through the labyrinth of alternatives."

"The teacher will become an orchestrator rather than a dispenser of information" predicts Mr. Beilis. "She can choose from many resources what is best suited for her class. Hopefully, she will be free to spend more time inspiring her students and doing the things that only a good teacher can do."

Economic problems also are receiving top-level attention. Federal legislation passed in 1965 makes more innovation in educational media possible. And the cost of computers and computer programs are shrinking. Copyright problems that arise from widespread reproduction of printed material have so far been among the thorniest issues in the new educational technology, but here, too, teams of experts are striving for an equitable solution.

No one believes tomorrow's educational problems are insoluble. As the nation's needs mushroom, technological help in stretching educational resources will have to play an ever more important role. ▢



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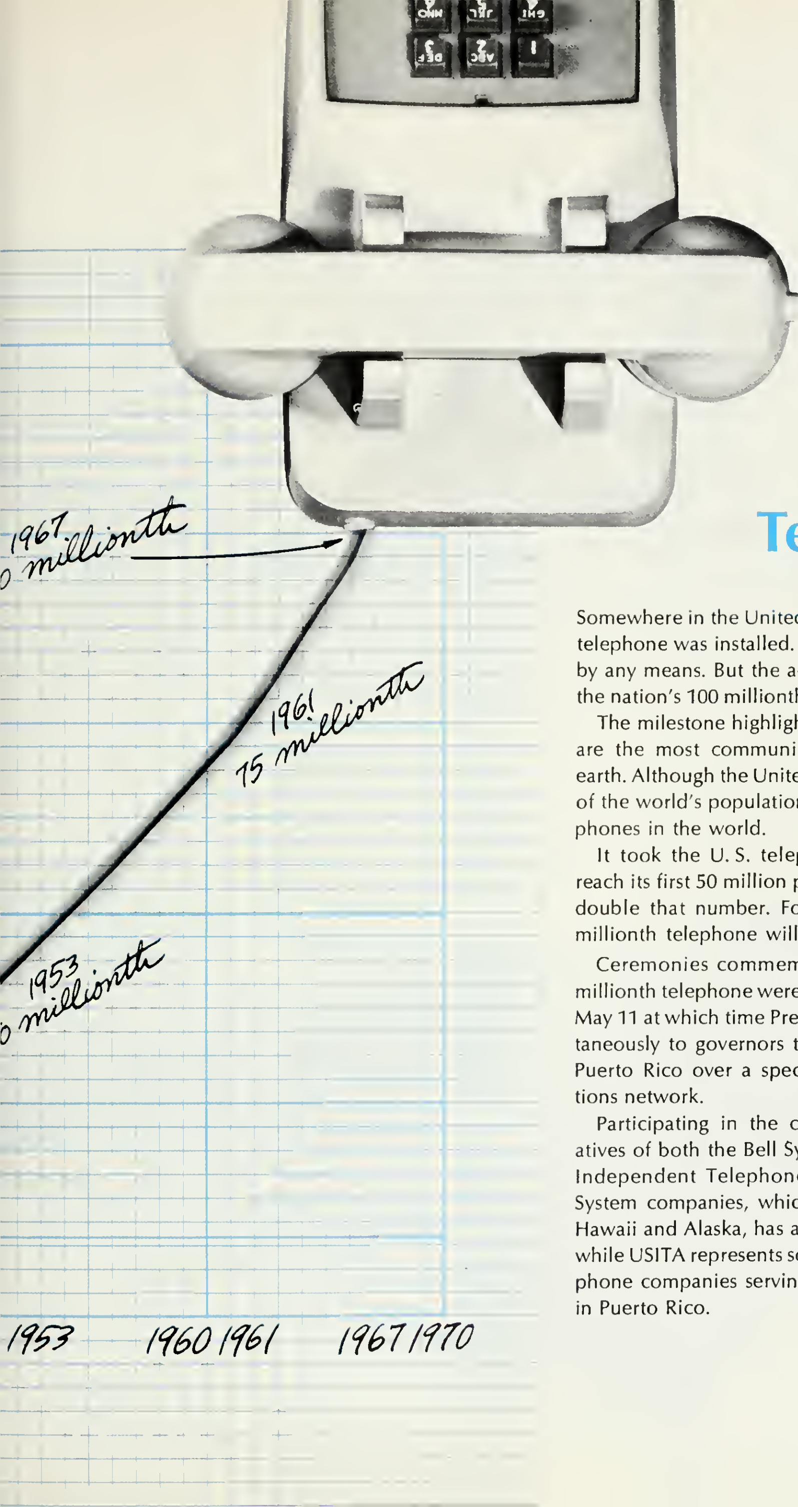


# 100 Million Telephones

Somewhere in the United States in early May another telephone was installed. Not an unusual occurrence, by any means. But the action was significant: It was the nation's 100 millionth telephone.

The milestone highlighted the fact that Americans are the most communications-minded people on earth. Although the United States has only six per cent of the world's population, it has nearly half the telephones in the world.

It took the U. S. telephone industry 77 years to reach its first 50 million phones, and only 14 years to double that number. Forecasters estimate the 200 millionth telephone will go into service by 1991.

Ceremonies commemorating the industry's 100 millionth telephone were held at the White House on May 11 at which time President Johnson spoke simultaneously to governors throughout the country and Puerto Rico over a specially arranged communications network.

Participating in the ceremonies were representatives of both the Bell System and the United States Independent Telephone Association. The 23 Bell System companies, which serve in all states except Hawaii and Alaska, has about 80 million telephones, while USITA represents some 2,300 independent telephone companies serving in 49 of the 50 states and in Puerto Rico. □


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# A Time of No Longer and Not Yet

The 300-plus men and women in the sparkling new auditorium on the University of Illinois' Chicago Circle Campus were there to lay bare the soul of the corporation. Mostly businessmen and educators but with a sprinkling of clergymen and labor and government representatives, they were to spend two days discussing the social responsibilities of business, a subject as ancient as man's thinking about ethics and yet one that cries for fresh insights.

The group harbored no illusions that they would find quick answers — indeed, any answers at all. The subject is too broad for that. They hoped, however, that the meeting would produce some guidelines and, equally important, represent the beginning of a continuing dialogue between the business, government, and academic communities on a subject that needs their combined thinking and action.

The idea for the meeting was spawned by the University of Illinois and nurtured by a grant from the Illinois Bell Telephone Company. "To the best of my knowledge," said Illinois Bell President James W. Cook, "there has not been an in-depth attempt to gather people from many . . . backgrounds with differing . . . beliefs and give them the time and the place in which to examine the subject of this symposium."

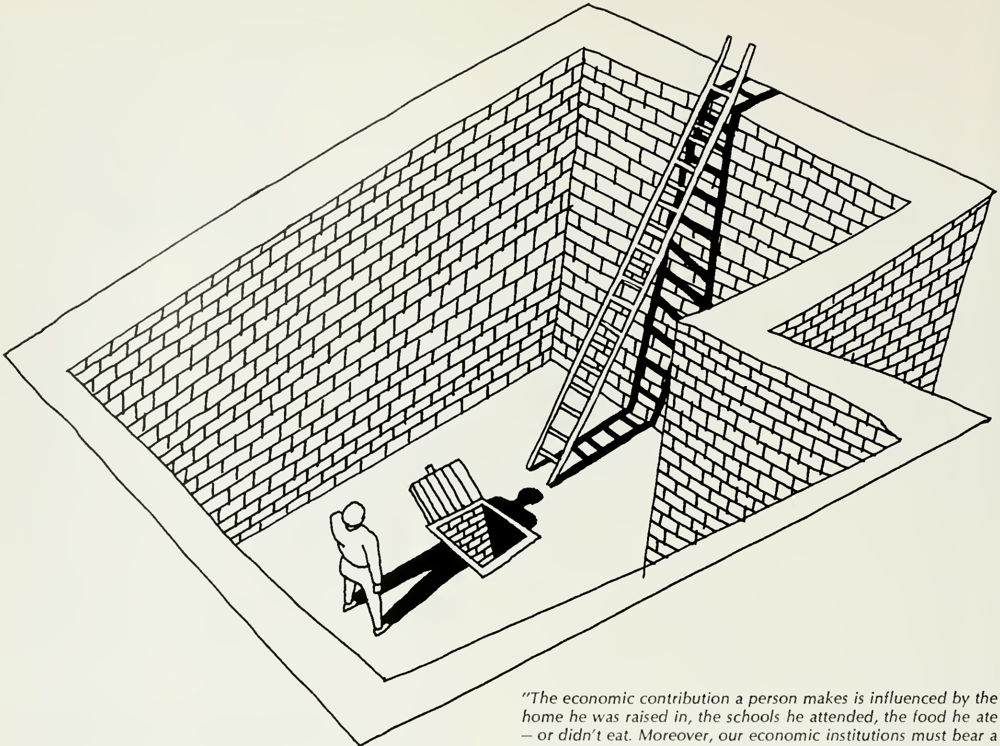
Illinois Bell's purpose in underwriting the symposium was not, as Mr. Cook explained, wholly altruistic. He and the other businessmen were looking for advice and counsel.

"We live at a period between "No Longer" and "Not Yet," Mr. Cook told the meeting. "Many of the old rules that guided business no longer hold. But we have not yet successfully worked out new ones to take their place. The earlier concepts under which business operated pretty much as it pleased with little concern for the general needs of the community no longer hold. But we have not yet found wholly satisfactory means by which a business can reach out into the community without undergoing some censure either for exerting undue pressure or for spending too much of the owner's money. We have not yet found a generally accepted balance between a business's logical and valid need for profit and its obligations as a corporate citizen—whatever they may be."

The real dilemma for today's businessman as expressed by Mr. Cook, is not whether he should or should not accept responsibility for helping to solve the nation's ills. His dilemma, rather, is how to identify the public areas in which he can properly and helpfully operate.

Dr. Howard R. Bowen, president of the University of Iowa and one of the speakers at the symposium, observed that businessmen today are torn between two obligations: one to society as a whole and the other to the concept of free enterprise. Most businessmen, he said, are "quite rightly . . . deeply conscious of limitations on their power to choose policies which deviate very far from their profit-making interests. They feel, and they are, hemmed in by competition, by labor unions, by government control, and by the need to protect their sources of capital. Their room for maneuver is severely limited."

And yet despite these limitations, the speakers at Chicago pointed out, more and more companies are finding that opportunities are open to them, that a balance between social and economic obligations can be reached. As a result, many businesses are breaking away from the traditional, somewhat passive, concept of social responsibility that once prevailed. Gone are the days when social responsibility stopped at contributing to the Community Chest —



*"The economic contribution a person makes is influenced by the home he was raised in, the schools he attended, the food he ate — or didn't eat. Moreover, our economic institutions must bear a portion of the guilt we all share for the continuation of discrimination in its various forms" . . . Gardner Ackley, chairman, Council of Economic Advisors.*

worthy though that may be. "Social responsibility in that sense," said Harvard's Emmanuel G. Mesthene, "is what the original Rockefeller was dispensing in the form of shiny new dimes."

Today's businessman has come to recognize that his responsibility to society is much greater — and not just from a humanitarian standpoint. "Everything that affects the life of a community, affects the companies that do business there." Mr. Cook said. "If the community prospers, the companies are in a position to prosper, too. . . . If the community is gripped by social unrest, this unrest will seep into the local businesses and take its toll."

In a way — as one of the speakers at Chicago emphasized — business has no choice but to involve itself more deeply in the life of the community. "Since the efforts to meet the society's most pressing needs will move ahead regardless of what business does," said Arjay Miller, president of the Ford Motor Company, "business has only two choices — to become an unwilling participant in policies and programs it has had no hand in developing, or to join sensibly and purposefully in helping to map out sound courses of action."

The social problems which business leaders are trying to face up to are, of course, partly of their own making. Expanded business activity and technological innovations have helped give this nation an unprecedented standard of living. But at the same time, they have brought about changes that have had substantial and, in some instances, adverse effects on social and economic structures.

Because of this "deep and all-pervading" change, Mr. Miller stated, "no institution — and business least of all — can escape the need to reassess its basic role in our society." Mr. Miller added that business has a special challenge. "Because the corporation is itself a primary instrument of change," he said, "it must share in the responsibility for dealing with change."

To help meet this challenge, the Chicago symposium pulled together some guidelines for action, broad though they may be. In general, they fell into three categories: (1) the need for business to devote more attention to protecting human values in a time of great technological change; (2) the need for more cooperation among businesses and between business and government in tackling social problems; and (3) the need for business to apply voluntarily its unique expertise to finding solutions for society's problems.

Addressing himself to the first category, Dr. Bowen said business has an obligation to ease the impact of technological change. Much could be accomplished, he suggested, through systematic manpower planning, providing workers who lose their jobs with assistance in finding new jobs, and vesting certain benefits such as insurance and pensions. Dr. Bowen also called on business to use new technology not only to increase productivity but also to improve working conditions. It is still an obligation of every employer, he said, to make work "a meaningful and satisfying experience."

Two areas in which business could play an especially important role, Dr. Bowen said, were those concerning education and discrimination. The corporation, he said, is more than merely a bystander and supporter of education — "it is itself a major educational institution." But, he argued, many companies are not fully meeting their responsibilities, especially to workers at the lower levels of skill.

Along these same lines, business must increase its efforts to overcome discrimination in employment and job advancement. Neither laws against discrimination nor company policies that simply oppose discrimination will solve the problem, Dr. Bowen said. "A solution requires carefully designed positive efforts, and responsibility for these efforts necessarily falls upon the corporation."

In the discussion at Chicago, it was acknowledged that competitive pressures make it difficult for businessmen to proceed as rapidly in some areas of social responsibility as they might like. One solution, Dr. Bowen suggested, is for the leading, prosperous companies to set the "competitive norms which will eventually gain general acceptance." Another answer lies in the cooperative efforts of businessmen. "What may often not be in the interest of a corporation if done individually," Gardner Ackley, chairman of the Council of Economic Advisors, said, "may sometimes be in the interest of each if a group of corporations all support it."

As an example, Dr. Ackley said, it may clearly be unprofitable for a single corporation to attempt to

*"The rising expectations of people everywhere for still higher levels of well-heing are a kind of consumer demand that no realistic businessman could aiford or would want to ignore" . . . Arjay Miller, president, Ford Motor Company.*

raise the economic status of the Negro. "Yet if a group of corporations engages individually or collectively in the effort, the impact on the future stability and efficiency of the community may definitely advance the interests of each."

Dr. Ackley added that it would be optimistic to "suggest that the problems of poverty, urban decay, delinquency, inadequate education, and health care can be solved by the local action of public spirited corporations, even with substantial participation by local government agencies and voluntary organizations. Federal programs are also basic to the solution. Yet Federal efforts can often join those of local communities and business groups in finding solutions to national problems through local action."

On the community level, he called attention to Chicago's "Jobs Now" program as representing an "imaginative and constructive response to some of the problems of disadvantaged youth" in which private employers, city and state government agencies are participating. "In many respects," he said, "it is being taken as a model for similar activities in other ghetto areas around the nation."

Dr. Ackley added that "the Federal government has only begun to explore entirely new ways of enlisting the combined self-interest and public interest of private corporations in the great tasks of training the disadvantaged, rebuilding our cities, providing adequate transportation, and so on." He described this as "a challenge to the social inventiveness of both corporate and public officials."

How can business best apply its experience and skills to the tasks which Dr. Ackley and others prescribed? Arjay Miller suggested two important roles:

"First, the corporation must be an active participant in decisions as to how the society can make progress toward desirable goals with minimum sacrifice of other worthy goals. Second, the corporation must go beyond its traditional role of business enterprise and seek to anticipate, rather than simply to react to, social needs or problems."

Mr. Miller added that given sound guidelines, business will find a way to accomplish the tasks that society expects from it. "The corporation," he said, "is a remarkably adaptable institution."

The adaptability of the corporation, however, may be put to a much sterner test than many businessmen realize, according to Emmanuel Mesthene. Dr. Mesthene, who is executive director of the Program for the Study of Society and Technology at Harvard,

*"One of the major weaknesses of our educational system, especially at the secondary and college levels, is that it is too insulated from the experiences of real life" . . . Howard R. Bowen, president, University of Iowa.*

views the current social ferment as the inevitable effect of powerful new technology.

"Government, industry, education, and other institutions as well," he said, "are seeking new procedures, new alignments, new organizational and management structures, as they try to grapple with the altered circumstances and exploit the new opportunities that new technologies are forcing upon them. The point to stress is that none of these institutions is very likely to emerge unchanged from the experience."

Not only have new tools succeeded in mixing up and reorganizing previously distinct institutional roles and responsibilities, Dr. Mesthene observed, they have also blurred functions in the society at large that were previously either clearly public or clearly private. As examples, he cited the government-private industry relationships which have been forged in such national technological endeavors as the Apollo program and the operation of the communications satellite system. Dr. Mesthene sees the same thing happening in the area of social problems with "the role and importance of the corporation . . . determined by the effectiveness of its partnerships with other institutions — chiefly government — in contributing to national goals that will increasingly be arrived at in public ways."

What is evolving, Dr. Mesthene concluded, is a society in which the corporation will no longer enjoy a privileged position. "That then leaves businessmen," he said "with no more responsibility than that of people to join with their fellows in the design of an intelligent society."

And in part, this is what the Chicago symposium was all about. The businessmen who traveled from many parts of the country to attend the meeting indicated that they want to be more than mere bystanders in the design of an intelligent society. They want, as Arjay Miller put it, to "join sensibly and purposefully in helping to map out sound courses of action."

Up to now, there has been more than a little confusion as to what are the social responsibilities of the corporation. Sound and durable answers are beginning to emerge, however, and out of discussions such as the one in Chicago will eventually come a blue print for active and positive involvement in social problems. The real concern is that time is running out. Business cannot long remain between "no longer" and "not yet" or the answer may one day be "too late." □

# BELL FORUM:

## Statements of policy and opinion

*Editor's Note: The administration-proposed Public Television Act of 1967, which recently passed the Senate and is now before the House, calls for establishment of a Corporation for Public Television and proposes other steps toward strengthening non-commercial broadcasting.*

*During Senate hearings on the act, a long list of witnesses representing educational and commercial broadcasting organizations, communications common carriers, and others gave their views on the proposed legislation. Among those who testified was Kenneth G. McKay, vice president-Engineering of AT&T. Pointing out that "our business is communications," Mr. McKay limited his comments to those aspects of the bill that concern the field of communications. His text follows:*

I appreciate this opportunity to present the Bell System's views on the Public Television Act of 1967 (S. 1160).

At the outset, let me say that we are in accord with the purposes of this Act. In our view it provides a sound start toward the development of a system of public television in this country.

We claim no special competence in recommending the organizational format that will best assure "freedom, imagination, and initiative" in the expansion and development of non-commercial broadcasting. We are not educators. We are not broadcasters. Our business is communications. Consequently my further comments will be limited to those aspects of this Act and of various proposals for its further implementation which have a bearing on the field of communications. My comments will be quite brief. For, measured against the full range of policy questions the Committee must weigh to assure the vitality and the independence of public television, the question of that medium's particular transmission requirements is a relatively minor one. Nor does it bulk too large in the scale of the long-run financial requirements of a fully developed system of educational television.

Transmission, or, as it is called in the bill, "interconnection," relates to the development of ETV in two ways: first, in the pattern of program distribution or of interconnection that might be most appropriate for public television and, second, in the prospect that satellite transmission might offer economies from which ETV might derive some measure of financial support.

I have three main points I would like to make on these matters:

The first is that, whatever the pattern of ETV's transmission requirements may turn out to be, the Bell System is going to do its very best to meet them. It is now just 40 years since the Bell System first demonstrated long distance television. On April 7, 1927, President Hoover, then Secretary of Commerce, and Walter S. Gifford, the president of our company, conversed between Washington and New York and, while they talked, Mr. Gifford watched Mr. Hoover on a TV screen 2½ inches square. As you know, beginning in 1948, first on a regional and then on a national basis, our facilities have provided the means for the highly developed and flexible system of network television we have in this country today. Our ability to do so is very largely based on developments in our own Laboratories — notably continuing advances in coaxial cable and microwave radio relay systems. And our efforts to develop television transmission continue apace — witness the first satellite transmission of television via Telstar.

However, as we told this Committee last August, our interest in this business is not a proprietary one. We recognize that we shall continue in it only so long as our services remain the best and most economical way to do the job. It is in the same spirit that we face the prospect of a considerable expansion of the program transmission requirements of educational television.

My second point is this: we believe that communications satellites can offer significant economies in domestic communications of all kinds, including television transmission. To this end the Bell System last December proposed to the Federal Communications Commission a Space-Earth Communications System that is designed to provide for the optimum use of satellites and terrestrial facilities for communications services of all types — TV, voice and data — between now and 1980.

This proposal reflects our conviction that the expanding requirements of *all* users of common carrier communications services, including commercial TV and ETV, can most economically be met by a multi-purpose satellite system integrated with terrestrial facilities in such a way as to optimize the advantages of each. We are anxious to proceed promptly with the implementation of the first stage of such a domestic satellite system. Whether the system as it develops will be deployed in precisely the configuration we have proposed, I am not sure. Considering the pace of advance of today's technology, it is a virtual certainty that new considerations will arise that will alter in some degree the economic balance between satellite and terrestrial facilities on which its design is based. Yet I believe that satellites will play an important role in the future domestic communications system in this country.

What is important, however, is the principle on which our proposal to the Federal Communications Commission is predicated — the principle that satellites should be employed in domestic communications so as to provide their advantages to the benefit of all users of communications services. In addition to cost, the need to assure reliability through diversity and the importance of conserving the resources of the frequency spectrum and the equatorial orbit path are other factors that must receive most careful consideration.

We recognize that the way satellites may come to be used in domestic communications is not at issue in this hearing. As the Committee knows, the Federal Communications Commission is currently considering the whole question of satellite systems for domestic applications. Our proposal for an integrated multi-purpose satellite system is but one of several proposals submitted in the course of that proceeding; some of these proposals call for specialized systems for television distribution alone. Admittedly there remains considerable disagreement as to their relative merits. Searching analysis and systems engineering will be required to reach right answers on this matter. In our view, the decision will have far reaching consequences. For inevitably the establishment of specialized systems — by preempting satellite usage — would seriously delay, if it did not altogether preclude, the economies of scale and the reliability of service that would flow to the general public from a multi-purpose system serving all users.

But — and this is my third point — public television need not wait for domestic satellites. S. 1160 does not hinge on the use of satellites — or, for that matter, any particular mode of transmission. Satellites are relevant to public television only to the extent that they may provide more economical interconnection. As I have indicated, we believe that satellites can and will play an important role in this regard. But the establishment of any satellite system to meet the reasonable needs of ETV can, at best, take several years.

Fortunately, however, the means of interconnection for public television are available now. As I said at the outset, we in the Bell System are ready to do everything we properly can to provide services that match the needs and resources of public television. As an earnest of this intent, we last week filed with the Federal Communications Commission a tariff which will permit us, on a trial basis, to offer TV transmission service between 2 a.m. and 12 noon at about half of current rates. While this tariff is available to all our customers for program transmission service, it is designed to meet what, on the basis of our reading of the Carnegie Commission's report, appears to be one of public television's basic needs: an economical means of transmitting program tapes during off-peak hours for later broadcast at times of the local station's own choosing. I am hopeful that the ETV broadcasters will soon make effective use of this new service.

But we shall not wait upon the conclusion of this experiment to consult with authorities in the field of educational broadcasting. These consultations are going on right now with the aim of developing further offerings tailored to their needs.

In this connection, we note that Section 396(h) of the bill provides that nothing in the Communications Act of 1934 shall be construed as preventing the common carriers from offering "free or reduced rate communications interconnection services" for ETV. I do not believe that I need belabor the point that there is nothing "free" that somebody doesn't have to pay for. And it will be equally apparent that "reduced" rates for ETV have implications which relate to other users of like and other services. However, the enactment of this section of the bill would reflect a policy that public TV should receive interconnection services at the lowest feasible cost. Let me say that we are not unsympathetic to this objective and we share the interest in developing a sound basis for supporting ETV in this regard. We shall certainly continue to search for ways by which we may come up with interconnection rates to the advantage of this medium. Necessarily — and properly — any such proposals will require the concurrence of the Federal Communications Commission.

I am sure that you will understand that I cannot be more definite on this point until the specific needs of public TV are more clearly delineated. You may be sure that we will work closely with the Corporation for Public Television, when it is established, and with the Federal Communications Commission to reach the best solutions possible in the light of the specific requirements of ETV as they emerge. ▢

# Bridging the Gap

Rapid advances in the communications arts—like the development of integrated circuits—call for ever closer coordination between research and development and engineering for manufacture

When Mrs. Betty Wolf goes to work at Western Electric's Allentown, Pa. Works, she isn't entirely sure she'll still have the job she left the day before. Not that she's afraid of losing her job; it's just that Mrs. Wolf works on the Pilot Line, where today, products of the new technology — integrated circuits — are being proved in. And individual tasks on the Pilot Line can change just that fast.

Mrs. Wolf, who has been with Western Electric for over 16 years — and incidentally is a very youthful grandmother — likes dealing with new things and new ideas, and learning new skills her job requires.

"We really get the brunt of change here," she says. "Sometimes we just get started on a new process or product when, Zing! Somebody changes it or takes it back to start all over. Then *we* start all over."

When somebody "takes it back," it goes to the Design Capability Line, known with affectionate brevity as the DCL. Although located right in the middle of one of the manufacturing areas in the Bell System plant, and surrounded by the bustle and noise of electronic component production, it is operated by Bell Telephone Laboratories. There, on what Western Electric development engineer Robert Whitner calls "our solid ground between design and product," manufacturing engineers work side by side with

*New technology demands new manufacturing methods: "We don't stamp out metal parts now—we make precision photo masks for integrated circuits."*

members of Bell Laboratories' technical staff.

"Our job is to determine if the design of a new device will be amenable to manufacture," says Mr. Whitner. "Then we send specific suggestions for manufacturing methods to the Pilot Line. The engineers in the Pilot Line develop the ideas, design and develop the production equipment, and debug it."

Kermit Kalna, department chief, Bell Integrated Circuits, oversees the operation of the Pilot Line and the DCL. Running a lean hand through a shock of white hair, he says, "This pilot operation isn't a production line, but sometimes it looks like it. We're the man in the middle. In a very real sense, we live in both worlds — design and manufacture. We have to prove in the design, how to make it, how to test it, how to maintain standards. When it leaves here, it's ready for production, and it should never have to come back. It's our job to see that it never does."

The interaction of Western Electric with Bell Laboratories—the Bell System's manufacturing and supply unit and its research branch — isn't new; the two have long worked closely together to translate concept into product. But the extent and the timing of this cooperation in the process of producing new tools of communications is quite different today from what it was only a few years ago.

"Back in the electromechanical era," is the way Dr. Morris Tanenbaum describes it. As Director of Research and Development at Western Electric's Engineering Research Center in Princeton, N.J., Dr. Tanenbaum looks both back and forward at Western's position in engineering for manufacture.

"A few years ago, areas of responsibility were fairly sharply defined," he says. "The manufacturing process didn't change quickly or radically. But now, in the electronic era, research and manufacturing have to be more closely interlinked. We're dealing with new materials, new techniques, new degrees of precision. And this has led to a basic change in Bell System organization: The organization has had to adapt to its technology, instead of making technology adapt to organization, so manufacturing developments can parallel design developments."

A. E. Anderson, Engineering Director at Western's Allentown Works, considers that this basic change — the establishment of regional laboratories in Western manufacturing locations — is a vitally important link between design and production.

"It's necessary," he says, "to reach a level of common understanding, common language, between the inventors, often working in pure science, and the manufacturers working with the tools of production. These regional laboratories have effectively pushed back the interface to points nearer and nearer the genesis of the idea. We must interact with the Laboratories at the exploratory design stage, sometimes even in discussion of the idea itself."

The transistor is a case in point. First commercially produced at Allentown, this tiny device that revolutionized electronics also revolutionized manufacturing processes.

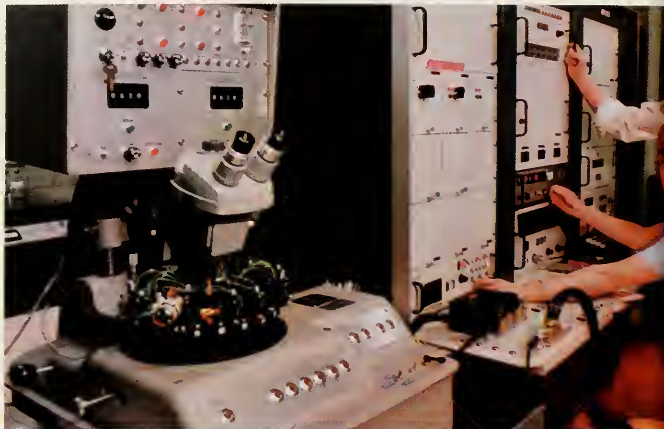
"We sat down with Laboratories people," says Mr. Anderson, "long before they were ready to ask us to make the transistor in quantities. We had to. We were going to have to handle materials we'd never used before — at first germanium, then later silicon. We had to know purity standards, tolerances, operating requirements. And we had to project this new technology in terms of people and the tools they would use. If we hadn't been able to work with Bell Laboratories in the early stages, we'd have been lost before we started. Since the technology is evolutionary and is always changing, our early interaction with the Laboratories is a never-ending affair; in fact, it is growing as it must as designs and technology become ever more complex."

While the regional laboratories, now in nine Western Electric locations, have brought design and manufacture together under the same roof, they were augmented some time ago by a still closer link in the Laboratories-Western relationship.

"Back in '50's," says Dr. Tanenbaum, "we began

*It takes new materials — sometimes home-grown — new tools, new skills to make today's new products. High-purity silicon crystals, grown in WE's Allentown Works, upper picture, provide raw material for integrated circuits. In lower pictures, Terri Kukitz, left, is the only one who operates pilot model of machine, bonding 16 leads at once on new beam lead integrated circuits. Marie Dalmaso, right, had to learn exacting skill in matching microscopic photo masks to silicon slices cut from crystals shown above.*

*Increasing complexity of new products — integrated circuits — makes testing process more complicated and difficult. Mrs. Laura Charles, left, works on pilot testing of new circuits for Touch Tone® Trimline® phone. At right, Mrs. Betty Wolf and WE development engineer Stanley Hause do computerized testing and fault evaluation of these products of new technology.*



to realize that the regional laboratories concept, good as it was, could be greatly strengthened. An even earlier interaction with the designer could play a major role in coping with the advancing technology. Then the design of the product and the way to make it could evolve together from the earliest concept. This led to another innovation in Bell System organization — the establishment of Western's Engineering Research Center, which meshes still more closely design development and manufacturing process development."

Dr. Tanenbaum remembers the advent of tantalum thin film technology, one of the newer branches of the solid state electronics family. Basically this consists of depositing an extremely thin film of tantalum on glass or ceramic plates, then modifying it to produce high quality resistors and capacitors.

"Early in the exploratory design stage, Bell Laboratories asked us to explore the manufacturing process this new product would require. This was well before design was complete and a few years before production could even be considered. The process had to operate in a precisely controlled partial vacuum, and it had to be continuous for volume production.

"We came up with a process that moved the plates continuously through a series of vacuum chambers and a controlled atmosphere of argon and nitrogen, where electric 'sputtering' deposited the film.

"Developing this took several years of close collaboration between WE's process research engineers and Bell Laboratories' exploratory design engineers. By the time the design was ready, we had the new manufacturing process ready."

Such innovations in products place heavy demands on manufacturing know-how. As Mr. Anderson says, "The more radical the innovation, the more difficult the transition from theory to product."

"We're old hands here by now at making transistors, for instance. But as the technology has changed, the transistor itself has changed. As it has had to work at higher and higher frequencies, so have critical dimensions shrunk in size. Now we make several thousand on a slice of silicon just over an inch in diameter. You can hardly see the separate transistors — they're about the size of a grain of black pepper — and just about as hard to get hold of and handle, too.

Getting them into manufacture meant inventing and designing new tools — vacuum needles, superprecision lead-bonders (or welders), micromanipulators — and providing microscopes so the girls can see what they're doing. It also meant training girls to use these new tools.

"With transistors and now, especially, with integrated circuits, the manufacturing process is not only more sophisticated than with traditional things like relays or switches — it's entirely different. We're working with tolerances about the size of a virus."

Having been on the crest of the breaking wave of new technology for years, Mr. Anderson appreciates the adaptability of people. So does Joseph Santangini, development engineer on the Pilot Line.

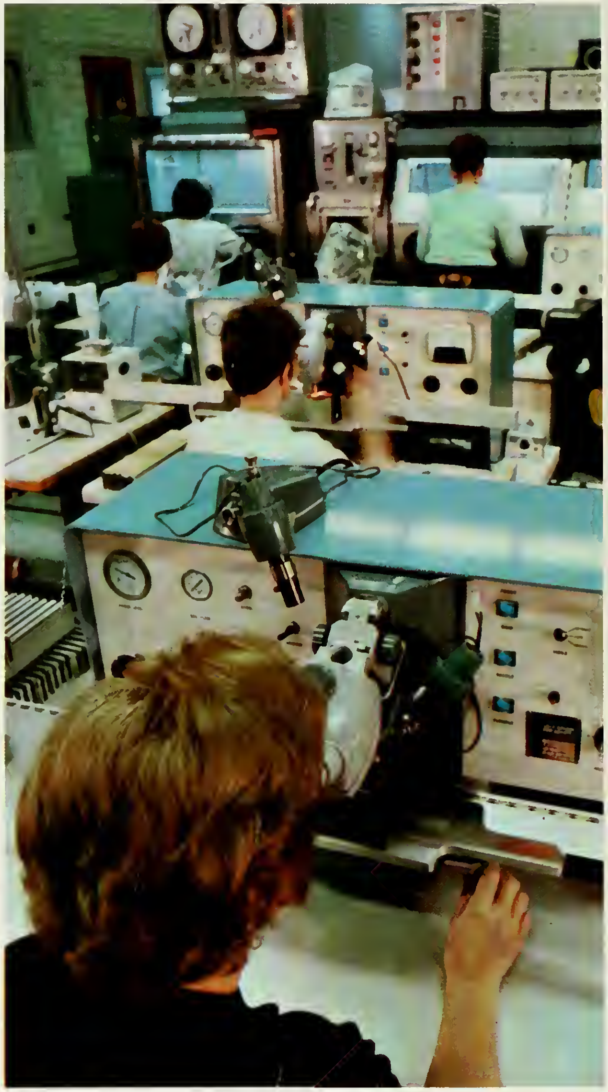
"We're the proving ground for new processes and we have to do some human engineering, too."

The jelling of a new design into a firm production process involves developing processes, controls and facilities that production line people can cope with. It's the job of the Pilot Line to explore and develop suitable ways of doing this. The exploring — trying, testing, discarding, trying again — by its very nature entails change. The new technology — integrated circuits, for example — is based on transistor technology, but involves many new techniques.

Richard Corazza, in charge of integrated circuit assembly and testing in the pilot section, says, "You get used to testing under microscopes with three probes — we've been doing that with transistors. Now we're using anywhere from 9 to 16, and there are new circuits with 18 to 20 on the way. It makes the testing job that much more complex. It also makes it that much more difficult to develop a working production line process. The more complicated and delicate these things get, the bigger our job is. With whole circuits, you're speaking a different language."

With new designs arriving from the DCL at today's accelerating pace, Mr. Santangini's "human engineering" is important. "People here enjoy working with new things," he points out. "They can't be bothered

*Allentown production line turns out integrated circuits for electronic switching systems. Behind this manufacturing process lie many months of experiment, development and close cooperation between Bell Laboratories and Western Electric.*



*Working interface between Bell Laboratories and WE: on the design capability line at Allentown – the step between design and pilot line – Western development engineer Robert Whitner, left, and Bell Laboratories' Paul Perron determine if newly designed products will be amenable to manufacture. "Today it's beam lead integrated circuits," says Mr. Perron. "Tomorrow it may be something else, requiring different materials, different methods and equipment. Whatever it is, it will require continuous coordination between research and manufacturing."*

by change. They thrive on it. That's one reason they're here. When a new product gets through the course here, the production process has been broken down into separate operations that can be learned and handled efficiently by the operators on the line."

Says Mr. Anderson, "My idea of real sophistication in a manufacturing process is *simplicity*. One good example is our introduction of the vibrating jig. This is a small, bench-mounted machine, essentially very simple, that enables the girls to handle tiny piece parts and prepare them for mounting, hundreds at a time. The jig simply vibrates them uniformly into tiny holes in a plate, like bees returning dutifully to the honeycomb. Then they can be stacked up in jigs all at once for bonding, instead of individually. Many operations, though, have to be done individually, and here is where human judgment and skill come in.

"It is common, in fact pretty general, to view efficient manufacture as highly mechanized or, even more popularly, as automated. This is probably the right solution for some problems and may be the only solution in many cases.

"The machine is specialized and therefore highly inflexible. In our fast-changing and developing field it is very easy to find designs and technology changing faster than machines can be designed, built and proven in. When this happens, the inflexible machine becomes a 'boat anchor.' For our kind of business, at least, you have to think long and hard before you try to compete with the tactile sensitivity of the human hand, the sensing capability of the eyeball, and the judging, directing and controlling capabilities of the mind. People are the most flexible, most versatile means we have of assembling or making things. With patience, people can be taught to do many things, but it is pretty tough to teach a machine to do something it was not designed to do.

"What we get out of this is a blend of people and machine, with each doing what it can do best. We adapt machine to people, never vice versa. Above all, we try to keep it simple. The lead-bonding operation in silicon transistors is a good example. Here we bond a gold wire, so thin you can't even see it, to contacts on the transistor — also so small you can't see them. This is all microscope work. The bond or weld must be done *just so,* to meet requirements and to be reliable. The girls on the production line orient, adjust, and carry out the several necessary motions.

"We might make a machine that would have sensing and motion patterns, but not so simply. The girls can *see* if they have a good bond, they can *see* and *know* if there is a jam-up. We haven't yet devised a machine with that kind of delicate judgment.

"On the other hand, the pressures and temperatures in the actual bonding operations are critical, and are far more easily controlled by built-in mechanical features. This blend, or integration, of girl and machine came out of much study and development on the DCL and Pilot Line. We may find improved tooling and improved blending with people, but I doubt very much that any machine by itself will provide a better solution to our present production problems in terms of simplicity and flexibility."

The future, even for men like Mr. Anderson, is sometimes a little difficult to see into. "I hardly dare think," he says with a sigh, "what's coming next — but, man, I can hardly wait." The only certain thing about it is that the things Western Electric makes for the Bell System will continue to change.

New needs breed new technology. And as the new technology is born on the physicist's blackboard, on scratch pads, in long hours of talk, the bridge that has been built between the scientist-designer and the engineer-maker more and more will close the gap between idea and reality.

"If we didn't have this working interface with our inventors and designers," says Mr. Anderson, "we'd still be making buggy whips in the jet age. We can't afford to do that. Our job is not just to keep up but to keep ahead. I think we've devised the best means there is for us to accomplish the mission." ▢

# BELL reports

## Overseas Facilities Expanded

AT&T is continuing to expand and improve its network of radio, cable, and satellite facilities to meet the growing demand for overseas telephone service.

With calls between the U.S. and overseas points increasing at a rate of better than 20 percent a year, AT&T has in recent weeks added new radiotelephone facilities linking South America, acquired 80 circuits in a new Pacific underseas cable, and leased additional channels in communications satellites serving European and Pacific points.

Plans for a new overseas operating center in Pittsburgh were also announced. The center, which is expected to be in operation in 1970, will handle calls to and from Europe that originate or terminate west of Pittsburgh. The Pittsburgh overseas office will join other "gateway" centers now operating in New York City, White Plains, N.Y., Oakland, Calif., and Miami, Fla. (The Miami center will be moved to Jacksonville, Fla., next year.) Approximately half of all overseas telephone calls — including all calls to and from Europe — are channeled through these centers. The other half are dialed directly by regular long distance operators or, in the case of some calls to Canada and to certain Caribbean points, by the callers themselves.

While the number of overseas calls keep increasing, the cost of calling is steadily declining. The latest in a series of rate reductions lowered the cost of calls between the U.S. mainland and Hawaii. As a result of this and other recent overseas rate revisions, U.S. customers are now realizing annual savings of more than $11 million annually.

The increased use of satellite circuits has been a factor in several of the rate reductions. The largest commercial user of communications satellites, AT&T is now leasing 108 circuits in the Communications Satellite Corporation's Atlantic and Pacific satellites.

## New TV Camera Tube Developed

A new television camera tube that is more sensitive, longer lasting, and more reliable than presently available camera tubes has been developed at Bell Telephone Laboratories.

The new tube was designed for possible use in future models of the Picturephone* visual telephone but may, with further development, also find application in portable and color television cameras.

By combining the best features of the vidicon tube with the highly developed silicon technology used in integrated circuits, Bell Labs was able to overcome certain shortcomings of present camera tubes. A major advantage of the new tube, as far as the

*Service mark of the Bell System

Picturephone* set is concerned, is its extreme sensitivity. (The greater the sensitivity of a camera tube, the less illumination is required for the object or scene being televised.) Because the Picturephone* set is designed to be used in homes, offices, and other locations with no special lighting, a camera tube was needed that would perform well with normal lighting.

The new tube is the same size as the vidicon tubes now in use, and should have a comparable manufacturing cost.

### Data Processing Center Planned

To meet the need for additional space to handle its growing activity in the data and computer fields, AT&T is building a data processing and computer center in New Jersey.

The facility, which will be known as the Raritan River Center, will be located near the New Brunswick campus of Rutgers University, about 40 miles from New York City.

In addition to needing more space for computer equipment, AT&T also feels that data processing and computer operations can best be conducted in a building expressly designed for this purpose. The center will initially house some 300 to 400 people who will handle computer and data processing activities for the company's Treasury Department. It also will provide facilities for some divisions of the Business Information Systems Programs Department, a new organization which is responsible for planning and implementing Bell System data processing and computer operations.

The Raritan River Center will have direct communications links (including computer access) with other Treasury facilities concerned with data processing and computer work.

### Trimline Goes To Moscow

The Bell System's Touch-Tone® Trimline® telephone was one of 821 items included in the exhibit, "Industrial Design — USA," which was shown in major Russian cities this spring.

The exhibit, produced by the U.S. Information Agency as part of the U.S.-U.S.S.R. cultural exchange program, depicted the role of American industrial designers in planning and producing industrial products. A total of 179 American firms was represented.

More than a half a million Russians saw the exhibit when it appeared in Moscow, Leningrad and Kiev.

### Bonding With Infrared Energy

A new technique that makes it possible to bond simultaneously large numbers of flexible cables to printed circuits or to other cables has been developed jointly by Bell Labs and Western Electric's Engineering Research Center at Princeton, New Jersey.

By using focused infrared energy to solder the cable, the new technique provides a quick, easy and inexpensive method of interconnecting circuit boards such as those containing miniaturized solid state components used in computers and communications equipment.

Until now, connecting flexible cable required complicated preparation and each conductor had to be soldered individually. With the new process, fifty or more connections can be made in 10 seconds.

*A. P. Boyer of Bell Labs inspects new infrared soldering device as it bonds flexible cable to printed circuit board. With this process, 50 or more connections can be made simultaneously.*

### A Seller's Market

Some 45,000 companies, most of them small businesses with less than 500 employees, sold more than $1.6 billion in goods and services to the Bell System last year.

The sales were made to Western Electric, which acts as the purchasing agent for Bell companies. Purchases were made from suppliers in all 50 states and in 21 foreign countries and territories. In the U.S., the purchases were spread over some 4,000 communities.

Copper was again the major raw material purchased — $130 million worth — while telephone directories were the principal supply item bought by Western. The total bill for the latter came to more than $90 million.

### Laser "Knife" Developed

A new "light knife" which allows surgeons to use the focused beam of a laser as easily as they would a scalpel has been developed by Bell Labs. Designed to help the medical profession evaluate laser surgery, the new device guides the laser beam through a hollow, jointed arm to a small probe which is held like a scalpel. The probe is about the size of a fountain pen and can be moved easily in any direction by the surgeon. It may also be attached to a surgical microscope for more delicate operations.

Until now, laser devices used in medical experiments required flexibly mounted spherical mirrors or fiber optic systems to transmit the laser beam to the patient and did not provide much freedom of movement.

The "light knife" can be used with both pulsed and continuous wave lasers and may be useful for cutting a wide variety of materials besides its application in the developing field of laser surgery.

Bell Labs has been providing the medical profession with technical assistance on lasers because of its interest in learning about the effects of lasers — a potential communications media — on living tissue.

### Bell System Assists Job Program

Bell System information operators will be supplying a different type of information this summer. In cooperation with the President's Council on Youth Opportunity, information operators will assist in a nationwide program to find summer jobs for young people.

The President's Council launched an advertising campaign in May which asks that anyone who can offer employment to young people call an information operator and ask for "Summer Youth." The operator will then refer the caller to the local coordinating agency which may be a United Fund or Community Chest-type organization, a Mayor's Youth Opportunity Council, or a local community action agency established by the U.S. Office of Economic Opportunity.

The Bell System was asked to lend its assistance to the "Summer Youth" program by Vice President Hubert H. Humphrey, chairman of the President's Council, who said he is seeking the "widest possible teamwork" by both individual citizens and organizations in the effort to find jobs for young people. AT&T Board Chairman H. I. Romnes advised Mr. Humphrey that the Bell Companies would "cooperate in every practical way."

### Models Simulate Nerve Cells

Man may never completely understand all the workings of the human brain, but Bell Laboratories' Leon Harmon is using electronic models of nerve cells to help improve our knowledge of the nervous system.

A member of the Information Processing Research Department at Murray Hill, N.J., Harmon has been working with neural models, or neuromimes, which are electronic circuits that simulate the functions of living nerve cells. Bell Labs is interested in learning more about the nervous system because, as one of the most efficient communications systems in existence, it might provide knowledge that could be applied to man-made communications.

Concentrating on eye and ear nerves, Harmon uses the models to make predictions which can then be checked by neurophysiological experiments. For example, Harmon observed some curious relationships between stimulus and response frequencies in the model's electrical circuit. Some of these phenomena were later found by physiologists to duplicate the signals in nerves that control the wing beats of insects in flight.

In recent work, Harmon and his colleagues stimulated several neuromimes that were interconnected as in a biological system. They found that the complicated patterns in the individual electrical units are generated — not because of the stimulus — but because of the type of connection. How and why these patterns appear, how to predict them, and how to relate them to patterns seen in biological systems is the goal of their current investigation. □

# Taking Stock of Share Owners

Share owner relations have become more than an annual report or a proxy statement. AT&T is also listening carefully to what the owners of the business have to say.

"You sure you want to talk to *me?*," a Cleveland, Ohio resident said recently when he received a telephone call from a manager at the Ohio Bell Telephone Company. "After all, I only own five shares of AT&T."

The caller assured the share owner that he did indeed want to come out and visit him and that the amount of stock he owned didn't matter. (In fact, until the information was volunteered, the caller had no idea how much stock the share owner had.) The reason of the visit, the manager explained, was to talk about the business and answer any questions the share owner might have.

This year more than 100,000 AT&T share owners will have a chance to sit down with a Bell System management person and discuss the business in which they share ownership. The purpose of the visits is to strengthen the ties between the people who own AT&T and those who manage the business through mutual understanding — simply by talking informally about whatever subject the share owner might want to discuss.

For some people, it may come as a revelation that a company with more than three million share owners would want to visit even the smallest of its share owners. But for many share owners, the visit may be the first opportunity they've had to talk to a representative of the company other than as a customer.

The Bell System's Share Owner-Management Visit Program, as it's officially called, is probably the most extensive face-to-face share owner relations program of any major business. Like most companies, AT&T communicates with share owners in a variety of ways — through annual reports, proxy material, letters and booklets just to name a few. The share owner visit program, however, is the most extraordinary, and undoubtedly most effective, way the Bell System has of bringing the business closer to its owners.

The management employees who visit share owners are not full-time professional interviewers. They're people like Gene Barkhurst, an Ohio Bell commercial supervisor in Cleveland, who, in addition to his regular job, spends one or more afternoons or evenings each month going to the homes or offices of share owners and spending a half hour or so discussing the telephone business.

Like the 10,000 other share owner visitors currently in the program, Mr. Barkhurst was carefully selected for the assignment. His "credentials" include a solid working knowledge of the business gained through nearly 20 years of telephone experience, much of it in public contact work. This — plus the fact that he enjoys talking to people ("My wife says I talk too much") — has proved to be a valuable asset when it comes to handling the free-wheeling, no-questions-barred type of discussion that characterizes a share owner visit.

Obviously, the success of the visit lies in the ability of the employee to respond knowledgeably to the share owner's questions. When the visit program was started some 11 years ago, the visitor was more of a listener: he simply encouraged the share owner to talk and noted his opinions. Today, there is far more two-way discussion with the visitor fielding questions about company policies, positions and goals — the kinds of questions that formerly were referred to headquarters. The visitors can handle such questions because of careful advance preparation.

Before he made his first visit, Mr. Barkhurst attended an intensive training workshop, much of which was devoted to taped practice visits with the trainees alternating in the roles of visitor and share owner. At the workshop, Gene and the others were briefed on various topics and told that, throughout their participation in the program, they could expect to receive a steady flow of bulletins and other background information pertaining to subjects likely to come up during a visit. But there would be no fixed messages for him to memorize; he would be expected to use his own words.

Although the visitor in talking to a share owner may bring up some specific subjects that the company is specially interested in getting comments on, they try not to lead the discussion any more than necessary.

"Generally, the share owner will soon get around to the things he wants to talk about," Mr. Barkhurst says. "One share owner, for instance — a science teacher — wanted to talk mostly about space communications. On another visit, we talked primarily about financial matters. The share owner obviously knew a lot about finance. In fact, she knew almost as much about the company's finances as I did. On still another visit, this time with a graduate student at Case Institute, the share owner kept coming back to employee benefits. It turned out that he had just had a job interview with Bell Labs."

Although visitors try to answer all questions on the spot, there are times when it isn't possible. "If that happens, you make a commitment to get the answer and call back," Mr. Barkhurst explained. "The same holds true if the share owner has any service problems, something we always ask about."

The visits, of course, are not all business. Mr. Barkhurst estimates that about 50 percent of his discussions have been of a non-telephone nature. This is undoubtedly due in part to the fact that while the share owners to be visited are picked at random, they are assigned to visitors who live in the same general area, thus getting across the point that the business is managed by hometown people — in some instances, even neighbors.

Keeping the visit relaxed and trying to avoid leading the share owner to some preconceived notions held by the visitor is sometimes difficult. It may also have its pitfalls, as some visitors can attest. In one instance, the share owner was a 90-year-old grandmother who started telling him about her grandchildren. The visitor was there two hours without ever getting off the subject. "She was enjoying herself so much," he reported later, "I didn't have the heart to mention what I was there for."

What the visitor is there for, of course, is to seek information: what's on the share owner's mind, what if anything is bothering him about the way the business is being run, is there anything he doesn't understand or wants more information about? The visits also provide an opportunity for the visitors to clarify company policies and activities and to try to erase misunderstandings or misconceptions about the business.

After each visit, the visitor writes a summary on what was discussed. Significant excerpts from the reports are then sent to top management both at AT&T and the local operating company where they are carefully analyzed to determine the trend of share owner opinions.

"Management is interested," says Kenneth G. Horton, share owner relations manager at AT&T, "in general impressions of the efficiency and attitudes of our employees, share owner reaction to our service, and of course, comments on financial matters such as earnings, dividends, stockmarket prices, capital structure and capital requirements. While no business can operate purely on a popularity basis, a recurring consensus for or against some policy or practice carries weight, especially when it coincides with comments we get from customers, employees or the general public.

"Over the years we've noticed a great shifting of share owner interests and attitudes," adds Mr. Horton. "We've found that the visit program is very sensitive to changing share owner attitudes. For example, when the company was launching its Telstar satellites, the interest in discussing satellite communications was intense. In nearly half the visits, share owners would ask questions about satellites. More recently we had a sizable drop in the market price of AT&T stock and that's what many share owners want to talk about. Of course, we're careful never to advise them on their investments."

When the visit program began to take shape, Mr. Horton recalls, there was some concern about how share owners would react. The results have long since vindicated the decision to launch a continuing, long-term program. An overwhelming majority of share owners, Mr. Horton says, indicate that they appreciate the visit. Should a share owner say he does not want a visit — and a few do — it's dropped right there.

To help keep the visit program on target, AT&T is continuously surveying share owners who have been visited to get their reactions. Of particular concern to the company is the share owner who says that he raised questions the visitor could not answer. To hold this to a minimum, the Bell Companies have expanded their training programs and stepped up the amount of background material for visitors.

Having people with the ability to converse easily on company matters is important to the visit program, but Mr. Horton sees in the program a much broader application. "The telephone business touches most everyone and becomes more complex day by day," he says. "It needs explanation and, if the public understanding and support it must have is to be maintained, every management person worth his salt must be a competent spokesman."

The development of spokesmen for the business has been one of the side benefits of the visit program. Certainly, for those who have gone through the program, it has proven its value. "It was the best thing that ever happened to me," says one visitor. "It forced me to learn more about the whole company, not just my own job."

As extensive as the share owner visit program is, broader means of communications must be used to reach the majority of share owners. It is here that the written rather than the spoken word comes heavily into play.

Communication with an AT&T share owner begins with a welcoming letter from the chairman of the board. This goes out with an introductory booklet about the Bell System whenever an individual's name first appears on the stock list. He is then offered a range of booklets and brochures about the company and its policies. Annual reports and quarterly reports which accompany dividend checks, proxy material, and reports or share owner meetings are items of a recurring nature. In addition, of course, information in the press, which is sometimes based on news releases furnished by the company, is frequently oriented to share owner interests.

However, there are well-defined problems in communicating with mass audiences via the written word. Studies show that AT&T's mailings receive above-average readership, but none is read by all to whom it is sent. Comprehension is also a problem when the audience is composed of three million people. Recognizing this, AT&T is constantly looking for ways to make written communications more effective.

"One of the things most companies are trying to do now is to pinpoint what their readers really want to know," says W. H. Riggs, assistant secretary of AT&T. "One of the nation's largest manufacturing companies, for example, used to tell its share owners all about its heavy industrial installations. Why not? Those were the big profit-makers for the share owners. But then they surveyed the readers and found out they didn't really want to know about big industrial equipment, after all. But they had a lot of interest in the household appliances the company made.

"In the case of our own report, we used to — and still do — place a lot of stress on our people, and how they contribute to better service. Our thought was that because we are a service organization, that's what our share owners would be interested in. By and large we have been right. We have found, however, that readers today are even more interested in research and the forward-looking, growth aspects of the business. So our publications in the last two or three years have tended to emphasize these points."

Despite all the information that AT&T sends out, there are bound to be lots of questions. This is reflected in the heavy volume of letters and telephone calls that AT&T receives. Each year more than 300,000 letters and telephone calls are handled by AT&T's Treasury Department. Some 165 women bring the personal touch to this avalanche of inquiries which generally fall into certain categories. Some of the high volume matters concern the transfer of stock certificates, questions about dividends (when, how much, why hasn't it arrived) and changes of address. There are special, extra volumes of inquiries prompted by a stock split, the announcement of a dividend increase or a rights offering.

But, as might be expected with a large family of share owners such as AT&T has, the unusual is certain to crop up. A stockholder writes that the family dog has eaten the dividend check, and now what? Another objects to small machine punctures that strike part of his name on the check, and wonders if it can be cashed. Still another writes to explain why she hasn't cashed her dividend check in the past few years: "There's no point in cashing them until I really need the money."

Questions bearing on company policy are answered by the Secretary's Department. Each requires a special letter. These vary from five to ten thousand each year depending on circumstances. In addition, the secretary's office mails out some 16,000 booklets requested by share owners each year, mostly in response to the offer which goes out with the chairman's welcome letter.

With all of AT&T's share owner relations activities — letters, telephone calls, visits, printed materials and the annual meeting — Assistant Secretary Riggs estimates that about 20 million "contacts" are made each year between management and the owners of the business.

These contacts have been broadened considerably over the years, but Mr. Riggs is the first to admit that there is room for improvement.

"Share owner relations is far from an exact science and the future may hold more refinements than the recent past," he observes. "For example, our studies show that the great bulk of our owners feel they are getting about the right amount and type of information they need. But some say we give them too much. And others want more. The day may come, however, when we can isolate each group and tailor separate programs to their specific needs."

Whatever changes are made, one thing will probably remain the same. Share owners will place a particularly high value on direct contacts with the managers of the business, whether it be in the form of a letter, a telephone call, or a personal visit.

"I would expect the growing number of owners of industry to look on their managers with sharp eyes and demanding minds," AT&T Board Chairman H. I. Romnes said recently. It is what they perceive in their contacts with the business that will, in many respects, determine the future of business. □

# THIS MAN IS NOT SMILING

The headline you've just read is informationless. It tells you nothing you haven't already learned from looking at the picture.

If someone tells you your own name, he again transmits no information: you already know it. He doesn't resolve any uncertainty for you.

This idea—that whatever resolves uncertainty is information—was used by Dr. Claude E. Shannon during his years at Bell Telephone Laboratories to define and measure information for the first time in a way that was usable to scientists. Starting from such basic concepts, Shannon built a theory which has many applications to problems in communication and in other fields. In 1948, he published his classic paper, "A Mathematical Theory of Communication."

Before this there was no universal way of measuring the complexities of messages or the capabilities of circuits to transmit them. Shannon gave us a mathematical way of making such measurements in terms of simple yes-or-no choices—conveniently represented by binary digits, which Dr. John W. Tukey of Bell Labs and Princeton University named "bits."

As a result, we now have a benchmark. We know how much information a business machine, for example, can theoretically produce. We have a means for comparing this with the information of a telephone call or a television program. We have tools to help us design for high quality and high efficiency at the lowest possible cost.

Shannon's quantitative measurement of information is not only invaluable to the Bell System but to scientists and engineers the world over. It is exciting much interest among psychologists and workers in other fields in which information handling is so vital.

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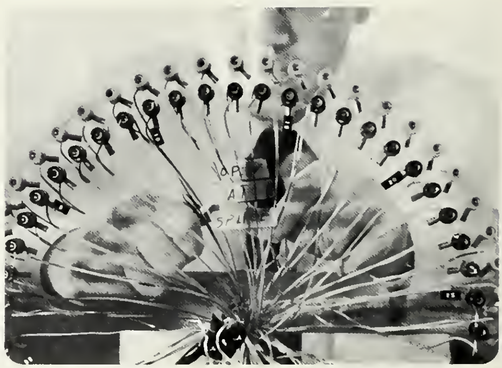

Peering through fanned-out ends of cable conductors is Virgil Johannes, an engineer at Bell Telephone Laboratories' digital transmission laboratory in Holmdel, New Jersey. Mr. Johannes is in charge of testing repeaters for a new, high-speed transmission system that carries voice, data, facsimile and Picturephone signals as a stream of binary digits or "bits." See page 20.

## CONTENTS

Dr. Walter (Wally) Baer is a 29-
Bell Telephone Laboratories ph
who, last September, took tem
leave of the world of science a
business to join the executive b
of the federal government. Alo
17 other gifted and highly moti
young people, Dr. Baer is takin
in an imaginative new program
called the White House Fellow

Designed to give a few outstan
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few into positions where they
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workings of government. Durin
year in Washington, Wally Baer
serving on the staff of Vice Pres
Hubert Humphrey. Other Fello
working as assistants to White
staff members, cabinet secreta
United Nations Ambassador G

The duties of a White House Fe
are challenging and far-ranging
Fellows help coordinate major
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research and suggest alternate
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rewards can be great, particular
the sense of accomplishment th
comes from contributing towar
solution of important national
problems. This is the story of h
White House Fellow views his
year at the top.

# The View from Within

**by Wally Baer**

Time is something you become very conscious of in Washington. There never seems to be enough of it. With so much going on and a crisis seeming to come up every minute, the top people here lead an exceedingly hectic life.

You sometimes wonder how men like Secretary Rusk and Secretary McNamara have been able to keep up the killing pace for seven years. Working with such people, one almost becomes a believer in what Jack Valenti calls the "extra glands" that he has attributed to President Johnson.

But if an outsider finds life in government to be more demanding than expected, it's not the only misconception that is likely to be dispelled once you've spent some time here. Most of the White House Fellows agree their year as a working member of the executive branch is an "eye-opening" experience. That, of course, is one of the primary reasons for the Fellows program. It gives people from the outside a chance to see what really goes on within government. Richard Neustadt of Harvard calls this "sensitizing one's fingertips," and I certainly have to say that there is no comparison between my present understanding of what happens within the federal government and what I knew before I came here.

Most of our conceptions of government, I've con-concluded, are really caricatures. For example, I approached my assignment to the Vice President's staff with some uncertainty as to what the Vice President's role actually was. Perhaps that is the result of hearing too many jokes about what the Vice President does or doesn't do.

What I found, however, is that despite the absence of constitutional or statutory mandates, the Vice President plays an important innovative role — I would say as a gadfly to the bureaucracy. More and more, the problems that government faces go beyond narrow agency or department lines, and it frequently becomes the Vice President's task to bring together various groups on an ad hoc basis to work on specific problems. As chairman of the President's Council on Youth Opportunity — to take a specific example — Vice President Humphrey has the responsibility to see that meaningful programs are carried out throughout the country. To do this, he had to coordinate the efforts of a number of departments and agencies including the manpower training programs of the Labor Department, many of the antipoverty efforts of the Office of Economic Opportunity, and a number of the educational functions of the Department of Health, Education,and Welfare.

To anyone not familiar with the federal bureaucracy, this may sound simple enough. But I assure you, it isn't. Government agencies jealously guard their prerogatives and powers to the point where it sometimes becomes extremely difficult to get action on administration proposals and directives. I'm reminded of something President Truman reportedly said when General Eisenhower was elected. "Poor Ike," he commented. "He's going to sit at that desk and give an order and then six weeks later, wonder why nothing has happened."

To some extent, this is the nature of a bureaucratic system — ponderous, slow moving, set in its ways.

But, you also soon come to realize that federal agencies are under tremendous pressure from all sides. As a result, some are as responsive to the Congress or to a particular outside interest or lobby as they are to the President. I'm reminded of my first course in physics which included an analysis of force diagrams that show how various forces moving in different directions affect a particular object. The forces at work in government are analogous. An agency may be moving in a certain direction, but all the time it's subject to many countervailing forces or pressures. The job of the federal executive is to see that his department is in dynamic rather than static equilibrium.

One of the most difficult tasks in government is to have an agency articulate meaningful goals for itself. Every administration has had to cope with this problem, but the program budgeting system that President Johnson has introduced is an important step forward. Program budgeting is the system employed in the Defense Department by Secretary McNamara and the people he brought in from business. In effect, it's the system analysis approach that many businesses, including the Bell System, have used with great success.

What the Defense Department did was to stop stating objectives in terms of so many wings in the Air Force or so many ships in the Navy and instead look at the purposes for which these forces were intended. One could then talk meaningfully about alternatives toward reaching the objectives.

This type of goal setting is now being brought over into the civilian area. About a year ago, President Johnson put into effect an executive order which requires each federal agency to go through this same kind of exercise to define its mission. Thus far, the idea has run into resistance because many agencies are used to doing what they've always done whether it's relevant or not. There has also been a good deal of resistance from Congress. Some Congressmen, particularly senior members who may be committee or subcommittee chairmen, feel it will disrupt their relationships with agencies that have been established through the years. This may well be; but rearranging government programs along the lines of national objectives is something that has to come, and one can only hope it will come sooner rather than later.

As a member of the Vice President's staff, I've been in a position to see a good deal of the interplay that

*His duties as a White House Fellow keep Wally Baer on the move and may take him from the Vice President's office (top left) to a meeting with Thomas W. Carr, director of the Fellows program (lower left) or to a briefing session on some phase of the space program (far right). Among his duties, Dr. Baer has helped interpret the possibilities of applying technology to public needs such as low-income housing.*

goes into the formulation of national goals. My first assignment, in fact, was working with the newly organized Council on Marine Resources and Engineering Development, chaired by the Vice President and composed of the secretaries of the different departments involved with oceanography. The Council's task was to merge the many separate and rather disparate agency activities into broad national programs. It has, I think, achieved a remarkable record in its first year of operation.

Along with this emphasis on setting meaningful goals, we're also seeing more political agreement on the necessary role of the federal government. For years, we debated how deeply government should get involved in some of the basic national problems such as education, social matters and the like. We now pretty much recognize that the problems are so great that everyone's help — including the federal government's — is needed. The big question is what can the people in Washington do, working with state and local governments, with businesses, and with other segments of the society, to improve the quality of our national programs?

This is one area where business can and must play a bigger role. We hear a lot of talk these days about the social responsibilities of business, but are business leaders really thinking big enough? We are already calling on business to help solve such broad problems as transportation, pollution, and rehabilitation of housing. Soon we may even see private corporations running schools, administering hospitals or otherwise providing public goods and services that traditionally have been left to public enterprise. We have only to look at the space program to see how business and industry can make an outstanding contribution to national objectives. There are many areas where business managerial talent, and particularly the ability to deal with large and very complex systems, would be of fundamental value in seeking solutions to national problems.

The talents of business are being tapped to some extent on advisory councils and task forces. Currently active in advisory capacities are men like Frederick R. Kappel, retired AT&T board chairman, who is heading up the task force looking into Post Office Department re-organization, James B. Fisk and William O. Baker of Bell Labs, who are serving in scientific advisory roles, and Paul A. Gorman of Western Electric, who is on the Defense Industry Advisory Committee.

It is no secret that President Johnson has relied heavily on task forces, made up of the best qualified people both in and out of government, to help shape major programs. Yet I suspect that not enough people outside of the federal government realize this when they are critical of the Administration.

President Johnson's anti-poverty program is a good example of how business is deeply involved. Many major corporations operate Job Corps camps, and more than 30 top corporation executives advise the Office of Economic Opportunity through the Business Leadership Advisory Committee.

Much the same thing is happening in other areas I have dealt with such as the space program, the Marine Sciences Council, and the Council on Youth Opportunity. And as time goes on, I think we'll have even more of this exchange of ideas between government and the business and academic communities. Hopefully, the same approach will be carried over into state and local government. We're seeing some of this in New Jersey, for example, where Governor Hughes has top-level panels advising him on such problems as higher education and air and water pollution. In New York City, too, the business community has become actively involved in the city's youth programs this summer.

Much more is needed, however, particularly at the community level. Since the Vice President is the liaison between the federal and local governments, I've been in contact with a number of mayors. One thing they all talk about is the difficulty of having to deal with so many different agencies on urban problems. I can well understand their frustrations. But it seems to me that many of their problems might be alleviated with the help and advice of business. Certainly, the managerial expertise of business would be a valuable asset in the planning and coordinating of city programs.

Earlier I mentioned that many of my conceptions about the federal government have turned out to be caricatures. This is probably especially true of the people in government. Like most of the other Fellows, I have been impressed by the quality of the top officials in Washington. It seems to me there is at present a conscious effort to get the best qualified people into government regardless of political conviction. However, like any large organization, the caliber of people varies widely. While there have been a number of career government employees promoted to high ranking positions recently, the federal government could do a good deal more within its own ranks to develop people.

One way would be to adopt the business practice of moving young managers or administrators from department to department to increase their understanding of how the organization functions as a whole. The Civil Service Commission is starting to move in this direction, but it is a long haul proposition. Like business, government also has a dearth of talent, and many agencies are reluctant to give up their best people. But to promote this kind of interchange — and you could broaden it to include other levels of government and even industry and universities — would be a very important step that could make an impact on government management.

This interchange of people, of course, is a two-way street. While it would be beneficial to have federal employees broaden their perspective, there is also a real need to have people on the outside who are more knowledgeable about government. The White House Fellows Program is one attempt to accomplish this. The 18 fellowships awarded this year may seem like a very small number; but in 20 years we will have a cadre of three or four hundred people who were exposed to a broad overview of government at an early age. Presumably all or most of them will go back to work in their professions or business. But they will undoubtedly retain an interest in government and a desire to contribute their services again at some later date. Even if they never return to Washington, they will at least be an influence in their own communities and help radiate a more realistic attitude about the processes of government. The same thing, I'm sure, is true of the businessman, the scientist, or the university professor who serves on an advisory group. All will take away a better understanding of what goes on inside government.

My own experience as a White House Fellow has certainly sharpened my perspective, not only about the functions and operations of government but also about the diverse problems that federal officials face. My staff assignments have run the gamut from space and oceanography to youth activities and urban problems. I have perhaps been fortunate because the Vice President's office covers the full range of government interests. But all of the Fellows have had a chance to get involved in a variety of activities.

It is, in fact, one of the stated purposes of the Fellows program that the assignments should broaden our understanding of the process of government but not necessarily entail work experience directly in our chosen field. As examples of this among the current Fellows, we have a lawyer working in the Agriculture Department, a computer systems expert with the Department of Health, Education, and Welfare, a marketing manager on the White House staff, an information systems analyst working for U.N. Ambassador Goldberg, and a management consultant in the Bureau of the Budget. All of this points up the fact that no agency in the executive branch is so narrow that a Fellow's individual abilities can't be utilized. For instance, one Fellow in the Post Office Department did a study on family planning which received wide attention.

*Working with Vice President Humphrey, Dr. Baer has found him to be not only a persuasive speaker but an impressive listener as well, with the ability to cut through to the essential points of a complex technical question.*

Work assignments are the heart of the Fellows' year, but there is also an extensive education program that runs concurrently. It begins with readings before starting the program, an intensive orientation in September, and then twice-weekly seminars throughout the year. At the seminars, we've had an opportunity to carry on informal, off-the-record discussions with cabinet officers, congressional leaders and other prominent people from private and public life. One of the highlights of the year, of course, has been our meetings with the President. In addition, we've made several field trips, one to New York City where we met with Ambassador Goldberg, Mayor Lindsay, and Governor Rockefeller, among others, and a second to Chicago where we had a three-day look at urban problems. Individually, many of us have also had a chance to travel with the officials we are assigned to work for. My most recent such trip was in late June when I accompanied Vice President Humphrey to Korea.

Looking back on the past year, I think something the Vice President once said in describing his job is apropos. He said he has "very little authority but lots of advice." In a way, this is how most of the Fellows have viewed their year in Washington. We may not have had much authority, but we did have an opportunity to come to grips with tremendously important problems and to contribute our own ideas and suggestions.

Because life in the federal government can be an exciting and challenging experience, the temptation to stay on is great. Five of the first group of White House Fellows did remain, although one has since left to join Stanford Research Institute. The others, I suspect, will be back in the private sector before long. Since the program is not in any way intended to recruit people for government, the great majority will always move on to make room for a new group of Fellows.

When we do, I'm sure we'll all take back a much greater sensitivity for government and a realization that things aren't always as simple as they appear on the outside. In particular, I think everyone who goes through the White House Fellows program leaves here with a strong desire to become more personally involved at all levels of government. If there is one thing we've learned here, it is that Washington doesn't have all the answers. ▢


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# Technology's Great Need: Information Retrieval

**By Walter K. MacAdam**

Someone once characterized engineering as the function of transferring bottlenecks from one location to another. Certainly experience tells us that every time we solve one problem we discover a few more staring us in the face. Today's major bottlenecks to progress tend to be man-made. And today, specifically, engineers and scientists are creating one all of their own. They are producing knowledge faster than they can collect and absorb it. In short, we are caught in a serious bottleneck in the transfer of scientific and technical information.

Information transfer problems are not new; they have beset mankind for hundreds of centuries, ever since man began to depend on a merged intellect, a summation of the knowledge of many individual minds. Survival became subject to the ability to communicate verbally and to remember. *Man's first knowledge limitation became one of language.*

About 6,000 years ago someone — probably an early engineer — moved that bottleneck by developing the art of inscribing information on a tablet. Language became written. The collective information available to mankind increased — but its growth rate was slow. For several thousand years, knowledge in terms of recorded pages doubled only once in every thousand years. Its spread among men was limited by availability of writing materials and the ability to use them. *Man became literacy limited.*

In the 17th century, another engineer invented the printing press — and with it, another bottleneck. Suddenly, the growth rate of human knowledge speeded up. As measured by printed pages, it began to double about every hundred years. Soon, *man became literature limited.* The mass of information grew, carrying with it the constantly accumulating heritage of past discoveries of men no longer in this world. The information growth rate quickened until, during the last quarter century, knowledge has doubled every 20 years. By the year 2000 it will be doubling every ten years or less.

Let's look at some specifics in this technical paper explosion. In 1966, 18 leading engineering societies in the United States spent $14 million in publishing technical literature. Even after a 40 percent cut by teams of reviewers, these societies published a combined total of more than 177,000 pages. This compares with only about 25,000 in 1946.

In the field of electrical science and engineering, the largest engineering society is the Institute of Electrical and Electronics Engineers, with a worldwide membership of 160,000. The IEEE publishes about 10 percent of the world's primary technical literature in the electrical field. Twenty years ago its predecessor societies published 3,000 pages in three journals. Today, this has increased by a factor of 10, with the publication of 30,000 pages in 42 separate journals.

The ten-to-one growth ratio is of particular concern when one considers that the reading abilities of engineers and scientists have not increased, but competition from other sources for their time *has* increased. While the Institute has introduced some selectivity by producing specialized journals in more

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*Mr. MacAdam, vice president, government communications for AT&T, is serving as president of the Institute of Electrical and Electronics Engineers.*

than 30 different fields, it still ships hundreds of thousands of journal copies throughout the world with the realization that members will find only a small fraction of the articles within their particular field of interest. We have reached the point where some laboratory management people are beginning to believe it is cheaper and quicker to reinvent something than to search the ocean of literature to find what has been discovered — even in the same laboratory!

Now, knowledge is no longer limited by the production of literature, but rather by the ability to locate and absorb what has been produced. We have moved the bottleneck again, and are now *information retrieval limited.* For the first time, also, a limitation is being imposed by man's physical and mental characteristics rather than by the techniques used to move and store information. In fact, we should consider ourselves fortunate that our previous bottlenecks have formed in the transfer system, which we could readily improve, rather than in the capacity of the human mind and its ability to understand, which remains relatively fixed. From now on, however, we will have to be more clever than lucky.

## The key: storage and retrieval

The increasing rate at which technical papers are being produced is compounding the inefficiency and dilution of resources to the point where a worldwide attack on the problem is mandatory. It is not only a matter of retrieving information; it is a matter of the individual engineer's ability to support financially a massive and growing system, distributing publications in bulk, which are read on a highly selective basis. What is needed is a more effective and flexible information storage and retrieval system, compatible for worldwide operation, and geared to man's limited information absorption rate.

This is why so many technical societies and governments around the world are feverishly working these days on information handling systems. In general, such systems are based on first producing a brief abstract of a technical article, then selecting a series of key words which appropriately classify the particular topics and application involved. This condensed information is next placed in a storage system — often these days in a computer — for rapid retrieval by individuals interested in a particular subject.

In the United States the engineering societies have developed and operated an indexing and abstracting service for many years. This is administered by an organization known as Engineering Index, which produces digests of articles appearing in a wide range of engineering and scientific journals throughout the world. Comprehensive abstracting service has also been provided by the Institute of Electrical Engineers in the United Kingdom and by a service in the Soviet Union known as VINITI. This covers publications in the USSR, which produces a large share of the world's technical literature, and also produces abstracts in Russian of articles appearing in other countries. None of these systems, however, seem to meet the growing needs in the electrical and electronics area.

One approach to designing better information handling systems is the work initiated in 1966 by Engineering Index, Engineers Joint Council and United Engineering Trustees in forming a "Tripartite Committee" to develop a plan for an up-to-date and comprehensive system. The IEEE and other engineering societies are cooperating with this effort. Also, the National Academy of Sciences and National Academy of Engineering have appointed a joint committee, funded by the National Science Foundation, to study information systems concerned with science and engineering. Hopefully, this will be a clearing house and a means for avoiding wasteful duplication.

Increased emphasis is also being placed on having authors or editors produce and publish abstracts and index data when an article first appears in print. The Engineers Joint Council has made specific recommendations and has issued suggested procedures for this so-called source abstracting and indexing, using a standard set of terms contained in a special dictionary or thesaurus. This will eliminate long delays in subsequent abstracting and indexing by reference publications or information repositories.

## Computers will help

Existing manual systems are also being converted to computerized storage and retrieval facilities. However, great care must be taken to avoid losing data within the storage system as a result of defects in the indexing and retrieval codes. Likewise, the computerized arrangements must not deliver a shower of unwanted material as a result of too broad characterization of the inquiring terminology.

The IEEE, recognizing how critical the situation has become, has taken several steps to organize a concentrated program for selective information indexing, storage and retrieval suitable for computer application. This includes organizing a working group composed of experts in the field and adding to the headquarters staff an outstanding specialist, previously head of the electrical engineering department in one of this country's major universities. In addition, the IEEE is cooperating with other societies in a joint study to explore interdisciplinary problems.

The Institute is also undertaking another experiment. For the first time it is producing abstracts of articles which have not been published. One of its technical divisions, the Computer Group, which publishes one of the specialized journals, has started a separate bimonthly publication titled "Computer News." Each issue includes, among other items, abstracts of recently received papers on computers, which papers have been stored in a central repository. Copies are available at a moderate charge to any member who, having read the abstracts, concludes that they will be useful. At the same time, a group of reviewers studies and selects papers of sufficient general interest to warrant subsequent publication in "Computer Transactions." This tends to reserve for that magazine's wider circulation those papers which are of interest to a larger audience. The primary purpose of the experiment at present is to assess the effectiveness of the new service. The central repository may be a useful storage medium for papers which are too long or too specialized to warrant general circulation.

While we have only scratched the surface of a large and complex problem, these developments may indicate future modification of the role of a technical society in both its publications and its conferences. The exact shape of these changes is not clear, but there are several possibilities. The increasing need for selectivity among myriad specialized subjects may bring about the day when membership in an engineering or scientific institute will include the privilege of receiving two specific types of publications. The first might consist of one or more journals containing articles selected for their general interest. The second might contain indexed digests of specialized articles available for prompt retrieval from a central information repository.

It is conceivable also that the technical library, as we know it, will assume a role of diminishing importance. It is manifestly wasteful to store the same rapidly growing mass of information in thousands of different locations to meet scattered needs. On the other hand, one could easily forecast emergence of technical information access centers containing only current reference texts and broad coverage periodicals, but having access to centralized information repositories via facsimile communications channels.

If these trends materialize, the improvement in technical communication will be felt worldwide, in view of the universality of all new technology. Cooperative planning must be undertaken by all engineering societies, national and non-national. Members should be encouraged to contribute progressive ideas to a worldwide exchange of views. For this is the only path that can lead us to a solution of our common problem — the means to cope, within our human limitations, with the world's growing body of scientific information. □

# Looking Into Learning

Freely mixing practical and "pure" research approaches, behavioral scientists at Bell Telephone Laboratories are doing some highly individualistic prospecting into a barely mapped part of man's nature . . . "the learning process."

Dr. Ernest Z. Rothkopf, a behavioral psychologist specializing in studies of the human learning process at Bell Telephone Laboratories, is a very skeptical man. He doubts, for example, that educators and businessmen *really* know how to teach, primarily because they do not yet have what he calls a sufficient "technology of instruction."

"Despite the millions of dollars that are spent annually on education and training, we honestly don't know yet how people learn, what is the best way of presenting material, and how to evaluate how well the material is comprehended," Dr. Rothkopf emphasizes.

Trying to find the answers to some of these questions — and many others like them — is one of the aims of Bell Labs' behavioral research laboratory in Murray Hill, N. J. There, on behalf of Bell telephone companies, scientists are exploring the learning process in an effort to improve educational and training programs throughout the Bell System. With more than 800,000 employees and a constantly changing communications technology, even a small improvement in the quality of its training programs can provide the Bell System substantial savings.

"What we are trying to do," Dr. Rothkopf says, "is to find out more about methemagenic behavior, that is, behavior that gives birth to learning. This behavior has a shape that can be charted, and a persistence in time that can be measured.

"To find out scientifically the factors that affect the shape and duration of the learning activity requires isolating and studying one variable at a time, subjecting every tentative hypothesis to statistical verification. Though this may seem like moving a mountain with a teaspoon, there are a lot of people with teaspoons attacking this mountain."

The work of Bell Labs' behavioral research laboratory is divided into three broad fields with a number of facets to each field:

- A "Sensory and Perceptual Processes" group, whose studies include short-term and primary visual mechanisms; computer studies of depth perception; and the physiology of depth perception.
- A "Learning Processes and Measurement" group, which includes a sociologist working on information retrieval, plus psychologists specializing in subjects ranging from visual distortion to psycholinguistics.
- A "Human Information Processing" group that includes the Rothkopf studies in written materials, an experiment in new forms of self-administered instruction, a statistical analysis of speech quality, and an

effort to plot the mental processes involved in retrieving material from memory.

"What we get from this," Dr. Rothkopf observes, "are pipelines to findings in many fields. Besides his own studies conducted here, each psychologist keeps up-to-date in his speciality and is alert to apply what is discovered elsewhere. In this way the Bell System can apply what may be pertinent to its needs, and at the same time support work that contributes to the general body of knowledge which others—educators, for example—can also use."

## Questions dictate reading strategy

One current series of Dr. Rothkopf's experiments of special interest to educators and training directors zeros in on the role of questions in producing "mathemagenic behavior." Tests he has conducted over several years have convinced him that the nature and timing of test questions play a key role in learning.

"According to the experiments we have made so far, people adjust their reading according to what they have previously been tested for. But they must experience an actual test. Merely telling them they will be tested does not have much effect. Questions are the main form of dialogue between teachers and students. If we understand how to use questions we can devise a system for helping people through difficult material."

In addition to the experiments on the role questions play in learning from texts, Dr. Rothkopf also is conducting studies on the effect of repeated readings on both comprehension and ability to spot new materials added to paragraphs. "The long-range aim," he says, "is to write more effective educational and training texts."

Projecting ahead, Dr. Rothkopf foresees one application of a "behavioral technology of learning" in the creation of a new kind of job: an "instructional editor" who will be trained in the learning-from-texts principles uncovered by the behavioral scientists. The

*Among the studies of the learning process underway at Bell Labs is the experiment Dr. Ernest K. Rothkopf is conducting to determine the relation between mental effort and dilation of the eye.*

instructional editor will know the ideal places to present key information, the best length of paragraphs and sections for retaining attention, the best order for presenting concepts, how often to repeat facts and ideas, when and how to include tests, even perhaps the words most easily assimilated.

As Dr. Rothkopf describes him, the instructional editor, trained in psychology and statistics, will fill the gap between the author who tends to write from his experience rather than to a student's learning needs, and the conventional editor who is concerned with format, grammar and style.

"Most important," Dr. Rothkopf says, "the instructional editor would be responsible, and have the requisite skills, for evaluating the effectiveness of the texts he prepared. But," he adds, "before we can have the services of such a fellow, we must first discover the principles we intend to teach him."

The behavioral research at Bell Labs that may contribute to the skills of tomorrow's instructional editors include studies in such learning-related facets as man's attention span, memory retrieval, and language manipulations, including the computer-aided studies of Dr. Sheila Pfafflin in paragraph structuring and learning with the aid of mnemonic devices.

The study of paragraph structure is, according to Dr. Pfafflin, a relatively new area of study. "Much work has been done on smaller units of language, phrases and sentences. But if we are ever to write with predictable effectiveness, more will have to be understood about what we call 'connected text.' "

To dig into the way people understand paragraphing — even if intuitively — participants in one of Mrs. Pfafflin's experiments are confronted with "disassembled paragraphs" — lists of sentences that were parts of paragraphs — and asked to judge which were first and second sentences in their original context.

The findings indicate that some sentences contain clues that help reveal their location in a paragraph. While first sentences of first paragraphs are more easily recognized than first sentences of last paragraphs, the majority of the consistently identified cues to paragraph structure occur in second sentences, which tend to contain "linking structures" with antecedents in a prior sentence.

## The influence of structure

In a related effort Mrs. Pfafflin gives participants a set of sentences in random order and simply requests that the original paragraphs be assembled. "This gives curious results," Mrs. Pfafflin notes, "which we're trying to evaluate. Words in common in a number of sentences don't explain the way participants organize them, as we thought it might. Pronoun references may explain order better, but we're getting the feeling that something deeper in the structure of language may key people's way of organizing material.

"To follow this lead, we're devising new experiments where we replace 'content' — nouns, verbs, adverbs and adjectives — with 'paralogs,' made-up words that roughly correspond to the originals in form, but without recognizable meaning. Out of what's left, the 'structure' part of language — such as prepositions, conjunctions, and pronouns—we'll get insight into the role structure plays in building up a meaningful text."

Stressing that these explorations are new and may take many unforeseen turns, Mrs. Pfafflin feels one possible benefit could be more compact texts than most of those in use today. If we knew what really carried the meaning burden in written material, we could write more efficiently.

In addition to studying paragraph structure and the role of questions in the learning process, behavioral scientists at Bell Labs are addressing themselves to problems of languages. "In a way, studying how people learn, process and experience language is like a fish trying to study water," says Lee McMahon, of the learning processes and measurement department.

"To determine what features of language people remember," Dr. McMahon says, "one psycholinguist here, Mrs. Jacqueline Sachs, reads test participants stories and then asks whether a test sentence occurred in the story. She's found that only the general meaning tends to be recalled, not actual word orders or other features ordinarily thought of as necessary conveyors of information. In fact, only the last sentence of the story is likely to be remembered verbatim.

"If the actual language need not be remembered exactly for the information to be conveyed, as Mrs. Sachs has found, then where is this information, and in what form? How do people extract — or, maybe, impose — information from or on sentences?"

By parcelling out carefully delimited statements to test subjects, Dr. McMahon has obtained data suggesting that most incoming words and sentences trigger memory stores, rather than carrying their own meaning. A simple example is the statement, "There will be snow tomorrow." Literally, this could mean many things, from "The snow which is here today will remain tomorrow," to "Somewhere in the world there will be snow tomorrow," etc. Yet, the hearer has no trouble instantly adding all the necessary information — such as the concept of "falling," which isn't actually mentioned — to complete the communication intended by the original speaker.

"An experiment currently under way is providing a more precise description of this phenomenon, and yielding other data, too," says Dr. McMahon. "While we're not ready to publish final results, we are beginning to determine through reaction-time tests, which of several grammatical structures are most easily understood, and even which among a group of synonyms are picked up fastest by the test subjects."

## Probing "the retrieval aspect" of memory

Psychologist Saul Sternberg concentrates on another aspect, "the retrieval process — a big unknown in most theories of memory. In any given case," Dr. Sternberg asks, "how can we say whether something is forgotten or merely unretrievable at the moment, unless we understand about this process?"

Citing studies dating back into the 19th century, Dr. Sternberg shows that "the most popular line of inquiry has always concerned retention and forgetting, without explicitly dealing with the obvious fact that without retrieval there can be no evidence about retention." To isolate this process, he asks test participants to remember a list of from one to six digits. Then he or she is asked whether a particular "test digit" is one of those in the list. Reaction time required to answer is measured to the nearest millisecond, and the times for the various list lengths are plotted on a graph.

Among the findings to date is one that Dr. Sternberg describes — in one of the articles he has written for scholarly journals in his field — as "remarkable." This is the mind's automatic scanning of the entire list regardless of whether or not it contains the test digit, or of where in the list the test digit appeared. If, for example, the memorized sequence is 312654 and the test digit is "2," it takes the average subject the same time to push the "yes" button as it does if the test digit is "5." In other words the mind scans "312654" then says, in effect, "Yes, 2 is here."

In explaining this phenomenon, which would at first glance seem "inefficient," Dr. Sternberg emphasizes the extreme high speed at which the scanning is done: 30 characters per second, on the average, or about four times as fast as man can "talk to himself." "This speed factor," says Dr. Sternberg, "may prove the process 'efficient' after all, because it probably is more 'economical,' i.e., faster, to scan the whole list, and then decide whether the test digit appeared, than to stop for a decision at each digit, saying as it were, '3 is not 2, 1 is not 2 — ah, 2 is 2!'

"When we ask a subject to name the item that follows a test digit in a memorized list, and thereby require him to locate the test digit rather than merely to determine whether it is present, the rate of 'data processing' comes down from 30 to about four characters per second — closer to the speed at which we can 'talk' inwardly." Another study — in which a list of digits is flashed on for a fraction of a second, and leaves the subject with a brief visual afterimage to answer questions from — shows that the scanning process in this instance is self-terminating. In other words, the "scanner" flicks off when it hits the digit that's asked for.

Armed with evidence that the retrieval process varies with the kind of information being retrieved, Dr. Sternberg is now embarked on new studies on character recognition. "Consider," he says, "how many forms of the letter 'A' we can recognize, written by many hands, printed in dozens of type faces. What happens in the mind to permit this? What effect does distortion have on retrieval time? How much processing occurs before the image is compared with memory? Answers to questions like these may have implications for transmission systems, training and education methods—even perhaps the way telephone books are arranged."

Another set of studies focuses on auditory perception. Dr. Anne Treisman, who with her scientist-hus-

*Behavioral scientists at Bell Labs looking into the learning process include, left to right, Lee McMahon, Saul Sternberg, Ernest Rothkopf, Sheila Pfafflin, Anne Treisman and Wayne Gustafson.*

band is spending a year at Bell Labs as visiting researchers from England's Oxford University, currently is charting "the limits of people's ability to attend to a variety of auditory stimuli received simultaneously."

An attractive brunette whom, as one of her co-workers puts it, "no one would take for a scientist — until they hear her on her subject," Dr. Treisman has published a number of monographs on the qualities of human attention. At present, she is probing into what has been called the cocktail party effect. "If we analyze what the ear hears in a roomful of conversing people, it becomes astonishing how the brain can, more or less at will, eavesdrop on a particular conversation while 'monitoring' other channels for specially relevant information, such as one's own name," Mrs. Treisman says.

By piping two different kinds of data into a set of earphones and asking people to listen to one, both or "mostly one but also certain kinds of material in the other," Mrs. Treisman has begun forming a working description of what are the limits of attention. A key finding so far is that all input information can usefully be divided into the "form" (loudness or softness, male or female voice) and "content" (particular words and concepts). "If the earphone the subject is told to listen to is carrying a connected discourse, about all he can hear of the other response is some general sense of the 'form' of it. The 'content' is so supressed that even when tapes are played backward or switched to German, subjects do not notice. However," Mrs. Treisman notes, "if we tell subjects to listen for a specific signal — to say, tap when the word 'tap' appears in either channel — their ability to 'monitor' and perform this task is much greater."

Dr. Treisman feels that a more precise understanding of the operation and capacity of human attention is relevant for educators as well as businessmen who must know what can be demanded of people in order to plan new jobs. Beyond that, however, she is reluctant to speculate more precisely about how her data may be applied.

## Does "new" mean better?"

Like most researchers, the behavioral scientists at Bell Labs are disinclined to speculate about the specific applications of their work. Dr. Rothkopf puts the problem in perspective when he says, "Society must educate increasing numbers of people. And since education is a life-long process, industry must carry its burden through training programs and at the same time, assist in the field of general education. For everyone to benefit, we must get at the fundamentals of the learning process.

"So much formal training and education is going on, so much money is being spent, and yet we know so little about our effectiveness. Until we can be more precise in measuring today's systems of imparting information, how will we be able to evaluate the relative usefulness of new techniques?" Dr. Rothkopf asks. "We must strive for a real technology of learning, measurable and predictable. So much depends on it in this time of increasing demands." □

# BELL FORUM: Statements of policy and opinion

*Editor's Note: "Communications Technology in a Changing Society" was the subject of a recent conference at the Bell Telephone Laboratories at Murray Hill, New Jersey. Prominent educators in the humanities and social sciences from 38 colleges and universities attended the program, which focused on the impact of the telecommunications industry on society. Among the speakers was Ben S. Gilmer, president of AT&T, who discussed "Business Responsibility in a Changing Society." A condensed version of his text follows:*

Just what is the social responsibility of business? Does it extend beyond the production of goods and services at a profit? And if so, how far?

In themselves, these questions would have been deemed specious a few decades ago. Then it was accepted with reasonable certainty that the responsibility of business was solely to produce products or services for the customer at a profit.

How has this changed, if at all?

I believe it is realistic and candid to say that industry still operates primarily to provide goods and services at a profit. Every other job a corporation can take on depends on this. Of course, it is often said, too, that the corporation, by nature, originates with public permission and exists by public approval. But its survival also depends on its profitability.

It is still the chance of reward that motivates people to invest their money in any undertaking. People who invest in our business expect a profit that is sufficient to encourage them to commit their savings.

This principle, as I said, is basic. But what does seem to be changing is the concept of the corporate role. I would term it a broadening of objectives. As important as profits are, they are not an end in themselves — they are a *means* to an end. The end is a better society with opportunity for all to share in the abundance our industries produce.

As you know, the corporate device originally was used to relieve the developing nations of Europe of some of their burdens. The East India and the Hudson's Bay and the London companies were well known examples.

In this country, the idea of the social function of the corporation has persisted from early days. The Virginia Supreme Court said in 1809 that corporations should not be chartered except "in consideration of services to be rendered to the public."

**A revived obligation**

So when we talk of the broad responsibility of corporations we are reviving an old idea that was temporarily eclipsed in the era of trusts and tycoons.

Evidence now indicates that we are edging back to the earlier view in which corporations are expected to assume a broader role in society. Beyond magazine articles and speeches, we hear a clear invitation from government for corporations to enter the social sector. President Johnson said in the Economic Report last year:

"Only through a creative and cooperative partnership of all private interests and all levels of government — a creative Federalism — can our economic and social objectives be attained." Just a few weeks ago, the President went a step further. He appointed a committee to determine how the resources of private business and labor can be mobilized for a broad assault on city slums.

Clearly a pattern is emerging. The government apparently would welcome business help. Many public groups are asking for business help, and some business leaders have indicated a willingness to become involved. The problem is how to go about it.

I'm sure that many of the commitments to greater involvement on the part of businessmen today are motivated by what is known as the "enlightened self-interest" theory. I might give you just one example from my own business of how enlightened self interest can motivate action in social problems. I would estimate that our present plant investment in large cities and metropolitan areas is 70 per cent of our total plant investment.

Obviously it is in the good interests of the company if the deterioration of the central cities can be halted, if practical urban renewal projects can be undertaken, and if the average American family can once more feel that cities are pleasant places in which to live. So it is not remarkable that many telephone company people have involved themselves in urban rehabilitation. Call it practical business judgment, or if you prefer, enlightened self-interest.

At the risk of oversimplifying, I believe it is useful to think of the corporation's responsibilities to society as having three different origins.

First, there are responsibilities that are imposed, such as hours of work and minimum standards of compensation, health standards, working conditions.

Second, there are responsibilities that the corporation *creates* through its application of new technology.

And third, there are responsibilities that the corporation *adopts* or assumes upon itself.

I shall not dwell on the imposed responsibility. There is little option here — Government sets the standards after all voices have been heard, and industry complies. We have lived with government regulation for many years and accept it without reservation.

However, I *would* like to say a few words about the created and adopted social responsibilities. In those areas there is considerable option available to industry.

First, the created social responsibilities: the conversion of the telephone system from manual operation to dial is a good example. Bell telephone service is now 99 per cent dial. In 1920 it was 99 per cent manual.

The conversion to dial was set up on a gradual schedule. Operators were offered jobs in other departments or in other locations. We took advantage of the high turnover among women employees. When operators left to start families, we didn't replace them. Thus the dislocation of people was minimized.

Technology is said to be neutral. But it is people who apply new methods and experience the consequences. And it is they who must be considered when change is introduced.

My belief here is that in considering created social responsibilities, corporations are more and more aware that new technology changes society, and sometimes leads to profound consequences. Circumstances demand that careful consideration be given to the social implications of each change. It is no longer enough, if it ever was, to introduce new technologies and let things fall where they may.

It is in the area of adopted or assumed responsibilities that business is offered the broadest opportunity to make important contributions that can correct social ills.

**Bell System actions**

I'd like to take a quick and candid look at what the Bell System is presently doing about its adopted social responsibilities. Let me say, most earnestly, that we have a long way to go. But I do believe that more than lip service is being given.

Cutting down air pollution is an adopted responsibility that we take seriously. Within the last three years we have halted the use of incinerators in 181 buildings, and are moving to deactivate more. Nine out of ten of our heating plants are now fired by gas and light oil, not heavy oil. We are working to increase this proportion. The Bell System's fleet of 113,000 motor vehicles could add seriously to air pollution. We have made it a matter of company policy that all cars and trucks added to the fleet have exhaust-control equipment whenever the manufacturer has it available.

As for providing minority groups with enlarged opportunities, cooperation with the Plans for Progress and such organizations as the Urban League has enabled us to increase substantially the number of Negro employees in Bell telephone companies. In the last three years the number has grown from 29,000 to 51,000, a 75 per cent increase, compared to a 13 per cent overall increase in employment. A number of programs have been initiated by the Bell companies that provide aid, education and training to the disadvantaged, particularly high school dropouts. We estimate that during this summer we'll provide work for about 8,500 young men and women, or about one for every 100 current Bell System employees.

Beautifying the environment can be costly. But in the interest of more attractive residential neighborhoods, we have determined that where terrain permits we are going to put all telephone cables underground. Of new homes built last year, 600,000 or about 60 per cent of new residential construction, could be served with buried cable, and that percentage is going to go up substantially this year and next.

Finally, as for support of higher education, this is a social responsibility that has already been accepted by almost all large corporations. In 1966, financial support of education by corporations totaled $288,000,000. The total for the Bell System, mainly grants to private institutions, was about $3,000,000.

The desire to enlarge its involvement in social problems is, I believe, a prevailing feeling in industry today. But I believe it is realistic to acknowledge that anything we accomplish in the area has its roots in our nation's productive capacity.

I'm sure business is going to find its role in solving socio-economic problems and fill it as vigorously as it has in producing goods and services. Business has some unique qualifications. Particularly, it is structured to understand and meet the needs of people at the local level.

In conclusion, let me raise one more question: Is this relatively new willingness to get involved in the social area a legitimate pursuit for business?

I believe so, it puts us in league with the future, and I accept Ibsen's thought when he wrote, "I hold that man is right who is most closely in league with the future." ☐

For handling the fast-growing variety
and volume of communications today and tomorrow,
techniques such as pulse code modulation
encode various kinds of electronic signals
into streams of binary digit "bits" which,
in the next decade, will carry thousands of phone calls,
several TV programs and computer data
all on the same channel.

# The Code's the Thing

If anyone examines even briefly the history of human communication, he will find running through it a common — and basically simple — thread. From the howls and grunts of cavemen to today's television via satellite, communication has consisted of the *coding* of intelligence. This process has taken many forms — aural, visual, and electrical — but its essential feature is the reduction of information to arbitrary symbols.

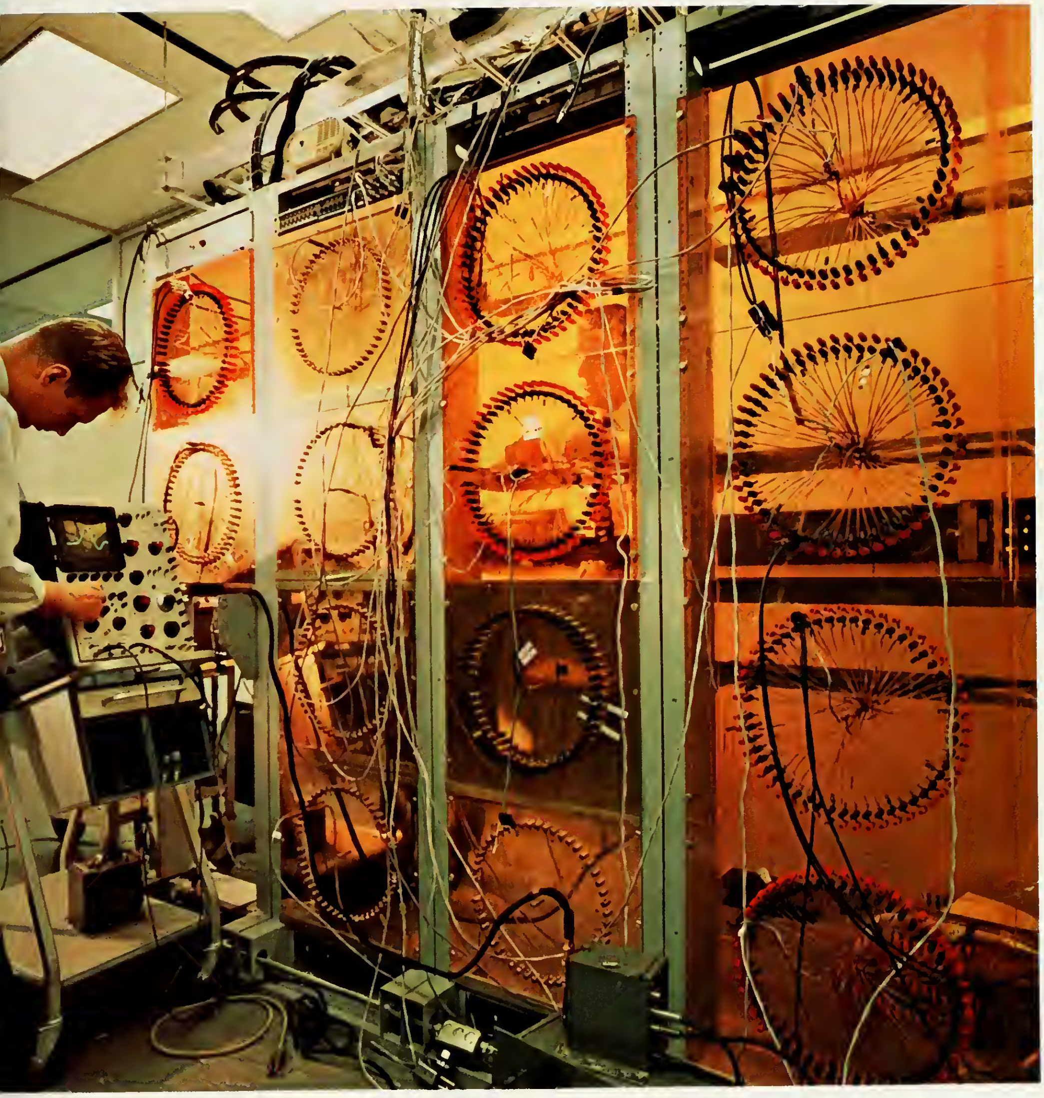
No one today knows what the cavemen's spoken language sounded like, but certainly it covered the basic needs of a primitive face-to-face information system. Then came more permanent means of coding and transmitting information: written symbols — the hieroglyphics of ancient Egypt, the stylized pictograms of Chinese, the Roman alphabet you are now reading — supplemented spoken words and extended communication from its individual, man-to-man limitations.

Indeed, for centuries men have been preoccupied with the problems of communicating over the increasing miles that separated them. Greek relay runners, smoke signals, jungle drums, the printing press — all helped, but it was electricity that gave man his seven-league boots and enabled him to communicate instantly across a continent or an ocean.

The telegraph harnessed this new power, but worked on a principle as ancient as civilization: the coding of information in its most simplified form, on-off pulses that produced audible clicks. Essentially the same principle is used in present day digital computers to process and record information as ones or zeros, which can also be described as yes-no, is-isn't, or present-absent.

"Basically," says Dan F. Hoth, director of Bell Telephone Laboratories' transmission facilities planning center at Holmdel, N. J., "the same method of coding is being used today in the Bell System's new digital transmission systems which represent various

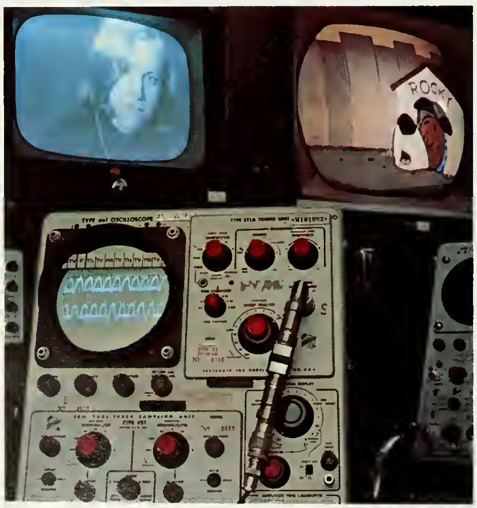
*Richard Kerdock runs tests on repeaters for new T2 digital transmission system. Fanned-out cables facilitate measurement of simulated transmission flaws, such as cross-talk.*



kinds of electronic signals — voice, television, facsimile, computer data — as a stream of binary digits, or bits. Since the stream consists simply of on-off pulses, ones or zeros, all signals look and behave exactly alike once they are converted into bits — reduced, in the electronic sense, to the least common denominator."

A "bit" has been described as the amount of information needed to remove the uncertainty between yes or no. While this description refers to an electronic yes or no — the presence or absence of a pulse — it is an instinctive and natural course for modern technology to take. The encoding of information into yes-no, on-off pulses grows from insight into the fundamental process of human reasoning. Things, at least in the logic of the Western world, cannot both be and not be. Aristotle proclaimed that a thing can only be itself, never its opposite. And the Bible, (the Book of Matthew) says, "But let your communication be Yea, yea; Nay, nay: for whatsoever is more than these cometh of evil"—a Biblical command, if you will, to use the binary code!

Decisions never spring from *maybe,* for a decision, by definition, must be yes or no. Everyone constantly makes yes-no decisions to choose alternatives or guide actions. The housewife: Shall I lock the door or leave it open? Shall I put the cat out or leave her in? The executive: Shall we risk going for more debt capital or not? Shall we launch the new product now or not?



*The shape of things to come: the oscilloscope shows the actual pulses in a stream, operating at 224 million bits per second, and carrying two television programs at once.*

In any case, the yes or no answer precipitates specific action, either positive or negative . . . something to be done or not done. The chaining together of such simple yes-no answers as on-off electronic pulses in a stream makes it possible to transmit the wide variety of information by which men today communicate. One means for translating such signals into binary digits — ones or zeros — is called pulse code modulation, which is becoming increasingly important in the Bell System.

"Flexibility and economy are key words in digital transmission," says Mr. Hoth. "For years we have been working on ways to make better use of our transmission facilities. In large metropolitan areas, there is a limit to how many ducts and cables you can put under city streets."

First introduced in the Bell System about five years ago, digital transmission has provided one answer to the problem of economically handling the growing volume of communications. Systems now in use can carry 24 simultaneous two-way conversations on two pairs of wires in a cable and have proved to be highly efficient, especially in the nation's large cities.

While this use of a binary digit pulse stream to transmit the human voice is helping to meet an immediate need, it is not an end in itself. It is now what might be called the progenitor of a hierarchy of digital systems, each progressively higher in capacity. Higher capacity comes through higher speed of the pulse stream — that is, the more pulses, or bits, per second, the more information the stream can carry. The high-speed systems also operate over longer distances, just as high-speed roadways are designed to carry cross-country traffic. Now under development at Bell Laboratories are systems operating at nearly 300 million bits per second, which one day may carry thousands of phone calls, several TV programs and high-speed computer data all on the same channel, across the continent.

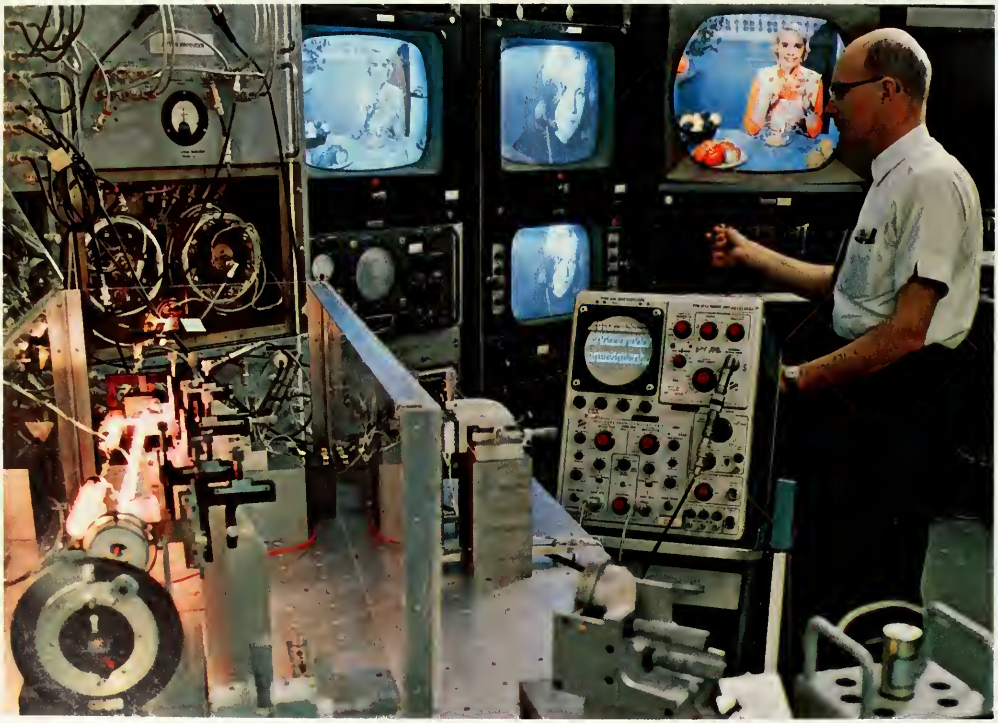
"We have to see the end of the road before we start at the beginning," says Mr. Hoth. "We look ahead to a complete, nationwide network built on digital transmission. We're looking ahead more than ten years, but we know we're going to need it."

Indeed, the need is evident. In one area of Bell System development alone — Picturephone service — high capacity transmission systems will become of primary importance. There is now no practical way to transmit any volume of Picturephone calls over long distances with the high quality the service must have to be commercially successful. High capacity, low distortion digital systems may be the only means of putting Picturephone service on a working basis. Also, the business and educational uses of high speed data processing equipment are multiplying so rapidly that the volume of messages generated by machines "talking" to machines may soon exceed the number of voice conversations between people.

Communications engineers, faced with the shape of things to come, consider that high speed digital transmission systems, with their capacity for carrying many different signals at once, will provide the most efficient, the most economical and the highest quality means of meeting these new needs looming on the horizon.

"Because all kinds of signals — voice, TV, data — become alike once they're converted into streams of electronic pulses, we can interleave pulses from different sources and send several different kinds of signals over the same channel. We can monitor the quality of transmission, regenerate the pulses every mile or so and then convert them from pulse form back to their original form at the destination," says

*At Bell Laboratories' digital transmission laboratory in Holmdel, Francis Rusin watches a transmission system of the future take form. Predecessor of the one-day T4, this experimental system transmits 3,456 voice channels or two TV programs at once via the laser beam in left foreground, and operates at 224 million pulses per second.*



Richard A. Kelley, who is director of the digital transmission laboratory in Holmdel.

"Imagine that you're the postmaster in a local post office, confronted with the Christmas avalanche of packages. They're all sizes, shapes and weights. Imagine, too, that you have a machine which can break down all packages into small units of the same size and weight, give them identifying numbers, then shoot them out through a tube to a distant post office. There another machine sorts them out, restores them to their original shapes and sizes, and gives them to the parcel post carrier.

"Obviously, you can't actually do that with packages. But essentially that is what pulse code modulation does with electronic signals. Digital transmission not only allows us to fit signals from many different sources on the same channel but it also eliminates interference between signals carrying different kinds of information," adds Mr. Kelley.

The technique can also be valuable for other reasons. For example, the pulse stream can be scrambled, and there is absolutely no way to unscramble it except with a planned decoding system. Since encoding and decoding in pulses can be done only at the origin and destination, anyone who tapped the pulse stream along the route would get nothing but a meaningless jumble that would be impossible to sort out.

Research in the PCM technique at Bell Laboratories dates back to the 1940's, when experimental systems using vacuum tubes were built. It soon became quite clear, however, that these had serious limitations. It was the advent of solid state devices, specifically the transistor, that was the key to practical application of digital transmission in the telephone network. Just as "third generation" computers depend on such solid state devices as transistors and integrated circuits, so do high-speed digital transmission systems.

"One of the problems inherent in developing a transmission system is that what is introduced today must be compatible with what was introduced yesterday, and what will come along tomorrow," Mr. Kelley says. "Consequently, experimental work must be directed toward designing compatible modular system 'blocks,' which will work with existing equipment and with future transmission techniques such as wave guides and laser beams. We *must* always plan for complete flexibility of interconnection, and this is one of the most attractive features of digital systems. Another feature is the use of equipment common to more than one channel. For instance, equipment that does the coding into pulses can be time-shared, moving about among many channels as does a chess master, moving about among many tables, playing many games in sequence."

By year's end, the Bell System will have about 350,000 voice channels of the so-called T1 design that can transmit about 1.5 million pulses per second. Within the next few years, the T2 system with a capacity of 6.3 million pulses per second will be made by the Western Electric Company and introduced in Bell System telephone companies throughout the country.

Further ahead in the future is the top of the hierarchy, called the T4. When it emerges from the laboratory into commercial use, it will operate at a speed of 282 million pulses per second, and will transmit 4,032 voice channels or three television pictures at once, or combinations of Picturephone, data and other signals.

"The capacity and speed may not seem to mean much in this day of big numbers, but it is extremely important for its potential," states Mr. Hoth. "High speeds and huge capacity are necessary in today's technology to transmit signals without distortion and to 'speak the same language' as computers. Pulse code modulation, in effect, speaks the same language with all types of communications.

"With the growing demands for compatibility, flexibility, greater speed — as well as quality and economy — we're convinced," Mr. Hoth adds, "that the digital systems will meet the needs in the years ahead." ▢

# The Affair of the Spindled Manager


## by Richard W. White

In glancing over my notebooks for the year 18—, I am struck by the variety and complexity of the cases solved by those, by now, well known methods of my friend Sherlock Holmes.

The public is not yet prepared to hear all the facts concerning the notorious blackmailer, Baron von Boo. Nor is it yet prudent to reveal the events leading up to that April morning when Lola Leer, the music hall dancer, was found stark naked and raving mad in the bell tower of Winchester Cathedral. But a note from Holmes at his bee farm in Sussex assures me that it is time now to disclose the facts in the affair of the spindled manager.

It was a wild November night. The dun coloured fog swirled through the streets of London, driven by gale winds and lashing rain. My wife being away on an extended visit with her mother, I had temporarily taken up lodgings again in the familiar rooms in Baker Street. Nothing had changed. The coal scuttle with its cargo of cigars, the Persian slipper filled with shag tobacco, the gasogene on the sideboard, the bullet pocks on the walls from Holmes's occasional indoor pistol practice — all was as I had remembered.

A blazing fire danced on the hearth. Mrs. Hudson had cleared away the dinner things, and I had settled down with a novel. The great detective lay on the sofa, staring at the ceiling and sending up cloud after cloud from his cherrywood pipe. The ringing of the electric bell jarred the quiet of our cozy sitting room.

"Good heavens! Who can that be, Holmes?"

Holmes favored me with a heavy-lidded glance. "Given the present population of this city, my dear fellow, the possibilities are rather too extensive for my modest talents. But I hear steps and we . . ."

Before Holmes could complete his remark, there burst into the room a large, well-dressed man, ruddy, graying and obviously distraught.

"Which of you is Sherlock Holmes?" he cried, his chest heaving as he fought for breath.

"I am," said my friend, sitting upright on the sofa. "And this is my colleague, Dr. Watson. But you seem upset. Pray, avail yourself of the comforts of that arm-

*Mr. White, a contributor to a number of national magazines, is a member of the public relations department at The Southern New England Telephone Company.*

FORM 9DS SUPERCEDED
REWORK
FORM 91
ABSENCE REPORT
RUSH
EXPENSE VOUCHERS
DOCUMENT
Revise Office Supplies
RUSH
SPECIAL
tra

chair while Watson prepares a medicinal concoction for us. Something with gin, I should think, Watson."

While I busied myself at the sideboard, Holmes surveyed our visitor shrewdly. Then he said, "How can we be of service to you, Mr. Clyde Phinque of New Orleans, U.S.A.?"

Our caller started as though he'd been shot. "How on earth . . . ?"

"The card pinned to your lapel, the one that reads, 'Hi! I'm Clyde Phinque from New Orleans!' — it was a clue. The rest was simple deduction."

"Uncanny!"

"A trifle. Aside from your name, the fact that you suffer from hypertension, are a member of the Lions and the Greater New Orleans Chamber of Commerce, were a corporal in the Coast Artillery, and that you arrived here in a cab drawn by a roan mare and driven by a top-hatted East Indian with a broken front tooth, I know virtually nothing about you."

"You are a wizard, Mr. Holmes!"

"Hardly that, I think. Ah! Thank you, Watson. Now, Mr. Clyde Phinque, what is it that brings you out on such a night?"

"Murder, Mr. Holmes! The murder of Mr. Subordinate Whyne, London manager for my firm, Granny Mole's Sorghum Products, Inc."

The detective's eyes brightened. "Have you contacted the police?"

"No. But I fear they will be in touch with me. You see . . . "

At this juncture, a heavy knock sounded on the inner door. In a moment, Inspector Lestrade of Scotland Yard, flanked by two hulking constables, was in the room.

Mr. Clyde Phinque of New Orleans, U.S.A.," the little official said, "I arrest you in the name of the Queen for the foul murder of Mr. Subordinate Whyne, late London manager for Granny Mole's Sorghum Products, Inc."

"Oh, I am lost!" cried Phinque.

"There, there," said Holmes. "Pull yourself together. Tell me, where did the melancholy event occur?"

"At the office, at 111 Barleycorn Row. I'd just come from there."

"You're welcome to have a look around, Mr. Holmes," Lestrade said. "Nothing's been moved as yet. But you'll find it's plain as a pikestaff. Murder's been done. And this Yank done it."

"Did it," murmured Holmes.

"I didn't!" shrieked Mr. Clyde Phinque of New Orleans, U.S.A.

"We shall see. Go along with these men, Mr. Clyde Phinque. Watson and I shall go straightway to Barleycorn Row and see what's to be seen. Courage! When I have formed an opinion I shall make my report to you."

The police and their hapless prisoner departed.

"Come, Watson!" cried Holmes. "The game's a-foot! This is a dark business, and we shall have our work cut out for us to shed some light on it."

Holmes and I were soon rattling through the night and the storm, and in minutes we found ourselves in Barleycorn Row. The scene that awaited us in the office of Granny Mole's Sorghum Products, Inc., was one I shall never be able to erase from my memory. My scalp crawls as I recall it now.

There was no sign of a struggle. The Spartan interior of the office seemed undisturbed. But in the glow of the half-dimmed gas lamps we could see, sprawled forward on his desk, the late London manager — with a spindle through his heart.

"Poor devil!" Holmes murmured. "But what's this?"

Holmes pried a piece of paper from the dead man's hand. "Humph! Seems routine enough. Look at this, Watson."

I took the paper and read:

Dear Whyne:

This is to remind you that illness and absence reports are due on the 29th. Yours was late again last month, you'll recall.

Also, the interim projected year-end sales results estimate was due Friday last. And it would be helpful if you would submit your estimate of office supply needs by month's end. Use Form 363A1, which replaces Form 363A, please.

Are you quite certain you sent me those expense vouchers for September? They still haven't turned up. Perhaps you could work them up again?

Incidentally, your figures on the Correspondence Report don't tally. We don't have a 'Miscellaneous' category, so you shall have to make a judgment as to whether those five letters were orders, complaints or commendations, re-work your Form 90, and get it to me by the first of the month.

May I again remind you that Form 9D-3 has been superseded? Accounting will not honor your voucher for lamp chimneys until they have the proper document.

Let me remind you of our Beloved Founder's pungent motto: 'It's them little things what separates the sawdust from the sorghum.' I commend it to you.

Yours for a tidy operation,
C. Phinque

P.S. Your triplicate memo requesting an additional clerk should have been a quadruplicate Form Y2-30A. I mention it only as a matter of information as it will be impossible to add a person to your staff until Personnel have run an efficiency study on your force. I cannot foresee that happening before June. Tighten up! Delegate! Think sales And get those papers in.

C.P.

"What do you make of it, Holmes?" I asked.

"Julius Caesar, Act V, scene v. Remember your Shakespeare, Watson?"

"I don't see . . ."

"No, I suppose you don't. Just look at those files, Watson." He waved a thin hand in the direction of a row of wood cabinets lining the far wall. "I fancy we'll find what we're looking for there."

I followed Holmes to the files. His keen grey eyes scanned the labels.

"Notice, Watson, that of forty file drawers, twenty are labeled 'Forms;' ten 'Memoranda;' five 'Correspondence;' four 'Inactive;' and one — only one — is marked 'Sales,' which, I take it, is the chief business of the firm."

"What does it mean, Holmes?"

"It means," said Holmes, stuffing his pipe, "it means, Watson, that I have found the killer."

"That's wonderful, Holmes! Who is it?"

A bitter smile played about the thin lips. "There, old fellow," Holmes indicated the row of files with the stem of his pipe, "there is your murderer. Mr. Subordinate Whyne was the victim of those innocuous looking cabinets — or of their contents, rather. Consider, Watson, what it must have been like to try to run an active sales organization from beneath an avalanche of paper."

"I can imagine. But . . ."

"And when the unfortunate Whyne received this latest memorandum, the one we found clutched in his hand, it was the final straw. He flung himself on his spindle in despair, and so perished."

"Like Brutus running on his sword! That explains your citing Shakespeare."

"Precisely."

"What a ghastly end!" I stood for a moment contemplating the corpse of the late London manager. Then I cried, "But, Holmes! This means that Mr. Clyde Phinque of New Orleans, U.S.A. is innocent!"

"Is he, Watson? I wonder. I think we shall leave that to the official force and to British justice."

"You mean . . . ?"

"I mean that I wash my hands of this sordid affair. If Scotland Yard cannot make a case against him, Mr. Clyde Phinque of New Orleans, U.S.A. will go free. But in the court of my private opinion, Watson, he is guilty — as guilty as if he had spindled his London manager with his own hand."

Holmes buttoned up his waterproof. "Come, Watson," he said. "Shall we try the fried oysters at The Savoy? This outing has given me a devilish appetite."

As the public knows, Mr. Clyde Phinque of New Orleans, U.S.A. was released for lack of evidence. He returned to the States a broken man. I recall my illustrious friend's reaction to the newspaper accounts of the inquest.

"Well, Watson," said he, taking up his violin, "there is a higher court and a higher justice."

"You mean the Queen's bench? But, Holmes, the man's been exonerated. He's . . ."

Holmes chuckled. "Good old Watson!" He laid his bow across the strings, and the strains of *Autumn Madness* filled the room. ☐

# BELL reports

### Highway emergency phones

Motorists who use the recently completed 178-mile Adirondack Northway between Albany and St. George, New York, will not have to worry about being stranded in sparsely settled mountain country. Installed at half mile intervals along the Northway are 222 emergency telephones. Lifting the telephone off the hook brings the motorist into contact with the nearest state police office.

Similar highway emergency reporting systems are now in use in half a dozen states including Maryland's Belt Parkway and California's labyrinth Los Angeles freeway. Among the systems under consideration is one for the New York Thruway which calls for 1,148 phones spaced every 2,000 feet along the cross-state highway.

The reporting systems, which are installed by telephone companies under contracts with state and federal highway authorities, have proven to be effective and efficient ways to promote highway safety. One big advantage of highway telephones is that they are available to all motorists without any special expenditure on their part. And unlike car-borne, two-way radios, the use of telephones places no additional burden on the congested radio frequency spectrum.

This does not mean, however, that mobile radio has been shunted aside. On the contrary, radio equipped vehicles are being put to increasing use not only to report highway accidents or hazards but also to assist police and fire departments in providing better protection of human life and property.

Five Bell System companies are currently participating in the "Community Radio Watch" programs initiated last December by the Motorola Company. Together with other corporations and private citizens, telephone company employees driving radio equipped vehicles are on the lookout for street crimes, fires and accidents that may be observed during work activities. They call a central dispatcher or telephone operator who relays the report to the appropriate agency.

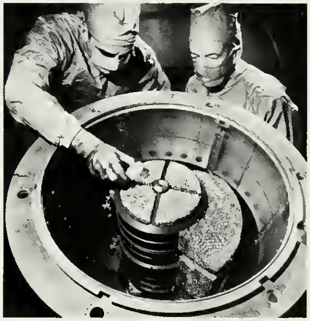
It's estimated that more than 40,000 radio equipped vehicles from businesses alone are participating in the emergency reporting program.

### Bacteria-free space vehicles

When space vehicles land on Mars or Venus, American scientists want to be certain they carry no microbes from earth to interfere with whatever life forms may exist there.

In preparation for the eventual probes of outer space, the National Aeronautics and Space Administration has asked the Sandia Corporation, a Western Electric subsidiary, to study ways of preventing contamination of space vehicles. Scientists and technicians at the Albuquerque, New Mexico, laboratory have assembled a model planetary landing vehicle in a specially-developed laminar-flow clean room that holds promise of being a bacteria-free environment.

Working with NASA microbiolo-



gists, Sandia scientists are running checks on the surface of the vehicle to see if any bacterial colonies can be found. NASA is looking to Sandia, a prime contractor for the Atomic Energy Commission, to come up with techniques for "debugging" future space craft.

### Superconducting temperature rises

The highest known temperature at which a material becomes superconducting — that is, loses all resistance to electric current—has been reported by Bell Laboratories scientists.

They recently announced discovery of a composition of niobium, aluminum, and germanium which becomes a superconductor at 20.1 degrees Kelvin plus or minus 0.1 degrees. (Superconducting temperatures are measured on the Kelvin absolute-temperature scale where zero is minus 459.7 degrees Fahrenheit and represents the absence of heat.)

The discovery is the first substantial progress in raising superconducting temperatures since 1954 when Bell Labs scientists succeeded in raising the transition temperature from between 16.9 to 17.1 degrees Kelvin to 18.05 degrees Kelvin plus or minus 0.1 degrees.

The seemingly small increase in superconducting temperatures, a 10 percent rise, has three important implications: (1) it shows that what had been thought to be a possible maximum superconducting temperature can now be exceeded, (2) it opens the possibility of building superconducting magnets that can produce higher magnetic fields than ever before, and (3) it eases the problem of refrigerating the superconductor because this can be done for longer periods with less coolant.

### International study probes effects of air pollution

Which is the greater health hazard: London's fog or our own East Coast smog?

British and American doctors hope to be able to answer that question and others when an international medical study is completed later this year. Co-sponsored by AT&T and the Johns Hopkins School of Hygiene and Public Health, the study is using hundreds of telephone men, most of whom work out of doors in suburban areas, to check on the affects of polluted air.

Many of the men taking part in the experiment also participated in a similar study five years ago. The 1962 results demonstrated that the British have more chronic bronchitis but that Americans were subject to more coronary disease.

Dr. R. W. Stone, assistant medical director of AT&T, said that by re-examining the group, they hope to learn whether the increase in atmospheric pollutants both here and in England has resulted in an increase in bronchitis and heart disease.

Telephone men were selected for the study not only because of occupational similarities but also because of similar social, educational and financial backgrounds. The big difference is where they live and what they breathe.

Three testing areas are being used in the U.S.: Washington, D.C., Westchester County, New York, and Baltimore, Maryland. Another study will be conducted in New York City next year.

A representative of the Nippon Telegraph and Telephone Company is also participating in the current study in preparation for administering a similar study in Japan.

*James Gogarty of New York Telephone is taking part in an international study of the effects of smog on outside telephone workers. Administering the checkup is Dr. Fernando Sanchez of the Johns Hopkins School of Hygiene and Public Health.*

### Telstar was space breaker

Live television broadcasts from London, Tokyo, and even Moscow occur so frequently these days that most viewers pretty much take them for granted. And yet, it was just five years ago that the Bell System's pioneering Telstar satellite ushered in the era of international television.

Launched July 10, 1962, Telstar I—and its sister satellite, Telstar II, which was put into orbit a year later—proved worldwide communications by satellite was both possible and practical.

Although radiation silenced it early in 1963, Telstar I transmitted the first live television across the Atlantic in addition to handling experimental voice and data transmissions. The higher-orbiting Telstar II was out of the reach of the radiation belts around the earth so that, for nearly two years, it was able to carry out a series of highly successful tests that included the first live TV from Japan.

Both satellites are still in orbit and will probably remain there for at least 200 years. However, neither is functioning any longer. Telstar II's very high frequency beacon was turned off in 1965 after all useful information had been obtained. The satellite was still in good working order, but the frequencies it used were needed for other satellites.

### Ceramic materials are quick frozen

Scientists at Bell Laboratories in Murray Hill, New Jersey, have developed a new "quick freeze" method of preparing ceramic raw materials.

The new process provides uniformity both in the size of the ceramic particles produced and in the mixing of chemical compounds within the particles — characteristics that are not possible with conventional milling or grinding methods.

The ceramic raw material, in the form of a water solution of high purity salts, is quick-frozen, then freeze-dried and heat treated to remove water and other volatile constituents. The converted droplets are then reduced to powder for ceramic manufacturing.

Particles formed by this method retain the exact chemical composition and high purity of the components from which they are processed because no contamination from milling and grinding is introduced. Also, with the new process, chemical reaction between ceramic raw materials is possible at temperatures hundreds of degrees below that required to attain equivalent results with conventionally mixed oxides.

### Rainfall patterns studied

If you sometimes think it's raining "bucketfuls," you may be very nearly right. A unique measuring system at Bell Laboratories indicates that the pattern of rainfall at particular spots during a storm may indeed resemble "bucketfuls."

The information comes from a system which records continuous data on rainfall at 100 points in a 50-square mile area surrounding Bell's Crawford Hill Laboratory at Holmdel, New Jersey. Rain gauges are mounted on telephone poles where they tell their story over leased telephones lines to recorders at Crawford Hill.

Because rain affects microwave signals, such data is important in planning microwave communications systems that beam signals over the earth's surface and from earth into space.

Once recorded by the Bell Labs system, data on a given rainstorm can be replayed on a computer and compared with taped data describing microwave transmission during the same storm.

The project is yielding interesting and surprising results. Measurements taken seconds apart in a rainstorm, for example, show that rainfall rates vary widely at a single gauge as well as simultaneously at the 100 gauges. Localized regions of heavy rainfall appear to drift about slowly, saturating certain areas with rain while other areas get less than their share.

### Electronic switching to increase

The Bell System will spend about $700 million over the next five years for electronic switching systems, AT&T Board Chairman H. I. Romnes told the New York Financial Writers at their annual dinner.

Describing the introduction of electronic central offices as the biggest development job AT&T has ever tackled, Mr. Romnes said electronic switching will, in effect, provide a nationwide special-purpose computer.

Such innovations, he said, are part of the increase in computer communications that "promises a vast enhancement of our capacity to manage" the Bell System's increasingly complex economic activities. Computer communications, he stated, are "our best hope for bringing order and direction of what might otherwise become chaos."

Mr. Romnes added that the ESS program is indicative of the Bell System's need for "tremendous sums" of capital. AT&T, he said, has been accounting for nearly 40 percent of the nation's total annual corporate equity financing and about 15 percent of all corporate sales of security issues each year. □

AT&T

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# BELL
telephone magazine



AT&T

# Incentives to Progress

**by H. I. Romnes**

*Chairman of the Board, AT&T*

*(Editor's Note: In connection with the interstate rate case, the Bell System has been emphasizing the importance of incentives that encourage service improvement. Mr. Romnes talked about these incentives in a recent speech at the Telephone Pioneers' annual meeting in Toronto. The following is an excerpt from that talk.)*

Of all times that I can remember, it seems to me that now is the time when government most needs to encourage the incentives of industry. It is now that we need to crank up the engine of economic growth to create jobs for more millions of people in the decade ahead. It is now that government and business need to work together to solve the problems of the cities. And in our own case, in communications, it is now that new technology, new systems, new services offer widening opportunities to help industry cut costs; to help educators meet their fast-growing tasks; to help government organize all its efforts; to help new businesses come into being and make their expanding contribution to the country's well-being.

So I urge, that in the broad framework of our need to meet investors' expectations, regulation establish ground rules that will aid and abet the most vigorous management effort. This means a regulatory approach that will warmly approve the goal of good earnings, taking into account at the same time that the business must not skimp on doing all the important things that it ought to do—pay good wages, adequately train its people, accept the risks and the costs of innovation, render quality service, and take firm conscientious initiative in helping to meet social and environmental problems.

Such a creative approach by regulation, I submit, is necessary to insure that all important requirements for a good job will be met. And the spirit I have in mind is the very opposite of cost-plus. For this same approach places an imperative demand on management for quality performance. It demands that we develop and invest in advanced technology. It demands that we continuously introduce improvements in service and economics of operation. It demands that we open new markets. It demands that we share the benefits of our progress, in all these respects, among customers, employees, and share owners alike.

This is what we get into, you see, when we ask for incentives. We get obligations. But this is exactly my point. This is what we want. We want obligations and we want to rise to them. We want every demand placed on us to show what we can do . . .

The key to the best progress is the freedom to strive toward the twin goals of good service and good earnings. It is surely the duty of regulatory bodies to require that we provide the best possible service at rates that are equitable and as low as we can make them consistent with what our customers desire. I am confident, however, that this can best be accomplished by the approach I have indicated. Put aside the outworn concept that low rates must be equated with narrow margins of profit. Let the kind of incentives I have been discussing impose their demands. We will respond, I am certain, with new dimensions, and new values, in communications service. □

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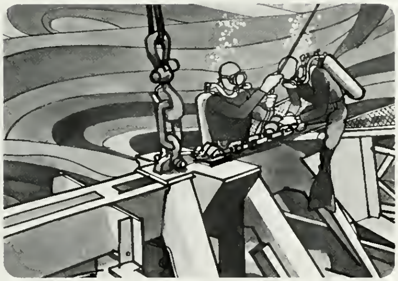

On the cover — Deep-Sea divers adjust a tow sling on the sea plow used by AT&T to bury parts of two transatlantic telephone cables beneath the ocean floor. Operation Sea Plow, launched last summer to increase the reliability of international communications, pitted a Jules Verne combination of mechanical mastery and human derring-do against the mysteries of the ocean deep. See page 2.

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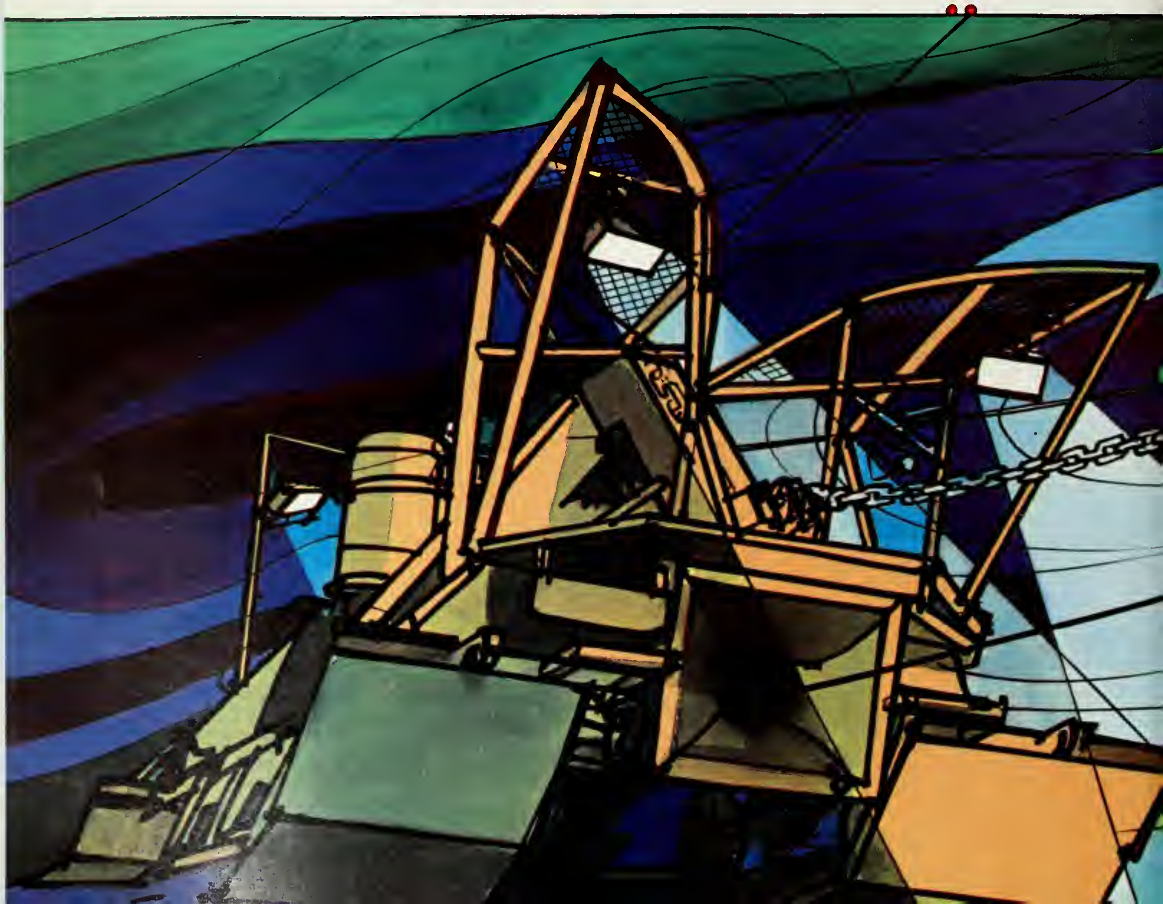
# Cables Under the Sea

Steadily increasing calling volumes and the growing importance of international communications create new demands for reliability. Helping to provide fail-safe communications is a unique underwater sea plow that buries telephone cables on the continental shelf.



There was a time, the theory goes, when the continents of North America and Europe were locked tightly together like pieces in a giant puzzle. Then the Altantic came between them, and it was a long, long time before modern communications bridged the ocean to reunite them.

Little more than a century ago, news from the Old and New Worlds was still traveling back and forth along the slow, uncertain routes of the ocean steamers. Then, in 1866, the first telegraph cable was laid successfully across the Atlantic. Other new transatlantic links followed: 40 years ago by radiotelephone, 11 years ago by telephone cable, five years ago by communications satellite.

Today, the people of the United States and Europe —in fact, people all around the globe—are bound closer together with each new advance in the transmission of telephone, telegraph, radio and television.

The steady increase in overseas telephone calling is one indication of the growing reliance placed on international communications. The role of communications assumes even greater proportions in times

of stress as the recent Middle East conflict showed. All available means were used to the straining point during the crisis to keep government officials in contact, to keep the peoples of the world informed, and to keep worried relatives and friends in touch. Despite the special arrangements made to handle about three times the normal volume of calls to the Middle East, delays in completing calls to Israel reached as high as 10 days during the height of the crisis.

Such events as the Arab-Israeli war highlight the pressing need to improve and make more reliable those means of communications that are now available.

The Bell System took a big step in that direction this summer when it plunked a yellow-painted sea plow into the waters off New Jersey to bury parts of two transatlantic telephone cables under the ocean floor. The purpose was to protect the cables against damage by commercial fishing vessels, damage which in the past has caused serious disruptions on vital transatlantic circuits.

The successful burying operation did more than increase the reliability of international communications and reduce AT&T patrol and repair costs. No longer will remote—and unusually more expensive—cable routes be selected in order to circumvent commercial fishing locations. Shore areas formerly rejected can now be selected for the new cables that will be placed in the years ahead.

Rapid strides have been made in the use of communications satellites since the Bell System launched its Telstar® satellite five years ago. But even though AT&T is the largest user of satellite circuits in the world, underseas cables continue to serve as the workhorse of international communications.

The need for fail-safe communications, coupled with steadily rising calling volumes, is the reason for the continuing use of both cables and satellites, as well as improved radio-telephone circuits.

"No single means of transmission can carry the burden of overseas communication alone," says C. C. Duncan, AT&T assistant vice president for overseas communications. "The key to dependable international communications is diversity. Satellite, undersea cable and radio-telephone circuits are the ingredients of this necessary mix—and will continue to be in the foreseeable future. Protecting cables by burying them is an important advance for one of those ingredients."

## Shore-end problems known for years

Before Cyrus Field completed laying the first overseas telegraph cable—which John Greenleaf Whittier once described as "the fall of the ocean's wall"—Matthew Fontaine Maury, a pioneer in the science of oceanography, warned Field that "the greatest practical difficulties" would be encountered "at either end of the line," where the cables reach shallow water.

As Maury foresaw, shore-end problems have plagued otherwise reliable submarine cable systems. The big offenders: commercial fishing nets and dredges that snarl and snap the cables as they are dragged along the ocean bottom. Cables have also been occasionally broken or damaged by undersea landslides, icebergs, currents, action of the surf and rough ocean bottom conditions.

The Bell System, aware of the threat posed by fishing activity when it laid the first transatlantic telephone cable, picked a route off Newfoundland which was relatively free of fishing activity. Within three years, however, trawlers had moved into the area in large numbers, and the cable was broken for the first time.

AT&T's Long Lines Department, which is responsible for overseas service, decided then that the best way to protect cables was to bury them beneath the ocean bottom. To examine Newfoundland's continental shelf, Bell Telephone Laboratories designed an electrically-powered sled with a television camera mounted on its front. The sled, able to maneuver underwater like a helicopter, sent its pictures through an umbilical cord linking the sled to a ship. The films showed the shelf to be an undulating plateau of clay, sand, gravel and rock.

## Bell Labs develops survey vehicle

Bell Labs then developed a 7,000-pound survey vehicle outfitted with communications and measuring devices to collect more underwater information. The towed vehicle had a weighted steel wheel to cut through the soil. The wheel told a discouraging story:

*Before the sea plow ever touched water, Bell Telephone Labs conducted practice runs, left, at its Chester, N.J., laboratories. At right, the plow's tailgate opens and a simulated repeater drops into a trench dug out by the plowshare. During the underwater operation, the trench filled in as the plow moved along, hiding cable and repeaters beneath a cover of sand and clay.*

the bottom was much harder than expected, and burying cable there would be impractical.

By 1965 two transatlantic cables had been laid off Tuckerton, N.J., an area seldom visited by the trawlers working the Atlantic coastal waters. But, it wasn't long before a Canadian fisherman discovered large scallop beds in the area, and fleets of scallopers raced to the scene. Soon the ocean bottom was being raked by dredges weighing 3,500 pounds, and the dredges were catching the cables.

Long Lines shifted its burying plans to New Jersey. Oceanographic surveys conducted by Bell Labs indicated the bottom was generally flat with several inches of sand blanketing a layer of hard-packed clay. Coincidentally, the underwater studies confirmed oceanographic theories about the glacial age makeup of the coast. A shoreline similar to the one now used by New Jersey bathers was found 40 miles out under 25 fathoms of water.

Results of the survey called for a plow to slide along the ocean floor on four sled-like runners. Telephone cable feeds from a towing vessel through the plow's bellmouth and feed tube into a four-inch wide trench furrowed out by the plowshare. Auxiliary plows automatically widen the trench when repeaters, amplifiers that recharge the signal every 20 miles, pass through.

## Sea trials useful

Sea trials for the 14-ton plow began in late 1966, and continued until last spring. Pulled through the firmly caked clay by the Canadian cable repair ship and icebreaker, the *John Cabot*, the plow buried practice cable about two feet under the bottom—deep enough to be safe from commercial fishing tackle.

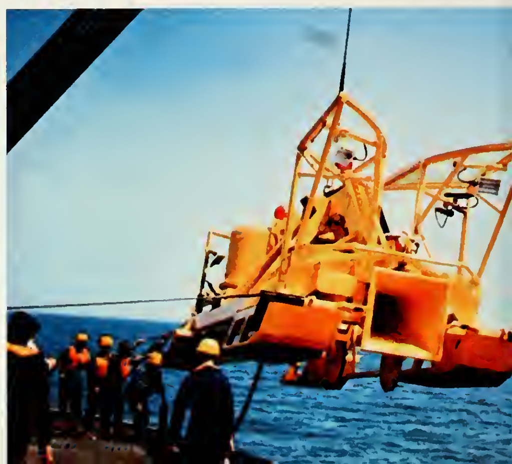
But there were some bad moments. Twice a towing sling broke, and the plow tumbled over on its back. Once the plow crashed into a small uncharted reef and became stuck—"like a snagged fish hook," according to one observer. As a result of such incidents, the equipment and plowing procedures were modified and more trials were conducted before actual operations got underway.

With the approval of AT&T's overseas partners and other owners of the two cables off the New Jersey

*Star III, a miniature submarine, found a safer path for the plow after an unchartered reef was encountered on the bottom.*

*Crewmen on the stern of the ship help to guide the plow as it is lifted off its mountings at the start of the operation.*

*The plow is slowly lowered over the side of the John Cabot by a 30-foot-long crane. Divers wait below in a motor boat.*



shore, "Operation Sea Plow" was launched during the first week of July.

In addition to the Cabot, the British cable ship *Stanley Angwin* acted as a floating test room throughout the operation, continuously making circuit checks as the new cable was placed.

The sea plow flotilla also included deep sea divers who were used primarily to hook and unhook the plow under water, two tugs, and a ship carrying the miniature submarine, *Star III*. Pictures taken from the submarine, which tracked the old route of the cables, helped determine how many miles of new cable should be buried, and showed that there was no need to bury inside the 20 fathom line where a double armored section of cable was found to be undamaged and partially buried by ocean currents.

With the *Cabot* chugging along at one knot or less in water ranging from 120 to 900 feet deep, plowing began on July 5 at a point about 35 miles at sea.

Some parts of the bottom were harder than others. When the plow ran into especially stiff clay, the plow would shudder to a stop and Captain Duncan Tosh would have to cut the power of the ship's propellers, carefully bringing them back into action as the plowshare slowly began to cut its way through the soil. At times, tension on the tow line reached 80,000 pounds, and as much as 4,500 horsepower was required to pull the plow.

Extremely precise navigational equipment kept the tow ship—and the plow—on course. Water-jetting bow thrusters with 1,000 horsepower each steadied the ship against the wind and current. When the weather turned bad, a tug tied to the bow helped maintain the ship in position.

By July 8 more than 40 miles of new cable had been buried and spliced at two ends to a cable leading to France. Burying of about 60 miles of cable to England began the next day, and was completed in five days.

The success of Operation Sea Plow clears the way for next Spring's laying of the first high-capacity transistorized undersea cable from Jacksonville, Fla., to St. Thomas in the Virgin Islands. Scallop beds about 40 miles off the Jacksonville shore aren't being fished at the present time, but they may attract fisherman in the future. Now, it doesn't matter. The shore-end section will be buried from the start. ☐

*As the plow hits the water, a diver gingerly hops aboard to straighten one of several guy lines from the ship to the plow.*

*Television views of the plow at work were taken by three cameras on the plow and seen on screens in the ship's control room.*

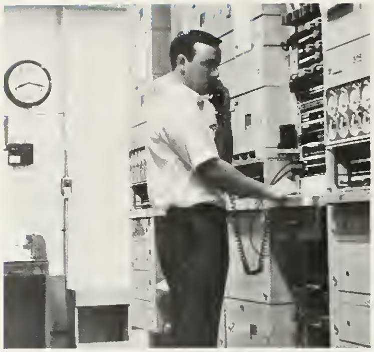
# Readiness to Respond

The Bell System's capability to respond swiftly and effectively to emergency situations was put to test on July 17 near Tucson, Arizona when a repeater station for the coaxial cable system running from New York to Los Angeles was dynamited.

About 30 minutes after the explosion, all 5,400 circuits carried on the three-channel cable were rerouted over alternate facilities and back in service. And within 12 hours, complete transmitting power was operating through tubes connecting the damaged cable to a van truck equipped as a temporary repeater station. Less than three days after the blast ripped through the station, new and refurbished equipment was operating, a new building had been constructed, and service was back to normal on the cable system. F.B.I. and Tucson Sheriff's Office officials conducting the investigation believe that vandalism rather than sabotage was involved.

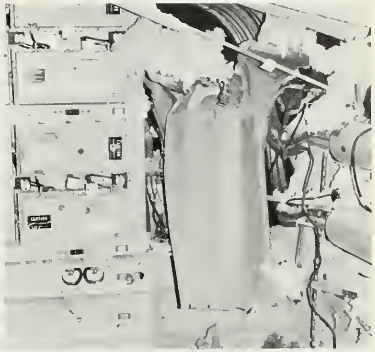
The ability to switch rapidly to alternate facilities while the cable system was out of service — and the speed with which the new facilities were built and installed — resulted from careful advance planning and close cooperation on the part of the AT&T Long Lines department, the local operating telephone companies, and the Western Electric Company, the Bell System's manufacturing and supply arm.

Ironically, it was another explosion that reinforced the Bell System's need for alternate facilities and plans that could be quickly implemented to restore communications services. On May 28, 1961, two major routes to the west coast were interrupted when dynamite blasts destroyed three amplifier stations in Nevada and Utah. Since then procedures have been modified to insure even more dependable communications. ▢




**July 19: 2:00 p.m.** — Refurbished equipment bays moved into new Splicing crews start restoring permanent cable facilities.
**8:00 p.m.** — Finishing touches put on roof of new building.

**July 17: 8:16 p.m.** — Alarm in El Paso central office indicates cable failure between Lordsburg and Tucson, Arizona.
**8:43 p.m.** — First circuits restored on alternate facilities.
**9:30 p.m.** — Technical crews inspect damage to repeater station. Discover rear wall demolished, door blown off, and roof partially destroyed. Interior of building and transmission equipment badly damaged.



**:00 a.m.** — Temporary service
by connecting cable
ıck equipped as repeater
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**ı.** — Installation of new
nt begins as debris of
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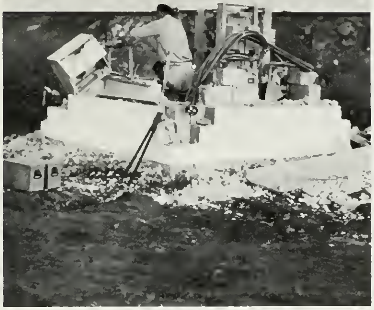
**n.** — Walls of
ding completed.



**July 20: 6:40 p.m.** — Less than three days after dynamite blast, building and all equipment completely restored. Service on cable system back to normal.

The use of simple and practical methods of communications to perform the complex tasks of cash management can produce substantial savings in time and money

# Managing Money Through Communications

**by Robert W. Ehrlich**

Companies today are vitally concerned with getting as much mileage out of cash as possible. Whether they are collecting, investing or disbursing money, Treasurers generally seek to keep the amount of idle cash at a minimum.

There has, of course, never been a single best answer to financial management. The methods used depend on the situation in each company, on the customers it serves, and on the federal and state laws where it operates. That is why, for example, the Bell System uses a wide variety of ideas and approaches in conducting its cash management. I'm sure that in other large businesses that operate on a nationwide, or even a regional basis, you'll find a similar variety of ways of performing these tasks. What these businesses share in common is a desire to operate over an extended region of the country while at the same time carrying on business as a local member of each community. It seems to me that communications — and here I mean communications in the broadest possible sense — represents the essential link in joining these diverse objectives in one method of operation.

The ways the Bell System manages its funds illustrate how communications can be an effective tool in financial operations. Not all of our methods are appropriate to every business, of course, but many of them can and do have wide application.

In preparing this article, I talked with financial people in a number of other businesses, and I found there are three fundamental stages to cash management that seem to emerge in any discussion of the subject. First, there is the question of how we go about rendering bills to our customers. Second, there is the problem of mobilizing the cash flow to put it in the

*Mr. Ehrlich is assistant treasurer — financial division at AT&T. His division is responsible for banking and financial practices, investment analyses, and management development and training.*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place where it will be of use. And finally, there is the matter of disbursing cash in order to meet the requirements of the business.

## 600 million bills a year

In the Bell System, bills are rendered on a monthly basis and include several kinds of items on one bill. This is in contrast to other businesses which may render a bill for each separate service at the time the service is performed. All of the 108 accounting offices in the Bell System use some form of cycle billing, mailing some of their bills each day or every few days. This is done primarily to smooth out the work flow.

In the Bell System as a whole, we render about 600 million bills per year which include, among other things, the charges for some 5 billion long distance calls. Records of these calls are initially recorded on punched paper tape or on machine readable tickets at a Traffic operating office through which the call is placed and most of the calls are then billed to customers by the closest customer billing office.

There are special problems, however, in handling the 350 million collect and credit card calls made annually. The customer, for example, who makes a collect call from San Francisco to his residence in New York obviously wishes the call billed in New York but the record of the call is in San Francisco. The records of many of these 350 million collect and credit card calls thus must be transferred to a distant office for billing. Until recently these records were shipped by various means to the billing office.

Today, however, several companies, Southern Bell, Bell of Pennsylvania and Pacific, are using a processing and communications system for transferring these calls between offices within their own companies. Records of the calls after certain initial processing by the receiving office are transmitted over a data link to a central location which sorts the records by billing office and redistributes them to the appropriate accounting office, again over a data link. The result is one or more days saved in the billing process.

The Mountain States and Ohio companies plan to implement similar systems and eventually the entire Bell System will be tied together in a Centralized Message Data System which will link the associated companies in a data transmission network which among other things will process the collect and credit card calls as described above for the whole System.

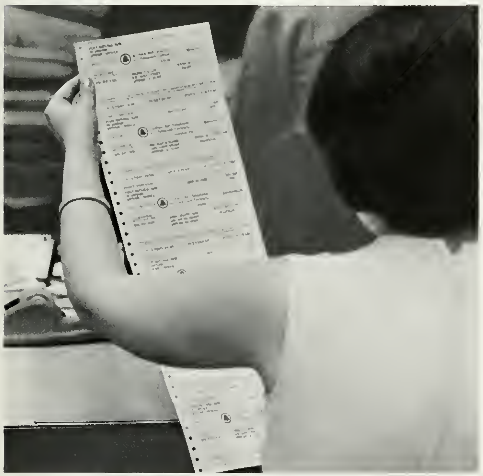
## Using bank communications

To speed up the billing process, a plan for the automatic payment of telephone bills through banks is also being tried out in Southern Bell. Under this "Bank Draft Plan," the customer authorizes his bank to make payment directly from his account based on the billing drafts which the company provides to the bank. All of the drafts for a large area are prepared at one central location as a by-product of the billing operation. But instead of being mailed to the various banks, they are encoded and delivered to a central bank in the headquarters city, from which they clear through existing bank channels to the various drawee banks. In this way, the company does not have to maintain a balance in every bank. It's also significant to note that here the banks' communications system is being used rather than some other means.

One other essential part of the billing process is to keep an up-to-date and accurate record of who has paid his bill so that unnecessary and sometimes embarrassing followups will be avoided. Processing centers for mail payments are, therefore, usually adjacent to a billing computer so that the prepunched card the customer returns with his payment can be used immediately to update the computer. In Sioux Falls, South Dakota, however, the Northwestern Bell Telephone Company has an operation for receiving and processing customers' mail payments that is nearly 200 miles from the billing computer in Omaha, Nebraska. They solved the problem of updating the computer by transmitting the payment information twice each day to the Omaha computer.

Let's turn now to the process we refer to as mobilization of funds — that is, the process of moving funds from where they first appear as checks or bank balances to other accounts or locations where they can be used for disbursement.

Although a variety of methods are used, most of them involve a combination of telephone company communications and those of the banking system. In those cases where the companies still use regular depository transfer checks (a type of check for transferring funds from one bank to another), they have found they can speed up the issuance of these checks by having collection data telephoned into the Treasurer's office as soon as receipts are deposited. More frequently used, however, is an arrangement for automatically transferring funds through a correspondent relationship with a bank in the headquarters city of the operating company. In this case, the principal communications medium is one provided by the banks.



*Under the Bank Draft Plan used by Southern Bell, telephone bills are paid directly from the customer's bank account. The drafts shown above are prepared as a by-product of the billing operation.*

Turning finally to the matter of disbursement of funds, there are again many ways of doing this. One particularly interesting system, however, is being used by Pacific Northwest Bell. Special arrangements have been made with the banks in Washington and Oregon to accept teletypewriter messages originated by the company to effect the movement of funds between banks. The Teletype message includes a special numerical code which has been agreed upon with the banks to establish validity of the message. With this system the company is able to direct a bank to transfer funds to New York, for example, for payment to Western Electric for equipment or for the payment of interest on debentures where the payment is deposited in a New York bank. Funds, of course, can also be moved to cover drafts presented for payment and for other purposes. All of the transactions are on a same-day basis in current-day funds useable by the recipient on the day the funds are moved.

The significant features of such a system are that register balances are reduced, no checks are required, communications are handled by a combination of regular telephone company facilities and those of the banking system, and all transfers are made on a current day basis.

Here then is an instance where we're getting pretty close to some of the concepts we talk about in the banking and financial systems of the future.

## The future of money management

And what about the future? What must we be prepared for as we move toward what has been called the "checkless" or "cashless" society? Will we scrap our present procedures and instead just hook everything up to some giant computer?

Let me begin by stating some things I think will *not* happen. First of all, I think we will continue for a very long time to use such things as checks and cash. There are still some virtues to these things that are not readily served by even the fanciest computers and electronic circuitry. And I do not think that credit cards are going to take over as a 100 percent substitute for cash either. They serve a useful purpose for the individual who wants to defer and consolidate his obligations, but this procedure is not appropriate for all transactions.

Having disposed of the conservative view, let's consider what might be possible with just our present electronic technology. It would be possible, for example, to hook up our telephone central office with the bank's computers and charge the customer's account without using any intermediary paper records. Or in the case of the transportation business, there might be a hookup between railroad and bank computers so that a customer's payments might be transferred automatically whenever a shipment is delivered or a passenger boards a train. Such schemes, though they undoubtedly will not have widespread application for a long time, would certainly represent the ultimate in instantaneous cash transfer.

Somewhere between today's system, which involves delays of all kinds in processing and moving checks, and the system of tomorrow, which will involve instantaneous transfer of funds, lies a tremendous job of organizing systems of data processing and communications. If the world consisted of only one bank and one corporation, it might be difficult

*More than 100 Bell System accounting centers, such as this one in Chicago, have the job of keeping tabs on some five billion long distance calls and processing about 600 million bills each year.*

enough to do. But in today's society of many banks and many corporations, it becomes a tremendous task to organize even the simplest system. Consider, for example, what a big project it was to institute the Magnetic Ink Character Recognition (MICR) system for clearing checks. This was certainly a great step forward but one which took years to accomplish. In fact, only on September 1 of this year were the final steps taken by the Federal Reserve Bank to implement the system. Exploiting the full potential of data processing and communications will take even more in the way of organizing and coordinating the work of diverse institutions.

Who will lead this great organizing job? Perhaps the banks will. To the extent that they do, then corporations will be able to depend on the banking system to not only receive and disburse funds but also, through forms of processing and communications, to handle more and more of the flow of funds all the way from customer to creditor.

## Communications should be simple

But in all probability, most businesses will continue to require some communications capability of their own for managing their funds. If this is the case, my main admonition, at least as far as communications is concerned, would be to keep the system simple and flexible. This is because changes in the field are taking place at a highly accelerated rate. On the data processing side alone, more advanced systems are appearing so rapidly that many are obsolescent as soon as the hardware is installed. Obsolescence can come just as rapidly on the communications side and can be just as painful if the system is elaborate, expensive, and too closely locked into one method of operation.

Cash management systems *can* make use of fairly simple communications media. Even the most sophisticated systems we have today got started by utilizing ordinary telephone lines. Other examples I've cited use communications arrangements ranging from teletypewriter messages down through a service sometimes called "POTS" — plain old telephone service. At the risk of seeming to "unsell" our most sophisticated and advanced services, I feel it best to emphasize how much can be done to expedite the cash management job with even the simplest forms of communications systems.

In conclusion, it seems that some form of communications, simple and inexpensive as it may be, enters into every phase of the cash movement process. The form of communication may range from sophisticated data messages down to simply mailing and delivering a piece of paper. In addition, it is the means whereby a nationally organized corporation is able to do business in each city and town just as another merchant along Main Street. □

*Pacific Northwest Bell is using teletypewriter messages to speed up money movement. This enables them to keep most transactions involving disbursement of funds on a same-day basis.*

# BELL FORUM: Statements of policy and opinion

*Editor's Note: John D. deButts, AT&T vice chairman of the board, recently spoke on "Industry Looks at Education" to the National Association of College and University Business Officers in New Orleans, La. Mr. deButts outlined the business world's expectations of higher education, stressing that "industry sees education in several lights, not merely—and not mainly—as a source of ideas that are critical of industry itself." A condensed version of his text follows:*

What does industry want academicians to teach their prospective employees, managers, and future leaders?

I hope to see educators produce more engineers who can write clearly and well, and more writers who can solve equations.

That's a simple — perhaps overly simple — way of saying that some breadth of study, some grasp of fundamentals in several disciplines seems more important than a head full of specialized knowledge that will be obsolete tomorrow.

There is nothing wrong with encouraging and developing special interests, but today's information will not do tomorrow's job. What is necessary is to have the perspective to sense relative values, and the quality of mind that will enable a man to develop relevant facts at the time when they will be useful.

In terms I am sure you have heard before, business wants people who have the capacity and the desire to think, communicate, and grow.

I would also like to emphasize the good old-fashioned word *character* — that is, the innate disposition and intelligence to discern what is right and the courage, the guts, to do it.

In business these days many decisions have to be made that involve extremely complex considerations. You don't just look at a print-out from a computer and say, "That's it—let's go." Nor can you go back to the theoretical approach of the textbook. Theory is too often based on averages, and there is no average company or average situation in my business or yours. Theory must be the jumping-off point for judgment. I am reasonably sure that you, like myself, in assessing what *your* business needs, may put the highest premium on "awareness" — a sensitivity to all considerations that have to be studied, appraised, and resolved — and not infrequently resolved under pressure and in a hurry.

### Skeptical students

It is clear to me from what I read that the current college generation — many of them anyway — are skeptical about business really wanting, or even deserving, sensitive and able men of high character.

I am not inclined to discount the criticisms made of business. In the main I think they come down to these points — that the world of business is narrow and materialistic, and that it is not challenging but routine and dull.

We could argue pros and cons all day on the subject of narrowness and materialism. I am sure there is plenty of both in business as elsewhere — and also plenty of breadth and vision and self-sacrificing labor and public spirit.

As to the notion that business, and especially big business, is so tightly structured, so defined in routine, so set in its ways that it lacks challenge—let's face it, there is truth in this criticism and we in business must continuously look for ways to inspirit people more effectively than we do.

But having said that I also want to say, I *must* say to this college generation, "Look, the world of business is just as full of excitement and challenge and responsibility as anything you could ask for *if* a life of action and change appeals to you and *if* you really have the energy and ability it calls for."

I have made two different comments. You may think they contradict each other. But I think there is room for both. We have tigers in our business who are continuously making their own excitement and challenge in spite of all routines. At the same time, there is always an awful lot more that any business can do and *must* do to keep its own bureaucracy off balance.

One thing we have done increasingly in the Bell System in recent years is to pitch new candidates for management jobs directly into responsible tasks, without prolonged programs of routine training that offer little chance for meaningful work. This on the whole has worked well. The men who have the stuff like it and those who don't are not encouraged to keep poking along in ways that *would* amply justify the sort of criticisms I've been talking about.

There is clearly a strong desire among many of the younger generation to contribute to the betterment of their fellow men. And there also seems to be some feeling that this can be done only through the Peace Corps, Vista, or other such programs. Business, many young people say, has no interest in the underprivileged, the uneducated, the unskilled, and seeks only to exploit them.

Certainly there are instances of this

attitude, but my experience teaches me that they are the exception and not the rule. Most businessmen I know are far from being insensitive to the human problems and tragedies around them. Their interest in working to alleviate them goes well beyond what is called "enlightened self-interest."

It is certainly true that improved family incomes provide larger markets for business and that training in work skills provides a better employment market. It is true also that open employment and family rehabilitation hold down welfare costs and that civic and neighborhood improvement programs improve the climate in which businesses operate. But the interest of businessmen in helping to build better communities has grown from much broader and deeper considerations than these. People in business want to help, and they take action to help, out of plain human feeling and the sense of brotherhood. If the students of today would shelve some of their prejudices and study the facts of programs initiated and carried on by corporations, I believe they might recognize and many might even want to share in the opportunities for serving the general welfare that they would find in business life.

There is one question that we in business are coming to ask ourselves fairly often: "What are the professors saying about us today?"

I am not trying to be facetious. Several things are evident. One is that higher education itself, the colleges and universities, are a principal competitor of industry in seeking to capture the interest and devotion of young people as they plan their careers. Another is that the professors have an advantage. They get first licks. They are there — quite properly — before we are.

A third factor is the growth of the educational establishment in numbers, material resources and prestige. I rejoice that the country can afford this great development in education — can prepare more people for tomorrow's complex tasks — can pay educators salaries more nearly commensurate with their contribution.

**Teachers' special obligation**

But I have some earnest hopes as well. Most of them can be resolved in the simple statement that I hope the professors will be fair. Not that they would wish to be anything else— I intend no such implication. But there is no escaping this fact — that the great majority of teachers, simply by reason of spending their lives as teachers, are not intimately and at first hand familiar with the facts of life in industry. It therefore seems to me that they are under special obligation to be sure their influence on young people with respect to industry is not based on attitudes wherein opinion fills a void unoccupied by facts.

Every socially useful calling needs talent — the professions, teaching, science, the arts, government service — all these and industry too. I say only, let those in education who are so aptly situated in time and place to influence young people avoid like the plague any disposition to steer able minds and stout hearts away from business on grounds that business is unworthy of their interest.

The continuing main job of industry is to translate an incredibly complex technology to the service of man. To do this well we shall need our full share of men of high intellectual attainment and moral commitment. If the power elite in education ever takes the view that the best and brightest minds should all go elsewhere, and business make do with what is left, the results will be disastrous — not alone for business, but for the professions, the arts, education itself, and the nation.

In our business we want to think of ourselves as partners with education, not rivals. We want to exchange views and increase mutual understanding. We have had quite a few meetings with distinguished professors from a variety of disciplines, and we expect to have more.

It is often said that we in business don't do enough to "tell our story." The implication of this is that if a teacher doesn't know what is going on, it is somehow our fault for not telling him.

I disagree with this. This is a two-way street and there is a need for initiative from education also. So far, that initiative seems to be left largely to the business school professors and a few others in economics.

I don't think this is enough and it seems to me that it might provide a welcome change of pace — and serve understanding as well — if among the celebrated novelists, poets, philosophers and public officials invited to share their wisdom in campus seminars and symposia an occasional businessman might appear. Given the right man, it seems to me that exposing the students to an executive, who — perhaps to their surprise — turns out to be no less ethically committed than they and no less idealistic, but who must bear the consequences of his actions, could prove a stimulating experience indeed.

Finally, it just seems to me that our country has too many tasks yet undone to permit us to tolerate barriers to understanding between two callings that *must* cooperate if we are to make a good future. ☐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A peculiarly American phenomenon, industrial designers have influenced our living habits by improving the appearance and function of mass-produced products. One of the foremost designers gives his philosophy on

# Adapting Products to People

During a career that has spanned nearly 40 years, Henry Dreyfuss has helped change the shape, color, and performance of countless products. As a consultant to Bell Telephone Laboratories since 1930, he has had a hand in the design of almost every Bell telephone as well as related products. From his drawing board have also come designs for television sets, airplane interiors, cameras, bathroom fixtures, gasoline service stations—even bowling alleys and flyswatters.

One of the original "big three" of industrial design (Raymond Loewy and the late Walter Dorwin Teague were the other pioneers in the field), Mr. Dreyfuss helped translate Louis Sullivan's principle that "form follows function" from architecture into industrial design. What he and other designers did was to demonstrate to American manufacturers that good design could be a "silent salesman" extolling a product's utility and other values.

Mr. Dreyfuss, who was once referred to as an apostle of human engineering, built his reputation on the belief that people are the most important consideration in designing a product. Displayed on the walls of his New York and California offices are line drawings of human figures (dubbed "Joe" and "Josephine") that describe in infinite detail the physical dimensions of "Mr. and Mrs. Average American." These anthropometrical studies have helped determine the height and shape of a chair, the length of a vacuum cleaner handle, and the size of a telephone handset.

*With silent partners, "Joe" and "Josephine," in the background, Henry Dreyfuss talks about designing for people.*

Mr. Dreyfuss, whose list of clients is limited to 15 at a time, is also a firm believer in personal research. In the course of his work he has done everything from running a diesel locomotive to operating a telephone switchboard.

A seemingly tireless man whose solemn appearance belies a lively wit, a long-abiding interest in the theater, and a passion for unusual gadgets, Henry Dreyfuss can look back on a career filled with honors and awards. He is more concerned, however, with looking to the future. Where industrial designers were once concerned mainly with a better looking or better acting product, they are now deeply involved in long-term planning, sometimes working on products for use 10 to 20 years from now.

It was while enjoying a brief vacation in Mexico that the request to do an article for Bell Telephone Magazine reached Mr. Dreyfuss. "My first impulse," he said, "was to put off your request until I returned to civilization—but on consideration, I realized how seldom I have an opportunity for uninterrupted thought. This holiday gave me a chance to ruminate and put down ideas about design that continually run around in the back of my head but are normally crowded out by more immediate problems."

On the following pages are the ideas—some new, some elaborations on old ones—as Mr. Dreyfuss expressed them.

# Adapting Products to People

## by Henry Dreyfuss

How do you start a product design? First, we take a look at those men, women, and children who will be using the product. In every way, we try to put ourselves in the place and environment of the user. We interest ourselves not only with dry anatomical dimensions, but also with matters concerning the senses — what colors, textures, sounds, and smells either please and attract or annoy and repel. In the words of our office creed:

"We bear in mind that the object we are working on is going to be ridden in, sat upon, looked at, talked into, activated, operated, or in some other way used by people."

Anyone who has worked with us knows that our every line is dictated by two anthropometrical silent partners, "Joe" and "Josephine." They have physical dimensions determined by a physician, sight characteristics supplied by an opthalmologist, hearing capabilities furnished by an otologist. We also know a good deal from psychologists and psychiatrists about how Joe and Josephine will act in periods of relaxation or strain.

To what Joe and Josephine tell us about the design of the product we add our knowledge of materials, manufacturing, marketing, and what we know about proportion, line, color, and texture. Many forms and functions are integrated into what we trust will be a pleasing and acceptable whole.

If we have worked closely with our client's engineers and been constantly guided by our technical knowledge, the product should be capable of being manufactured within budget and sold for profit.

Perhaps we could say the industrial designer acts as the product's conscience.

### Life with engineers

Our best friend and sincerest critics are engineers. It is inconceivable that an industrial designer could develop a product without the closest coopèration of the client's engineers. They are the wings on which

*During a visit to Bell Telephone Laboratories, Mr. Dreyfuss checks on the progress of a new telephone design.*

an idea can be borne into reality.

We have had the rare privilege of working with great engineers. Our experience has been that the greatest seldom say "No"; invariably they are stimulated by the seemingly impossible and say, "Let's try."

There was a time, however — and it wasn't too long ago — when an engineer resented an industrial designer's appearance on the scene. "What can he do that I can't do?" the engineer asked. "What's he got that I haven't got?" As a consequence, the industrial designer found himself struggling mightily to convince the well-established engineering groups that he had a valuable point of view to contribute. Unlike many engineers, the industrial designer did not readily accept the restrictions of material and machine. Or at least he accepted the restrictions as a challenge, and stimulated the engineers to do handsprings to develop superior means of fabrication, use new materials, and find new uses for old materials.

For example, the swift and great advances made in plastics — as well as their universal acceptance — may be attributed to the teamwork of engineers and industrial designers. We demanded a stronger material that was stable and durable, and the supplier rose to the occasion and delivered it. With a magical capacity to produce nearly anything demanded of them, plastics have liberated the form and shape of things. In turn, they have forced on the supplier new and improved means of fabricating older, competitive materials. So all have profited.

## How do you know you are right?

Certainly industrial designers do not have any special clairvoyance. But we do have past experience and past performance, which adds up to something we have dubbed an "educated hunch."

Objectively and vigilantly, the industrial designer studies the consumer for whom the product or service is being designed. What is the man in the street reading? What artist is he currently admiring? To what rhythms is he tapping his foot? Is his imagination being stirred by the promise of a bat-winged supersonic plane, or are the wonders of the deep sea awakening his soul? Is there a new movie queen on the horizon? Has the primitive African culture invaded our intellect? Answers to all these questions — and much more—will help the industrial designer discipline his thinking on the shapes of things to come.

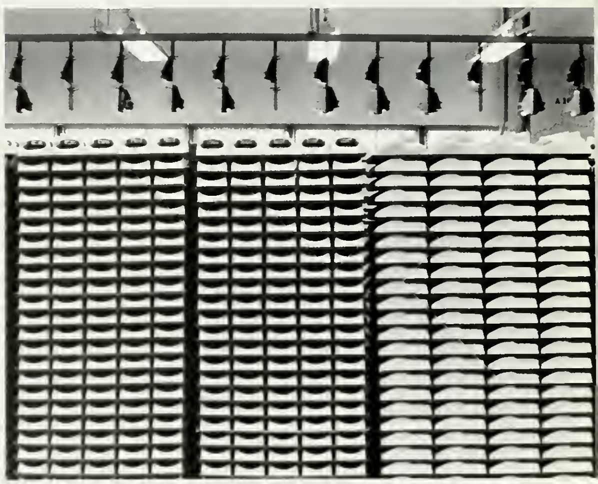
So many things in science and industry are measurable. But there are no known formulas for taste; it cannot be proven by numbers. Taste is nebulous, indefinable, nondetectable. It is probably an ectoplasm that experience alone can satisfactorily gather together.

Unlike science and engineering, you cannot prove the excellence of a good design. No equation has been written for good taste.

## Multiplication of error

A designer for mass-produced merchandise is forever terrorized by the fact that any mistake will be produced and reproduced by the thousands or millions once the drawings are released, the tools made, the unrelenting machines started. Before the first advertisement appears, distribution pipelines must be filled. And by the time the stocking of warehouses has been completed, there is no chance for correction. The point of no return has been long passed.

On the other hand, there can be no greater reward than to have those same machines turn out millions of an acceptable product. A well-designed product inevitably raises the level of consumer taste. This in turn conditions the consumer to exercise his improved taste the next time he goes shopping. Thus, by raising the level of public taste, the industrial designer has acquitted himself of a major responsibility.



*Each year, millions of telephones are turned out by Western Electric. The mass production of a well-designed product, Mr. Dreyfuss says, is a designer's greatest reward.*

## Designer for the future

When a painter, sculptor, writer, or musician completes his concept, it is immediately ready for presentation to the public. Often it becomes a timeless contribution to our heritage.

With the industrial designer, it's different. Given the task of having to make a particular contribution to industry, we have to discipline ourselves to produce for the future. Depending on its magnitude, it generally takes a product from two to seven years to move from drawing board to marketplace. First comes the call for a new product; then comes the incubation period for inventors, the engineering, the industrial designing, the prototypes, the market testing, the tools, the retesting, the production and the distribution. And, of course, all along there are time-consuming trials and errors, occasional disappointments, and a few headaches.

In our presentation to clients, we must direct their attention to the future. We must demonstrate that, if the design being presented were acceptable today, it would be out of date two to seven years hence. We have to convince them that the seemingly "way-out" model we are showing them will not be way-out by the time it meets the consumer in the marketplace.

## The computer and the industrial designer

It is hard to think of one single thing that has not been affected by the advent of the computer. Certainly the industrial designer has felt the quickening impact of that magic brain. It used to take weeks, even months, to answer technical questions, prove strength analysis of materials, translate market research. The computer does it instantly.

A part of the computer input of the future would be up-to-the-second vital statistics — or perhaps a government standard on anatomical information. It will become common for computers to verify the dimensions on drawings of all things used by people.

Computers should also help architects and industrial designers solve the thorny problem of selecting the right materials and components from the many available. Sweet's Catalog, the bible of our profession, grows more ponderous with the addition of every wonder. Eventually a similar catalog will be committed to computer tapes, with new data added on the hour. A phone call will give us a selection to meet our specifications.

But I question that a mechanical device can ever be truly creative. Granted that all combinations of all musical notes may be put on tape, who will call the opening chords of the Fifth Symphony into being? Even with all the curves and angles recorded, who is going to summon up the sweep of a staircase or the proportions of a fine chair? It will take a man with taste and perception, not a machine. However, if the computer will not make us better composers, architects, or designers, at least it will make us faster ones. We must learn to use it as a tool and with absolute discretion. It can be a great servant, but we must protest its being a runaway master.

For the most part, people seem to resent change. Although the younger generation goes in for "mod" clothing and a new tune every day, most of us are reluctant to shift gears. We are afraid to rock a smooth-sailing boat.

Often when a new design is presented, everyone comes to the defense of the current model. Yet when it was first shown, the current model was ridiculed in favor of the product then being manufactured. It seems we breed purple cows and are reluctant to topple these successful idols from their pedestals.

But although industrial designers are in the business of change, we resent planned obsolescence. A change in technology, improved efficiency, additional safety or comfort, a new utility development, an improved method of fabrication, the introduction of a new material — these warrant a new physical expression. But to put a "new look" on an existing piece of merchandise — this, to us, constitutes the duping of an unsuspecting public.

We say that a design expresses the excellence of its engineering and reflects the integrity of its manufacturer. That hardly suggests a seasonal change. We are not in the profession of style or fashion. Ours is a basic approach; our designing must be generic by nature. If the most contemporary of design can be called "classic," then call us classicists.

## On creativity

One of the best stories I know on creativity has to do with Edwin Land. While in Santa Fe on vacation, Land was taking snapshots of his family with a standard camera. His little daughter wanted to know why she couldn't see the pictures right then and there. Walking around town, Land kept thinking: "That's a good question. Why can't you?"

As he recalls it now, "Within an hour, the camera, the film, and the physical chemistry became so clear to me that — with a great sense of excitement — I hurried over to the place where our patent attorney was staying (in Santa Fe by coincidence). I was able to describe to him in great detail a dry camera, a camera that would give you the picture immediately after you snapped the shutter."

This ties in with a theory I have developed. Within each of us is a memory tube in which everything we

*Working with a young staff member in his New York office, Mr. Dreyfuss suggests some design changes. "The public today," he once said, "is getting better designed goods than the wealthy got forty years ago in made-to-order products."*

see, hear, feel, taste or smell is recorded on its interior walls and stashed away for future reference. The tube may be compared to our grandfather's rolltop desk in which information was neatly pigeonholed or to a modern computer in which all the input is ready to be called out.

Clinging to the walls of the memory tube are billions of little "experience blips" — the first sensation of pain, the smile of a teacher, the whistle of a train, the lights of Times Square, the taste of peanuts or caviar, the harmonics of a Brahms' symphony, 20 giraffes galloping in front of an oversized moon. What does it matter? It's all there, all of these experiences, many of them unknowingly absorbed. How many of these blips there are and how vivid they are depends on how astute our observations have been.

Let's say that suddenly we have an inspired thought and that it has a dire need for enlargement. We drop this request for aid into our tube. Down it spins, extending antennae which attract idea particles (the experience blips). If the particles are pertinent to the need, their contribution is accepted and then the blip is put back for use another time. By the time the idea has spun the length of the tube, all of our past experiences, our remembrances, good and bad, have offered their contribution. Our real creativity relies on how well we have stored the knowledge, on our perception in retrieving it, once we need it, and on our ability to synthesize it for use in the proper proportion. With a little bit of luck, good ideas may thus be born.

No one has proven what makes for creativity. But fortunate is the creator whose experience and knowledge can substantiate his dreams. Particularly fortunate is the creator who can direct his far-flung thoughts into a productive channel. ▢

*The evolution of a product design requires close cooperation with the client. Here, Mr. Dreyfuss reviews future plans with members of Bell Laboratories' customer equipment development group at Holmdel, New Jersey.*

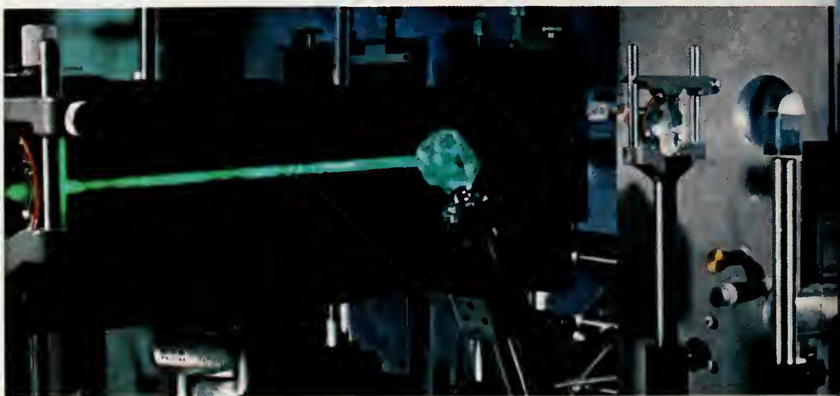
# LASERS

## the promise in a beam of light

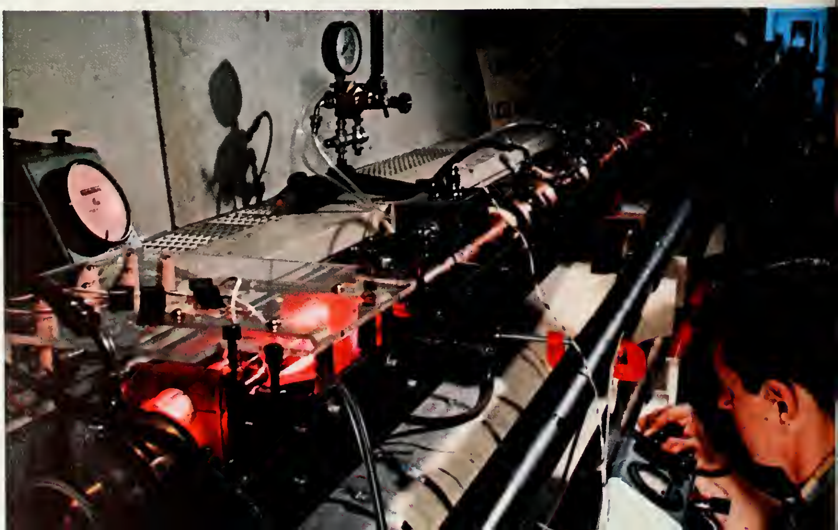
Scientists learned to manipulate matter and energy at the atomic level—and produced the laser, one of this century's most important technological achievements. In the few years since its inception, the laser has proliferated into many forms, directed to diverse uses in science, medicine and manufacturing. At Bell Telephone Laboratories, where it was invented, the laser is proving to be a powerful and versatile research tool. Scientists there are also exploring its potential as a communications medium. The following pages give a pictorial sampling of laser development at Bell Laboratories.

*Crystal modulates laser beam in on-off pulses for experimental working model of high-speed information storage system. Laser beam is "folded" — reflected back and forth between mirrors — as shown by H. A. Stein in this demonstration. This forms an optical delay line from which information carried by beam can be retrieved after a maximum of 10 millionths of a second.*

*Solid state laser emits bursts of infra red light in trains of 10 to 20 pulses; entire train lasts only one 50-millionth second, has peak power of more than 100 million watts. Bell Labs' scientists at Murray Hill have generated world's shortest pulses (less than one pico-second) and devised technique to measure them. Pulses provide a "yardstick" of a size compatible with events on the atomic scale and enable scientists to examine motions of molecules in liquids and solids. Picture shows invisible laser beam hitting crystal, which converts infra red to brilliant green spark. Somewhat similar technique involving a non-linear effect permits measurement of pulse widths.*



*Experimental laser communications transmission system uses gas lenses to focus beam. This pilot model operated by H. W. Astle, aimed at development of an eventual 4,000-mile line, uses ordinary air in each "lens"; by varying rate of air flow through heated tube centered inside sections of copper pipe, beam can be focused. Invented at Bell Laboratories, the gas lens can keep laser beam focused sharply over distances with almost no loss in energy, which is not possible with glass or quartz optics.*



*S. P. S. Porto at Bell's Murray Hill, N. J. lab investigates the effect of argon laser coherent light on molecular behavior of crystals. The known single frequency of laser beam enters the crystal, which emits a different frequency as a result of molecules in the crystal moving in certain patterns. Double spectrometer designed by Dr. Porto makes accurate analysis possible. "With the laser," he says, "we can do now in half an hour what used to take us weeks." Here, the argon laser's intense blue-green beam impinging on a synthetic ruby produces beauty seen only in the laser laboratory.*

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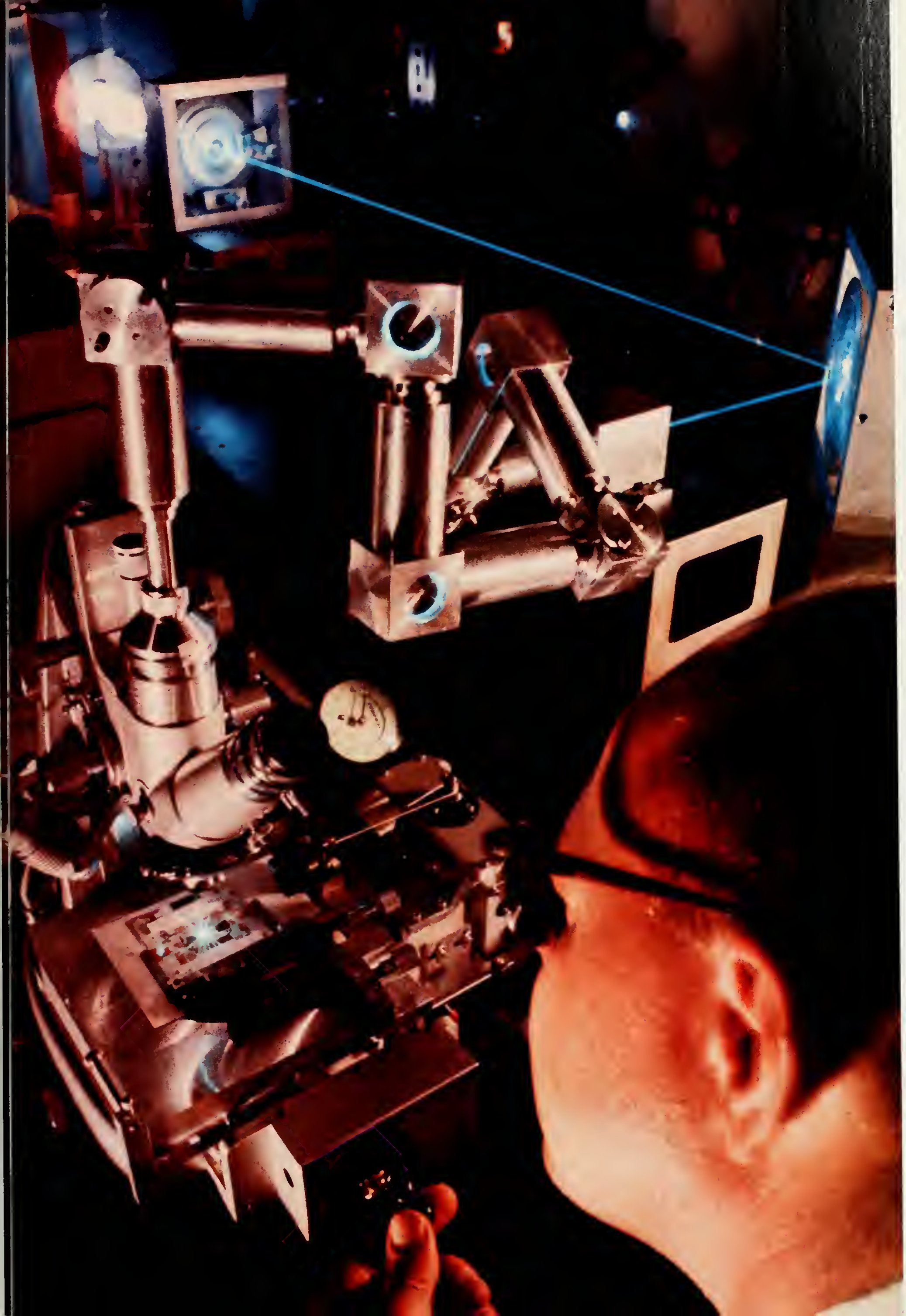

# BELL reports

## Bell Telephone Hour Honored

The American Symphony Orchestra League, in cooperation with the California Arts Commission, has awarded its Gold Baton to the Bell Telephone Hour television series "in recognition and appreciation of its generous and imaginative exploration of the world of music." The presentation was made in Los Angeles as one of the highlights of the 1967 National Conference of the Orchestral Association.

The Bell Telephone Hour returns to the air for its 28th season this fall, and will be seen every third Friday at 10 p.m. (Eastern Time) on NBC. Programs will feature such artists as Duke Ellington, Yehudi Menuhin, George Plimpton and the New York Philharmonic Orchestra, Zubin Mehta and the Los Angeles Symphony Orchestra, as well as the sights and sounds of Chicago and the Bach Festival of Bethlehem, Pennsylvania.

## Beautifying with Buried Cable

The Bell System program to bury all telephone cable serving new residential areas has accelerated dramatically since 1955 when buried cable served only 2,000 new construction units. Last year, the figure jumped to 637,000 and this year could reach 750,000 — meaning that over 60 per cent of all new units in the nation will be served by buried cable.

The success of the program is due largely to such Bell Telephone Laboratories innovations as the development of a moisture-resistant plastic insulated conductor cable and several new tools and methods for burying cable. The most recent development is a compacting auger that tunnels under lawns, streets, and other obstacles at eight feet per minute with minimum public inconvenience.

In addition to beautifying the area, buried cable is not as susceptible to storm damage as aerial wire, an advantage which means less interruption to telephone service. Though underground cable is sometimes cut accidentally, phone companies are reducing these mishaps by asking builders and homeowners to check cable locations with them before digging.

The Bell System buries cable in all new areas when technically and economically feasible. Essentially all new subdivisions are expected to be served with underground cable by 1970.

## A Better Electron Tube

A modified electron tube — the "416 Planar Triode" — now being manufactured by Western Electric shows excellent promise of helping to double the capacity of most radio relay systems. The tube's output capability has been more than doubled by the insertion of a ceramic insulator, which replaces the glass insulation used for the past 17 years. The new tubes are presently being field tested in an existing radio relay system from Adams, Texas, to Hardy, Oklahoma.

## Lab to Become Artist Colony

Bell Telephone Laboratories' former headquarters on New York's lower west side will soon be converted into a colony housing some 500 painters, sculptors, and other artists, due to the combined efforts of the J. M. Kaplan Fund and the National Council on the

Arts. The eight-building site, which housed Bell System research and development facilities from the turn of the century until last year, will soon be sold by Bell Labs for $2.5 million. When completed in early 1969 at a cost of $10 million, the center will become the nation's heaviest concentration of artists and the first of its kind in the United States.

### New calling services tested

Several new Custom Calling Services will soon be offered to most Bell System customers as the result of successful market trials in Wellesley, Mass. and Sioux City, Iowa. The new services include Call Waiting, Call Forwarding, Speed Calling, and Threeway Calling.

In Call Waiting, a short tone signals a person already talking on his phone that another party has dialed his number. He may then depress the button on the handset cradle, "holding" the first call while he answers the second.

Call Forwarding enables a person to transfer all incoming calls to another number in the same calling area by dialing a special code on the originating telephone. Speed Calling allows calls to a list of eight frequently called numbers by dialing one digit, instead of the usual seven or ten digits.

Threeway Calling permits a third party at another number to be added to a call already in progress. The person originating the call may "hold" one called party on the line while dialing another, then hold a private conversation with the third party before establishing the connection for a three-way conference.

### New Portable Phone Developed

An experimental lineless extension telephone — a battery-operated portable unit that performs the major functions of a regular telephone set — will soon undergo field trials in the Boston and Phoenix areas. The unit connects via a radio link to a fixed station which, in turn, is connected to a telephone line or extension in the regular telephone network.

Unlike walkie-talkies and push-to-talk telephones, the new cordless telephone provides simultaneous two-way conversation, as well as dialing and ringing. Designed to be carried on a belt or in an overcoat pocket, the phone now has a range of from 100 to 1500 feet from the fixed station.

The new phone is expected to be most useful in such locations as a construction site, on a convention hall floor, or in other situations that require temporary service, particularly if mobility is needed or if running telephone wire would be difficult.

### Overseas Calls Improved

The transmission quality of overseas telephone calls will soon be considerably improved with new high frequency radio equipment developed jointly by Bell Telephone Laboratories and the British Post Office. The equipment, which has been successfully tested between New York and Buenos Aires, performs almost as well under normal atmospheric conditions as modern coaxial ocean cable. During unfavorable conditions, the system performs better than conventional shortwave circuits. The new equipment reduces fading and noise.

### Information Service Demonstrated

A new service which permits students and teachers to have telephone access to a library of recorded information was demonstrated at the American Management Association's recent Education and Training Exposition in New York City.

The service, which will be offered to schools and colleges this fall by the Bell System, will enable students and faculty to call the school's "resource center" and hear recordings on a wide variety of subjects.

At the AMA meeting, the Bell System also demonstrated a special system which will permit educational institutions to offer a program of talks and discussions during the day or evening. Students would be given schedules indicating the times they can hear a recorded lecture by telephone. Live lectures can also be made available this way and, when feasible, permit students to question the lecturer by telephone.

## Appointment to Cambridge

A Bell Telephone Laboratories physicist, Dr. Phillip W. Anderson, has been appointed to a new chair of theoretical physics in the Cavendish Laboratory at Cambridge University for the next three years. He will alternate between half a year of teaching and research at Cambridge and half a year of research at Bell Labs. This is the first part-time professorship awarded in the university's history, though several Bell Labs scientists have similar arrangements at U.S. universities. Dr. Anderson was also recently elected to the National Academy of Sciences in recognition of his distinguished achievements in original research. He joined 11 other Bell Labs members in the Academy.

## High School Science Aids

As it has done since 1961, the Bell System is once again offering a program of science aids to the nation's high schools.

Designed to help teachers present important fundamental concepts in the physical sciences, the Bell System room unit that is intended to fill in where textbook and teacher information is incomplete or outdated. These units, which generally include a textbook written by a Bell Telephone Laboratories scientist, cover a broad range of subjects and take advantage of new knowledge gained from recent Bell Laboratories research.

The other teaching aid is a self-contained science experiment for students who are capable of doing more advanced work.

Since the inception of the program, nine teaching aids have been developed, covering such topics as similarities in wave behavior, ferro-magnetic domains, speech synthesis, and crystallography. Much of the material in the kits is offered at no cost while the rest can be obtained from outside concerns at nominal prices.

*This small tank is a precision apparatus which enables students to grow crystals in the classroom. Crystallography is one of the subjects covered by Bell System science aids.*

About 88 percent of the nation's physics teachers are aware of the Bell System program, a recent survey points out, and two out of three of the teachers surveyed are using the science aids in their classrooms.

## Weather Warning System

Within a few years, a tornado brewing in Kansas will hardly have a chance to form before an alert is being flashed across the country.

The reason: ESSA (Environmental Science Service Administration), a Teletype weather warning system developed by AT&T and the U. S. Weather Bureau. ESSA was introduced last year with circuits in Indiana, Kentucky, southern Illinois, and eastern Missouri. Iowa has since been added to the network, and by the end of the year, 13 more states and parts of four others will join the weather warning system. All of the states, which include most of the midwest, south, and southwest, are rated as "highest tornado frequency areas."

The system already has 105 weather bureau stations which can send and receive storm warning information, and by 1970, all 48 mainland states will be linked into ESSA.

Since the main function of the system is to warn the public in advance of tornadoes, hurricanes, and other potential natural disasters, the federal government is encouraging mass media to connect into the system. As a result, more than 700 newspapers, television and radio stations are now equipped with receiving Teletypes, and many more are expected to be tied into ESSA when it becomes nationwide.

Although barely in operation, the system has already been credited by an Iowa meteorologist with alerting people to a recent series of storms which might have cost many lives.

## Wild Life Preserve Created

AT&T Long Lines Department has leased for ten years without charge a 2,500-acre tract at Manahawkin, New Jersey, to the U.S. Bureau of Sports Fisheries and Wild Life. The area is now officially a wild life sanctuary. A natural habitat for geese, heron and other wild birds, the sanctuary will not affect the use of Long Lines overseas transmission facilities on the land.

AT&T

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# BELL

telephone magazine



The Persuasive Influence of Chemistry
Page 28

AT&T

*An editorial*

# Regulation and Great Enterprise

*In a recent speech before the Economic Club of New York, AT&T Board Chairman H. I. Romnes discussed the impact of regulation of business on the economic life and general welfare of the nation. His comments on the relationships of regulation to business exercise of its social responsibilities follow:*

I don't believe urban problems will be solved or will even be greatly ameliorated by government alone. I do believe the active participation of private business is essential and can be and will be influential.

But it costs money, there is no doubt about that. For example, it will cost a lot of time, energy, and money to develop methods for training and employing people who in past times would not have been considered for employment. The best way to encourage expenditures for such purposes, in my belief, is to give the regulated enterprise a certain latitude, a little elbowroom, let us say, that will influence managements to do what they know they ought to be doing. In the alternative—if a management is forced to act under strongly restrictive constraints—the tendency is bound to be toward concentrating on measures that will show immediate results. Wise action of longer range tends to be deferred.

Now, there is surely immediate and pressing need for action to meet the commingled problems of poverty, education, racial strife and Negro unemployment. But the immediate effort and expense entailed do represent a long-range investment in tomorrow, and to undertake it business managements must feel that they have the requisite freedom to act.

While this is more than a matter of self interest, it is certainly that as well. The good health of the telephone business, for example, is unquestionably wrapped up in the good health and vigor of developing urban life. Effective action on our part to help solve the problems and evils that threaten the cities is vitally important to our future as a business.

But this is not to say to a regulatory commission, "When we incur expense in this effort, please keep us whole." That would simply duck responsibility, as does any cost-plus approach. My point and my plea are just the opposite—that in the case, for example, of regulated business, managements should have open to them the latitude demanded for the exercise of judgment, choice, innovation, decision to save, decision to spend: in short, the range that *requires* us to accept all the *responsibilities* of management.

I can't refrain from restating my conviction that if industry is to accomplish its potential—if our enterprise is to be enterprise-plus, so to speak, rather than cost-plus—if we are to have, in fact, what I want to call *great enterprise*—this basic need for reasonable latitude and freedom will have as powerful an influence on the future as it has always had in the past.

In the last analysis our concern is to motivate people . . . The great responsibility of all regulation, it seems to me, is to get its job done through a process of encouraging people. The challenge here is really no different from that which confronts management itself—and it is equally difficult. The needs of people must be fulfilled. This is vital to them personally and to the quality of all work. □

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On the cover   Photo-chemistry research at Bell Telephone Laboratories crosses the boundaries of several disciplines: physics, physical chemistry, chemical physics and organic and non-organic chemistry. The cover picture shows dyes emitting light due to excitation of their molecules by long-wave ultraviolet, or "black light." This reaction in the dyes simulates what Bell Laboratories scientists believe occurs when certain plastics, particularly polyethylene, are exposed to light Such research may help develop materials that can be added to polyethylene during manufacture to reduce the destructive effects of light on plastic cable sheaths. For an insight into the pervasive influence of chemistry see page 28.

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# The Changing Role of the Telephone Operator

New technology and new operating procedures have altered almost all aspects of the job of the telephone operator. What has not changed is the role operators play in the sympathetic handling of emergency calls.

"I'm so sick," the woman's voice on the other end of the line said.

When Mrs. Linda Taylor, a Richmond, Virginia, telephone operator heard these words, she knew this was not another routine call.

The caller, who had suffered a stroke was only able to give her name and that of her doctor, but it was enough for Mrs. Taylor and her supervisor, Mrs. Norma Harris, to go on. Keeping the line open to the stricken woman, they called the doctor, only to learn he was not in. His nurse, however, was able to supply the address and an ambulance was dispatched.

The two operators then located the woman's husband at work and told him his wife was being taken to a hospital. Mrs. Taylor, meanwhile, was still trying to comfort the woman when she heard a man's voice on the other end. A member of the rescue squad that had been dispatched to the scene said he found the woman on the floor, unable to get up, but fortunately within reach of a telephone. Although in critical condition, she was rushed to the hospital in time to save her life.

An isolated example of a quick-thinking operator aiding a person in distress? Hardly. Each year, the first action nearly 15 million people take when they need help is to grab a telephone to dial "zero" for Operator. More than 40,000 times a day, Bell System operators receive frantic calls for aid from the sick, injured, helpless and frightened. Operators, often working in teams, have guided these callers to doctors, police and fire departments, relatives and clergy. Or, as in Mrs. Taylor's case, they quickly summoned the help that was needed.

The task that Mrs. Taylor and her supervisor performed is neither unusual nor unlike similar action that operators have taken since Emma Nutt became the first woman telephone operator back before the turn of the century.

And yet, in spite of the heroic efforts of operators, actually the best way to get help in an emergency is

*New traffic service positions reduce the time an operator spends on a call since equipment handles routine phases of a call.*

through a direct call, be it to the police, fire department, doctor, or whatever person or agency is needed.

Because of the operator's ability to keep lines open, route calls, identify calling numbers, and otherwise provide assistance, dialing her serves as a good back-up procedure to follow when the number for the specific agency needed is not readily available.

Recognizing their obligation to provide effective communications in emergencies, Bell System operators have acted as "midwives" to expectant mothers, assisted people stricken with heart attacks or injured in accidents, given instructions on mouth-to-mouth respiration, helped catch prowlers, and located lost children.

This dedication to serving the personal communications needs of individuals is about the only facet of the operator's job that has not changed in recent years. There are so many changes taking place in the operator's job today that it is difficult to compare her job with the familiar stereotype of yesteryear.

Although she is no longer able through personal knowledge of a customer's whereabouts to tell an individual that the person he is calling is visiting down the street, today's telephone operator has, in many ways, become more helpful. Since the routine calls — both local and long distance — are generally dialed directly by the customer, it is only where the customer has difficulty, or cannot complete the call himself, that the assistance of the operator is needed.

Consequently, operators require considerably more tact and judgment than was once needed. Call handling procedures, too, have been modified to

*Overseas operators at traditional switchboards now dial directly to telephones in seven European and five Asiatic countries.*

*Network management centers keep tabs on calling volumes and equipment irregularities so alternate routes can be quickly established. The centers also make plans to handle predictable increases in calling so calls can go through without delay.*

give her more flexibility in handling the individual requests of customers.

There is also an increasing trend to delegate more responsibility to the individual operator, a trend that is receiving a favorable reaction from operators and customers alike. Typical of the ways this is being done is by letting the operator use whatever phrase most appropriately fits the situation, rather than have her rely on a standard statement, and otherwise permitting her to use her judgment in handling calls.

The most drastic change — in physical surroundings at least — has resulted from the introduction of traffic service positions which are replacing the traditional switchboard. Instead of using a pair of cords and plugs to complete a call, an operator at a traffic service position depresses various combinations of keys.

With TSP, the customer dials person-to-person, collect and credit card calls, and the actual switching of the call is handled by the equipment. The operator, who can display the number he dialed and the number he is calling from, comes in on the line to provide assistance, deal with the called party, and to record special information for billing purposes.

TSP provides the customer faster service and more accurate billing of calls. Since there is less time spent in switching a call, and more dealings with customers, the traffic service positions provide the operator greater opportunity to use her own judgment and initiative in helping fulfill the needs of the customer.

Automatic call distributors, which regulate the

*About half of the calls to Information operators are for numbers correctly listed in the customer's telephone directory.*

volume of calls being directed to each operator, also contribute to better service. With the newer equipment now being installed, calls from one community can be automatically switched to operators in another office where an operator is available.

Finding alternate ways to complete a long distance call is also done automatically by equipment today. But network management centers, located throughout the country, play an important role in keeping track of the volume of calls on long distance routes so alternate routing arrangements can be made whenever calling volumes or equipment problems overload circuits.

The use of computers, too, is helping today's telephone operator. An operator in Minneapolis, for example, can obtain information on rates needed to complete a call by quizzing a computer in Omaha. Seconds later a recorded voice provides her the information she needs.

The most distinguishable change in another operator service — Information service — is in the volume of calls: in the last 10 years, Information calls jumped from about 6,000,000 each day to over 12,000,000, a significantly bigger increase than the total of all telephone calls.

The current trend in Information calling volumes will require the Bell System to increase the force of Information operators from the present 40,000 to 84,000 by 1980. The importance of providing good Information service is evident in the fact that today calls to Information have risen to the point where they constitute about 45 percent of all operator contacts with telephone customers.

The establishment of centralized information centers which handle requests from long distance callers has also heightened the need for good Information service. Many Information operators are now responsible for a much larger geographical area and must use more ingenuity and resourcefulness in order to fulfill individual requests. Operating procedures have been changed to give her more flexibility.

Because every request for Information is tailor-made to an individual's needs, it has been difficult to introduce time-saving equipment. But a couple of possibilities are now under development: One is a semi-automatic Information console in which all records will be stored in a computer. By keying into the computer significant data — like the first three letters of a person's name — all listings starting with those letters will be displayed on a cathode tube.

The other system under development will use computer technology with photocomposition devices to produce more flexible Information records. Daily changes in listings will be fed into a computer as they occur and stored on magnetic tape which will be used to set a telephone directory page in less than a minute.

Changes in the role of the overseas operator are somewhat at the stage that domestic long distance operators faced in the mid-fifties when direct distance dialing was beginning to be introduced on a broad scale. Modifications of call-handling procedures have been more significant than technological changes, except, of course, for the interchangeable use of cable and satellite circuits.

Overseas operator dialing made its debut on service to Hawaii in 1957 when operators there and on the U.S. mainland began dialing straight through to the distant telephone. It was subsequently expanded to other points in this hemisphere, and by 1963 Alaska, Puerto Rico, Bermuda, the Bahamas, Jamaica and the Virgin Islands were added to the list. Now operators can also dial directly to the called telephone in seven countries in Europe, and telephones in Australia, Japan, Hong Kong, Singapore and Malaysia.

Customer direct dialing, at present, is limited to the Virgin Islands, although a recent trial between New York, Paris and London indicated that DDD to overseas points is technically feasible, that customers like the service (especially its speed), and that customers experience little difficulty in dialing an international access code, or in understanding different ringing and busy tones, foreign speech, and foreign recorded announcements.

The fundamental problem in expanding DDD to overseas points has been the lack of uniformity among telephone systems around the globe and the number of digits that must be dialed. Significant progress, however, is being made in developing a uniform, world-wide numbering system and modifying equipment to permit small-scale intercontinental customer dialing early in the 1970's.

The rapid growth in overseas calling—at the rate of 20 percent per year over the last dozen years—is encouraging AT&T and its foreign telecommunications partners to use their best ingenuity to meet overseas traffic requirements.

Despite time-saving procedures and the introduction of new technologies, the growth in long distance calling—both foreign and domestic—will require a substantial increase in the number of operators. Though her job may be changing, the need remains for skillful, helpful and understanding operators. ▢

*Although operators are always available to handle calls, dialing directly is the quicker way to obtain emergency assistance.*

# The Growing Importance of Human Ecology

by Lawrence E. Hinkle, Jr., M.D.

A broad-scale attack on the problems of environment and health—such as the Bell System is taking on the relationship between work and heart disease—is needed because of our rapidly changing technology.

"Ecology" is an "in" word these days. You hear it used by people in government, business and academic life, by people who are engaged in activities as varied as the control of air pollution, the use of pesticides, the development of highways, the control of population growth, and the study of disease.

"Ecology" is the study of the "oikos": the "neighborhood," the "dwelling place," the "habitat." Specifically it is the study of the *interrelations* between organisms and their environment.

By its very nature all ecology is complex, but human ecology is especially complex, because of the complex nature of man. Not only must man adapt to the food he eats, the air he breathes, and the bacteria and pollens he encounters, but he must also adapt to his family, his community, his job, and to many other facets of his society, the people in it, and the rapidly changing technology he has created.

It has been this rapid development of technology that has led to the present growing concern about human ecology:

• As we have created new pesticides and have applied them to our fields in order to obtain a greater yield of food crops, we have found that when we

destroyed the pests, we destroyed other plants and animals that we wish to have. Furthermore, some of our chemicals have been eaten by fish or animals, which people in turn have consumed, and the chemicals have found their way into human systems.

• As we have developed electric dishwashers so we could get the housewife out of the kitchen, we have found that we needed new detergents to make them work well. Unfortunately, some of these new detergents were immune to the bacterial action that destroys soap. They passed through our septic systems and our sewage disposal plants. Soon we had suds in our streams and foam in our drinking water.

• As we have developed automobiles to get us around more quickly, incinerators to burn our trash, and power plants to supply us with our ever-growing needs for electricity, we have found that there is a haze in the air over our cities, and on still days our eyes smart because of the smog that we have created.

But these are only several of the simpler and more obvious effects of some of our interactions with our environment. In many ways, some subtle and some not, the whole pattern of human life is being changed by technology. If you compare the life of a farmer of five generations ago with that of an American working man of today, you can quickly see contrasts at almost every point.

Consider the farmer of the year 1800. His major threats to existence were infection, malnutrition and injury. To him the dangers he faced were immediate: an angry bull or a swarm of bees. Or they were unpredictable: pestilence, drought or storm. There were few options for him. He could meet his challenges by hard work, by prayer, or not at all.

Compare this man with an American workman of today. The major threats to this man's existence are no longer infection or malnutrition; he is much less likely to die or be disabled by the effects of an injury. No longer are he and his children prey of typhoid, dysentery, cholera, smallpox, diphtheria, pneumonia and tuberculosis. They do not starve or get rickets, scurvy, pellagra or protein malnutrition. They are not nearly so likely to die from the effects of compound fractures, osteomyelitis, or appendicitis. Freed

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*Dr. Hinkle, director of the division of Human Ecology at Cornell University Medical College and a medical research consultant to the Bell System, has worked with its medical directors in studying coronary disease among telephone employees.*

of these causes of early mortality, this man and his family live much longer than their ancestors. They die at a later age of heart disease, cancer and stroke, of suicide and alcoholism, and with a variety of metabolic disorders and an increasing number of diseases which apparently are caused by the disturbances of his own defense mechanisms.

## Diseases an outgrowth of environment

Physicians today — and especially industrial health specialists — are interested in human ecology because they believe that the diseases of modern man may be in part an outgrowth of his modern environment. Physicians suspect that the fatty atherosclerotic deposits in human arteries, which lay the ground for heart attacks and strokes, may be related to our abundant food supply, and possibly to our rich supply of protein and animal fat. They believe that our abundant food supply is also a factor in the prevalence of obesity, diabetes and high blood pressure.

Physicians do believe that the lack of physical activity among modern men contributes to the weakness of the muscles of their hearts, as well as to the muscles of their bodies, and that this prevents their hearts from developing that rich supply of nutrient vessels which would make them better able to survive the effects of the closing of their coronary arteries by atherosclerosis. The necessity for meeting deadlines and time schedules, and for stifling aggression, may have physiological consequences that make men more likely to have heart attacks. These features of modern life are an important reason why so many people have symptoms of anxiety, fatigue and insomnia. They may be one reason why the smoking of cigarettes and the consumption of alcohol is so high in our society, and why people are so reluctant to give up these habits. Smoke that men inhale may cause some forms of severe chronic lung disease as well as cancer. Other chemicals that men inhale, eat or drink may also cause serious illnesses.

The modern physician believes this, but he does not "know" it with the assurance that he "knows" that tubercule bacilli are involved in tuberculosis. The evidence relating to the causes of modern diseases is not as convincing or complete as the evidence relating to the causes of diseases of yesteryear. In the classical infectious diseases and nutritional disorders, the role of a single environmental agent was of such overwhelming importance that other factors could, in effect, be disregarded. It did not matter that pulmonary tuberculosis was a disease of the urban workers, or that pellagra was a disease of the southern sharecroppers; if you could control the infectious agent or supply the missing vitamins, the disease would disappear.

This does not seem to be true of coronary heart disease, for example. An abundant diet, a sedentary life, a large amount of smoking and the effects of meeting deadlines and struggling to get ahead have all been implicated as causes of heart attacks, but none of these seem to be "the cause" of the disease. There may be a common thread running through all of these causes, but such a thread has not yet been discovered. As of this moment it appears that a number of "causes" cooperate to produce the conditions under which coronary heart disease and many other modern diseases disappear.

The physician who is interested in the effects of human ecology upon disease likes to study people in their natural habitat as they go about their daily lives. He often needs large numbers of people. By studying different people involved in the same life pattern, or similar people engaged in different life patterns, he can gain some idea of the effects that a pattern of life has upon a man's health, and the method by which this effect is produced.

This is why we at the Division of Human Ecology at the Cornell University Medical College in New York City have asked a number of men in the Bell System to collaborate with us during the past five years in our studies of human ecology in relation to coronary heart disease. These men, selected from various Bell System companies, have undergone many different kinds of diagnostic tests, and have answered questions about their health, their activities, and their habits.

Several years ago, more than 100 men from the New York Telephone Company underwent a long series of psychological tests. Some of these men had had heart attacks; others had had a completely clean bill of health and showed no evidence of characteristics that are thought of as predisposing to coronary disease. In 1963 and 1964 more than 300 men from the New Jersey Bell Telephone Company went through an elaborate series of diagnostic tests, filled out a long questionnaire, and went through a number of interviews designed to find out about their past health, the health of their parents, brothers and sisters, their daily routines, and their habits of exercise, smoking, eating, drinking and taking medicine. These men also participated in a seven-hour test during which their hearts were monitored constantly. Now four years later, they are coming back to Cornell—New York Hospital for another series of tests.

## Studies yield mass of data

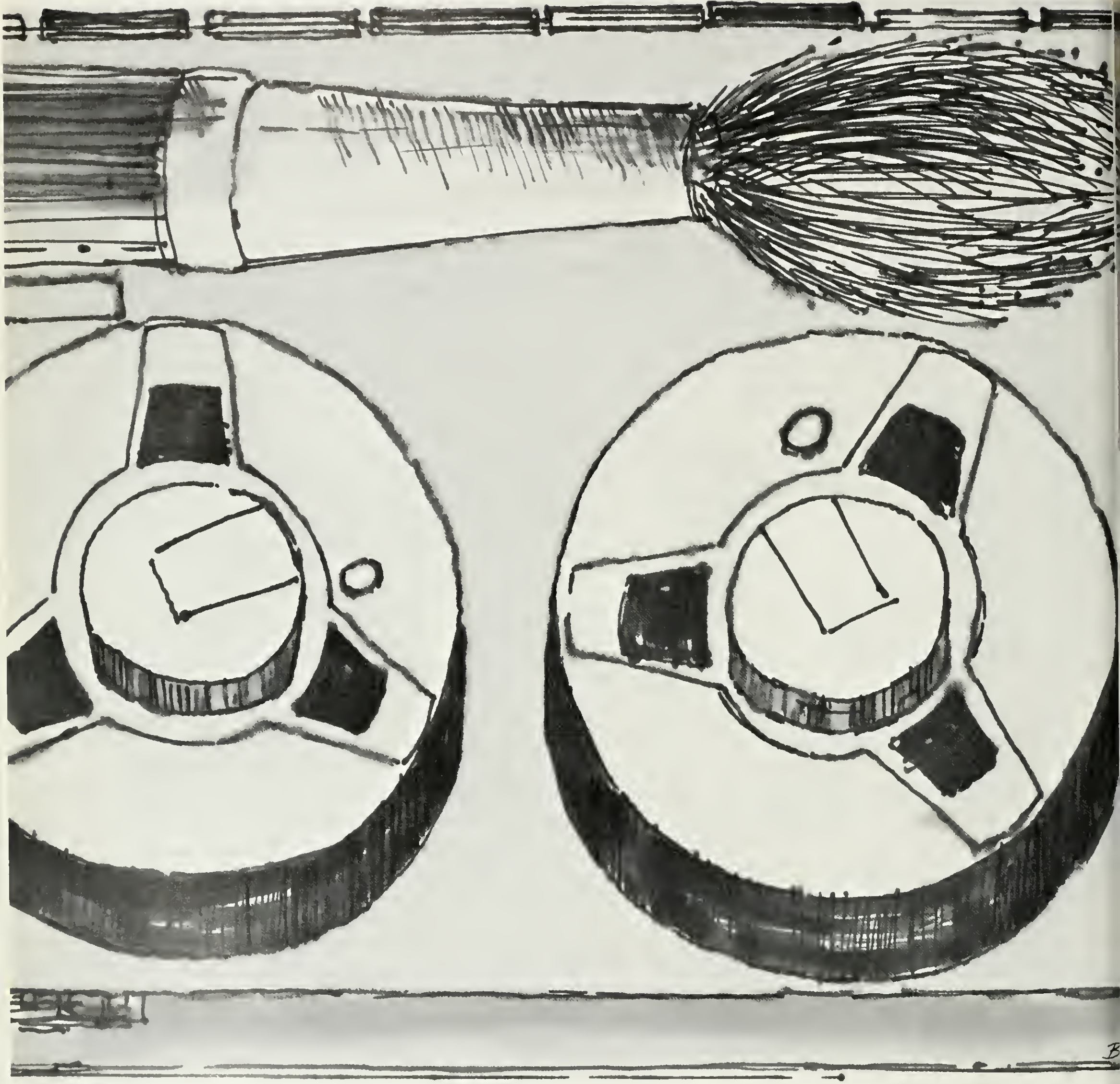
As you might expect, studies such as these yield a great mass of data. For each man in the New Jersey study, there are more than 80 punched cards of data to be analyzed by computers. In this study, every episode of disability caused by coronary heart disease among men in the telephone companies has been reported anonymously, along with information that would allow us to estimate how various factors of geography and work history have influenced the occurrence of heart attacks.

Some results of the studies to date can be summarized briefly. Although coronary disease is the most common cause of death among active male Bell System employees, the death rate from that cause here is slightly lower than that for men of comparable age in the nation as a whole. It is not peculiarly a disease of higher level managers and executives. The investigation so far shows no indication that such factors of work experience as promotions, transfers, or new job assignments, *taken by themselves,* have had any marked effect on the risk of death from coronary disease. The results of the studies are not yet final. Continued study will shed further light on the relation between life patterns and the incidence of coronary disease among men in the Bell System.

All of these studies have been concerned with the effects of the human environment on human health; but it would be wrong to give the impression that human ecology is concerned primarily with health. At many institutions throughout the country, scientists from many disciplines are studying many facets of human ecology: how different patterns of water utilization may affect the ecology of a river valley; how different patterns of industrial production affect the pollution of the atmosphere; how the heat produced by cities affects the weather around them; how population planning may affect the characteristics of national populations. There are studies of transportation patterns, housing designs, pesticides, and the effects of time change during air travel.

No single aspect of these studies is new. What is new is an awareness among modern scientists of the complex interrelations that exist between society, technology, people and the surrounding world.

Formerly those concerned with developing a new airplane considered only those features of the plane which would affect its flying qualities. Now, as the new supersonic transport is being designed, scientists are considering how its exhaust will contaminate the atmosphere; how its noise will disturb the people around the airport; what kind of new airports will be needed; how these airports may disturb population patterns, transportation, and the economy of the region in which they may be located. Such considerations of human ecology are becoming an ever greater part of the science of today. ☐



# Art and Science: Two Worlds Merge

Through centuries of civilization, the artist has used technical knowledge, but now scientists are finding that working with artists can broaden their own thinking in creative technology.

In this day of intensifying specialization, people often think of art and science as two completely disparate, even mutually exclusive, disciplines — areas of human endeavor as opposite as poles of the earth. And yet, a new affinity between the two is drawing together people who, until recently, might never have met. It is as though the rivers of science and art have reached a point of confluence where scientist and artist are intermixing in a mutually fruitful exchange of ideas.

Active in this confluence are a number of men at Bell Telephone Laboratories. What they are doing and their reasons for collaborating with artists are as diverse as the technical projects they are working on. Equally diverse are their feelings about interaction with the artist. Their point of agreement is that they all feel it is growing, that it is important, that technology contributes to art and that art is, and may become even more important to technology.

At Bell Laboratories, scientists studying the fields of speech, hearing and visual perception have become absorbed in the world of the artist in many ways directly connected with their work. Much of this scientific exploration enlists the aid of the computer, which is becoming more and more useful as a graphic tool not only in research but also, somewhat unexpectedly, in creating new art forms.

Occasionally, basic research has led to artistic byproducts from the scientists themselves. The "sculptures" of A. Michael Noll, which were exhibited at the Howard Wise Gallery in Manhattan, grew out of his research into computer-generated three-dimensional graphs and movies that compare mathematical models with reality and depict phenomena that are not directly observable. The precedent for this was Mr. Noll's creation of moving or "kinetic sculptures," which are made by describing their shapes and dimensions in numbers. He has also programed the computer to generate drawings composed of quasi-random elements in the style of abstract painter Piet Mondrian.

Obviously excited by the computer's possibilities as an artistic medium, Mr. Noll envisions the artist of the future working with the computer by direct man-machine interaction. "The creative potentialities of the computer result in a totally new kind of artistic medium — a creative medium with which the artist can interact," he says. "The potential of such a medium as collaborator with the artist is truly exciting."

Also exhibited at the Howard Wise Gallery was work done by Bela Julesz, who is concerned with basic research in visual perception at Bell Labs. He has created a computer movie of random patterns with texture which dramatizes visually the relationship between textures of physical objects and perception of their shapes.

## The difference is motivation

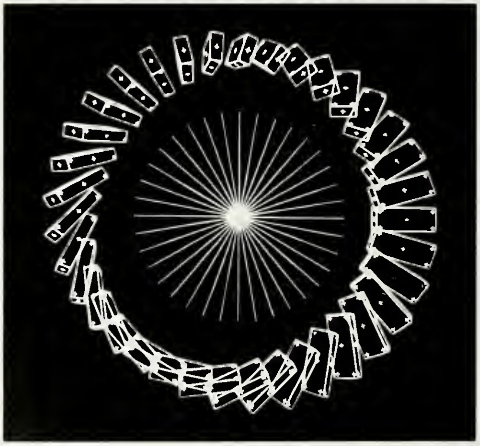
Mr. Julesz says, "When the scientist starts to see that some of his creations become artistic and are accepted at more than their scientific value, as a piece of beauty, it's an unusual experience. While these computer movies were intended for a study of visual perception, not as art, I think that visual perception is historically a common area for both the artist and the scientist, a common intersection where there is no gap or artificial bridge. The same kinds of things can be artistic or scientific; the only difference is the motivation.

"The artist is searching for an artistic truth, an intimate truth he wants to convey," Mr. Julesz goes on, "and I am searching for a scientific truth, which is testable and very defined. The artist is also interested in solving problems, and the computer might be a common tool to bring us together because it helps to execute the problem. It has made us more aware of the interaction between science, technology and art."

Kenneth Knowlton, another scientist at Bell Laboratories, has specialized in computer-produced motion pictures. He has devised a special programing language called BEFLIX, which permits the technologist to present a visualization of what he wants to explain. In collaboration with film maker Stan Vanderbeek, Mr. Knowlton has produced a one-minute film, "Man and His World," which, without story line, is a series of patterns with color background, created entirely by the computer.

Of this collaboration, Mr. Knowlton says, "It is teaching me something about art, about expressing myself, freeing up my own thinking so that I no longer think in nearly so stereotyped a way about the computer and the things one can do with it. Stan Vanderbeek has been using the BEFLIX movie language extensively; he is learning programing techniques so that he can push ahead with experimental computer movies."

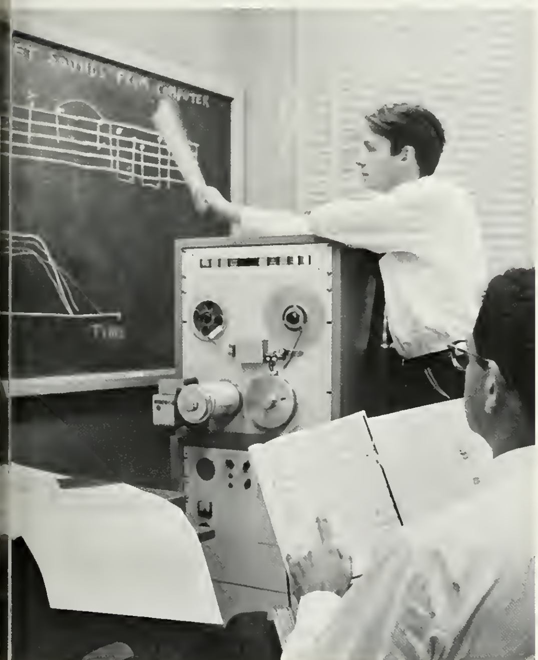
Mr. Knowlton considers that Vanderbeek's experience in presenting things visually through his films has helped in producing technical movies with the computer. "Vanderbeek thinks in visual terms," says Mr. Knowlton. "He's interested in color, motion, after-images, patterns; in making a film he has to consider all these. When I began making films with the computer I was not aware of these considerations. Vanderbeek is teaching them to me — I now appreci-



*Composite still from computer movie made at Bell Laboratories represents a communications satellite making one orbit of the earth. This helps scientists design attitude control systems.*

ate their importance in communicating visually, whatever the content of the film. I think that any scientist using the computer to make movies can profit from the seasoned film maker's knowledge and experience."

While these men — Noll, Julesz, Knowlton, and others at Bell Laboratories — in the course of their research have produced computer-generated images of artistic merit and interest, their primary objective still is research. Specifically, they are concerned with exploring the computer's manifold capabilities and its potential uses as a research tool. For example, Frank W. Sinden, a colleague at Bell Laboratories, has produced a series of computer-generated movies which attempt to isolate those three-dimensional effects that we detect entirely through motion or time sequence. As these researchers point out, their experience with the artist's point of view has provided a useful feedback into their own work — a kind of yeast in the cake of pure science. But the ultimate value of this experience, for them, will lie in its stretching of the horizon of research.



## Translating movement into sound

Manfred Schroeder, director of Bell Laboratories' acoustics, speech and mechanics laboratory, a year ago participated in an experimental entertainment called "Nine Evenings: Theater and Engineering." This was a collaborative project between dancers, artists, musicians and technologists. Engineers and scientists at Bell Laboratories contributed their technical expertise, working on their own time, to produce a fusion of music, painting, dance, abstract sound, film and live television.

"I became involved," says Mr. Schroeder, "because I am familiar with all kinds of sound effects. Acoustics is my speciality, and part of the endeavor here was to integrate acoustic effects into these performances. Dancer Lucinda Childs was asking for things to translate body movements directly into sound, so that she could actually create her own accompaniment as she danced. We came up with a device that reflected ultrasonic waves from her body, then converted them to audible sound. I got the idea from work I'd done years ago on stabilizing public address systems, and feedback problems with the Speakerphone, which under certain conditions produced howling or singing noises. It wasn't a very interesting sound. But while we were working with it we discovered that it would make all kinds of funny sounds if you did the

*Jean Claude Risset, visiting French physicist and composer, demonstrates trumpet tune synthesized by computer. This is part of continuing research in the basic properties of sound and speech.*

right things to it and if people walked through the room. When Miss Childs made her request, I remembered that work. But," he adds, "it needed some artistic concept to make it worthwhile and enjoyable."

Mr. Schroeder considers that such new uses of technology have a real future in artistic expression. "We certainly have a great storehouse of scientific information that would allow us to produce a variety of acoustical and visual effects. For example, we could have sounds whirl around in space, or we could have this translation of movement into sound, or light into sound, or sound into light."

## Computers could simulate dancers

"We could use digital computers to simulate a certain effect. One could write a computer program to simulate not only one dancer and a microphone, but also do the same thing for a troupe of 50 dancers. We could give the choreographer knobs on the computer console to change the movements of the dancers and hear the differences in sound — give him the possibility of altering his original idea."

Although he thinks of himself specifically as an engineer, in connection with "Nine Evenings" Mr. Schroeder foresees a more intimate interaction between art and engineering in the future. "I think it is quite conceivable," he says, "that we will have mixed personalities here, that artists in these fields will emerge from the engineering profession."

Another of the people at Bell Laboratories who has been actively engaged in collaboration with artists is Billy Kluver, who conducts laser research in the Physical Optics and Electronics Research Department. Mr. Kluver has worked with way-out kinetic sculptor Jean Tinguely, sculptor and film maker Andy Warhol, painter and sculptor Robert Rauschenberg, composer

*Bell Laboratories' Billy Kluver arranges helium-filled pillows at a recent show dramatizing the merging of art and technology, which Mr. Kluver considers "a natural marriage."*

John Cage, painter Jasper Johns, and others. He was a major motivating force behind the "Nine Evenings" project and worked with its performers in his spare time. While the show's mixture of sound, light and motion effects never before heard or seen evoked mixed responses from audiences, Mr. Kluver considers it a fruitful experience for all concerned.

The common ground where engineer and artist meet is illuminated more clearly when Mr. Kluver speaks of his own involvement. "The artist's work is like that of the scientist; it is an investigation which may or may not yield meaningful results.

"The artist and the scientist both work with the world around them; their perception of this world is their material. Their differences lie in the way in which they use this material. The scientist must build on and include previous scientific knowledge in his work. The artist, once he has made his choice as to the essential character of his work (be it painting, sculpture, music), will make every effort to avoid easy associations or connections with other works of art or other known fields of human activity. When you see a good work of art for the first time, it gives you the feeling of not relating to anything else you know — yet you are forced to become aware of it. I am interested in art as an engineer, not as an artist."

From his own experience as a technologist working with artists, Mr. Kluver says, "You do things you wouldn't normally do, because you're in touch with a mind whose vision is totally different from yours. The artist's vision and concern relate to other aspects of human activity, and that's the end that particularly interests me. I'm not so much interested in helping artists as I am in seeing what effect the artist could have on technology. In the future, I see the artist having more and more impact, as he learns more about technical processes. The contribution of the artist could conceivably lead to an increased awareness, a new view of the problems the engineer, designer, scientist has to deal with. For instance, it might reflect on questions like: What should the next mass media look like? We will have the megalopolis; what is it going to look like? I think that the main influence of art and technology together will come in the area of environment."

## By-products of research

It is perhaps in the field of sound — especially computer-produced sound — where the interaction between artist and technologist has been closest. Sound and music created by the computer are by-products of research in new techniques for transmitting voice and music over telephone and other communications systems. The potentialities of this "machine music" are being examined by many musicians and mathematicians at Bell Laboratories and elsewhere, including MIT, Princeton University, Stanford University, UCLA, and the Argonne National Laboratory.

Among those practicing musicians who have come to Bell Labs for aid in their explorations are Gerald Strang, member of the Music Department in the California State College system; composers Milton Babbitt and James Randall of the Princeton University music faculty; Vladimir Ussachevsky of Columbia University; and James Tenney of Brooklyn Polytechnic Institute. There were also the late Edgar Varese and Herman Scherchen.

Meanwhile, some Bell Laboratories researchers have themselves become composers, including John R. Pierce, executive director of the Research Communications Sciences Division, Max V. Mathews, director of the Behavioral Research Laboratory, and Newman Guttman, formerly of Acoustics Research.

Mr. Pierce, who is a writer of both fiction and articles, and a poet as well as a composer, says of his first adventure in computer music, "The first computer-played music was composed by Newman Guttman and programed by Max Mathews as an experiment in producing and using certain voice and other sounds. It was just a little flyer. I wondered whether a computer had to sound like that, or whether it was what

Newman had done. So I dug out a very short little conventional piece that I had composed and ran it through the computer, and it sounded more like conventional music."

## New insights into acoustics

Pierce and Mathews started using the computer to make "musical sounds," and that led them into amateur composing and eventually into the issuing of a record. Mr. Pierce emphasizes that it was the challenge of something new that made it exciting. "I have never untangled the art and the science in living," he says. "I certainly wouldn't have bothered to compose little ditties and I never would have gotten them on a record if it hadn't been for the computer. The only thing that led me to do this was curiosity — the chance to exploit and play with something entirely new. It was fascinating. It has inspired me, informed me."

Mr. Pierce points out that such excursions into computer-generated sound have led to new understanding of sound quality and acoustics. "Since Max Mathews and I devised various ways in which the computer generation of sound could be made more flexible," he says, "there has been a continued interaction among the psychoacoustics of perception, the study and production of speech, and our experiments with musical sounds.

"In my case," he goes on, "I have become more sensitive to, and have a greater appreciation of, sound quality. I've been interested in the generation of speech from phonetic symbols stored in the memory of a computer. I regard this as a very important and challenging problem in the field of man-computer interaction. Some of the experiments I have made with musical sounds have led me to believe that it will be possible to overcome the mechanical quality of computer-generated speech. Our studies of the quality of violin tones and trumpet tones are very closely related to our studies of the quality of computer-generated speech."

At present, spoken words produced by the computer are limited by the difficulty of describing the essential features of such complex sounds precisely. Here, Mr. Pierce considers the uniquely human sensitivities to be indispensable. "One of the most powerful human faculties," he says, "is that of being able to judge qualities even when we cannot measure them. Here the ear of the trained musician may be as valuable as the digital computer. We are looking for needles in haystacks, and only the sharp ears of musicians and the sharp minds of scientists will enable us to find them."

Max Mathews, a specialist in behavioral psychology, has worked with several composers in computer techniques, and has composed music himself. In particular, composers Randall, Tenney and Strang are writing music for the computer because, as Mr. Mathews says, "musicians can't play the music they write or wish to write. It is too precise and too fast, and requires things that are physically impossible." Using a sound synthesizing computer program which Mathews developed, these composers write out a score, specify the sounds they want synthesized, and the results can be heard through a loudspeaker connected to the computer as though emanating from an orchestra.

## Collaboration is a two-way street

In Mr. Mathews' opinion, collaboration between artist and technologist is, in a very real sense, a two-way street. "What the technologists get out of art are the same things that anyone else gets out of art, the same thing civilization gets. These are the very important, long-range permanent values; they represent some of our best achievements."

The scientist may also derive benefits unique to his own situation. "As far as unique things are concerned," says Mr. Mathews, "this depends upon him as an individual: he may get quite a bit of inspiration; he may get new ideas; he may get some idea from the

*Artist Robert Rauschenberg and dancer Lucinda Childs, performers in last year's "Nine Evenings" entertainment, discuss unique electronic environmental system with Bell Laboratories engineers Leonard J. Robinson and Per Biorn.*

art that he can use directly in his technology. We have, certainly, examples of this in the understanding of speech and speech quality that have come out of our studies in music.

"Currently, we have been concerned with experiments on tone perception, a new theory of consonance and dissonance, which was primarily studied for music. The sounds and the percepts are the same musically and speechwise, and music is a much simpler sound source, so we can study it in greater detail and understand it better. These tonal studies have given us a new insight which we would not have gotten directly from speech because it is too complicated."

Whatever course the converging rivers of art and technology may take, it seems certain that the convergence is permanent. The new windows now being opened by science and art working together are broadening the view to the mutual profit of both.

"Deeper understanding," Mr. Pierce says, "has broken down many of the barriers between various fields of science. Perhaps this will become true of the barriers of ignorance and temperament which have divided science and engineering from the arts. This could surely open new opportunities for artists, and I really believe that it can quite as much open the eyes and ears of engineers and scientists — and even their minds."

Max Mathews emphasizes succinctly, from the scientist's point of view, what the collaboration between the scientific community and the world of art means to him: "You get inspiration from working with the artists, generally wake up. And this is one of the requirements for doing creative research — to be awake!"

It may have been the eventual fruits of such collaboration that Sir Francis Bacon had in mind when he wrote: "The real and legitimate goal of the sciences is the endowment of human life with new inventions and riches." □

Bell Forum: A statement of policy

# Setting Rates for Services

*In recent testimony in the FCC interstate rate case, William H. Ellinghaus, AT&T Marketing and Rate Plans vice president, outlined the Bell System's pricing policy. Following is an excerpt of his testimony.*

The basic pricing objectives of the Bell System can be briefly summarized. Our rates are designed to achieve our over-all revenue requirement, to meet customer needs, to promote greater use of our services, and to encourage efficient use of our plant. We intend that the revenues from each principal category of service fully cover the costs incurred in furnishing that service, including a return on the related investment, and in addition make a contribution to the coverage of our common costs. Since message toll telephone (long distance) service accounts for more than 80 per cent of our total interstate revenues, it is plain that the most significant indicator of the appropriate rate level for this service is our over-all interstate earnings requirement. With respect to the other principal services, our objective is to price them so that each contributes as much to our total earnings as is reasonably practicable, taking into account market conditions, rate relationships and other relevant factors. In this way the contributions which these other services make to our earnings permit us to provide message toll telephone service at rates lower than would otherwise be required to achieve our over-all earnings objective. So long as each service covers its relevant costs (including return) and makes some additional contribution, our other services benefit.

A consideration of costs is necessary, then, to determine total revenue requirements and to make sure that particular services are contributing to, and are not a burden on, over-all earnings. Cost considerations, however, relate to the conditions under which we can *supply* our services. Having taken account of these conditions, we must also consider the impact of rates on the *demand* for those services. In this respect the Bell System is like any other business, and the rates for its services must reflect the realities of the market. In designing rates which are responsive to market conditions, factors in addition to cost are critical in shaping our pricing decisions. The development of a pricing structure to which customers will respond by buying our services is as much a part of our marketing requirements as the development of the services themselves.

Many of these non-cost factors involve the interplay of market forces and rate relationships frequently considered together under the general concept of relative value of service. In considering these factors it is important to bear in mind two significant characteristics of our business.

First, to a greater extent than in most other industries, the value of our services is directly related to their availability and to the extent of their use. One telephone or teletypewriter is useless by itself, but each acquires value to the extent that it may be used in connection with other instruments. Thus, the usefulness of a customer's service is enhanced by the amount, quality and type of service furnished to others or at other locations of the same customer.

Second, our service offerings interact and overlap with one another to a substantial degree. So much so, in fact, that the price levels established for one service will usually affect the demand for other services. For example, a change in Telpak rates may directly affect the demand for private-line telephone service. While these interactions are difficult to measure, and even more difficult to predict with accuracy, we know that they exist and must be considered in pricing our services effectively.

### Satisfying customer needs

To the fullest extent possible we endeavor to design our rate structures to permit customers to select the appropriate service arrangements which best meet their particular communications needs. Those needs are continuously changing. As Dr. William O. Baker (vice president, Bell Telephone Laboratories) showed in his testimony, the accelerating pace of technological advance is constantly creating new products and services which lead to significant changes in business and government operations. Our population continues to expand and become more mobile, and localities are changing their characteristics with urban growth. These developments generate new and expanded communications needs. Thus our goal is to offer a wide enough range of services and classifications to reasonably meet the varying requirements of all our customers.

In considering the degree of diversity in our offerings which may be appropriate in meeting these various needs, there must be a balancing of other considerations. For example, simplicity and acceptability are also desirable attributes of a rate structure. Rate schedules should be easy for the public to understand and for the carrier to administer correctly and impartially. In this regard it is desirable to minimize the number of rate elements and to select elements which identify meaningful service features.

**Encouraging increased use**

Rates should be designed to encourage greater use of service and to stimulate a pattern of use which provides for efficient use of plant. Such a goal serves to achieve the purposes specified in the Communications Act: the maintenance of universally available communications services with adequate facilities at reasonable charges.

As noted earlier, we must recognize that the usefulness of every offering is affected by the amount, type and quality of service which it makes available. Consequently, we believe that services should be priced within the reach of the broadest possible range of customers, and at levels which will stimulate the growth and development of such services.

In attempting to determine the rate levels which will best serve these ends we must give appropriate weight to the dynamic nature of communications technology and to the fact that unit costs are affected by the prices charged for our services. As pointed out by Mr. A. M. Froggatt (AT&T engineering economics vice president) in his testimony, continuing technological progress has also contributed to a progressive reduction in the unit costs of much of our added plant capacity. In designing rates we should, therefore, look to anticipated volumes and costs. Although the estimation of future volumes and costs is neither a simple nor an exact science, a requirement that rates be based solely on historically determined cost levels would work to the detriment of our customers. Such a requirement would inhibit our ability to introduce new services at attractive rates, would result in lower volumes of business, and would thus result in a less rapid rate of introduction of the new, lower unit-cost plant facilities which benefit all services.

Finally, we must constantly devise means to encourage not only increased use of our services but also more efficient patterns of use. This dual objective is illustrated in our message telephone schedule by the special low rates for evening and weekend calling, which are designed to induce customers (1) to increase their usage and (2) to divert calling from peak to off-peak periods.

**Competitive alternatives**

It is axiomatic that, in addition to covering the relevant costs, rates must be set at levels which take account of the competitive alternatives available to purchasers of communications services. The competition referred to here stems not only from other communications common carriers but also from non-regulated suppliers and from the availability of alternative Bell services.

Non-regulated suppliers offer communications equipment and services over a growing range of the market. In the area of bulk communications their influence is now most apparent because of the availability of high-capacity, low-cost microwave facilities and modern, electronic computers with switching capabilities as alternatives to common carrier services. In order to meet the growing needs for high-volume, flexible communications at rates which offer the customer a realistic choice between private microwave systems and common carrier service, we developed and offered Telpak service. We are faced with a situation in which we are offering to serve large, sophisticated buyers perfectly capable of providing their own communications systems, many of whom have already elected to do so.

Of course, customer choice is not influenced exclusively by price. But if our charges become significantly higher than the costs of such alternatives, we would find ourselves with a declining participation in the bulk market. This would inhibit the rapid introduction of technologically advanced facilities into our network and so reduce the potential for improved service and lower rates for the general public which uses our basic telephone message services. We are convinced that we can profitably provide bulk services at rates which are in the range of private microwave costs. If our rates and those of the other common carriers are significantly above that range, we will all find ourselves excluded from a major portion of the market. Such a loss would be detrimental to the customers for our other services.

We must also recognize that both the carrier and its customers have an interest in the relative stability of rates and the revenues which they produce. Customers should be able to make plans without the hazard of frequent, unpredictable wide fluctuations in charges. On the carrier's part, continual changes in rates can have unsettling effects on both its revenues and its ability to market its services effectively. Thus, significant changes in rate levels ought to be proposed only when needed to meet changed conditions which are reasonably well defined and are considered to be relatively permanent, and not merely transient, in nature. ☐

# COMMUNICATING PRESIDENTS

# Communicating Presidents

**by Merriman Smith**

As late as 1929, the President of the United States did not have a telephone in his office. Today, the most sophisticated kinds of communications help our chief executives carry out their duties as national and world leaders.

Air Force One, a gleaming silver and blue jet transport, speeds across America at 35,000 feet bound for the Orient and a Summit Conference of nations involved in the Vietnam war. The President of the United States sits in a reclining leather chair beside a long table in his combination office and sitting room. Tiny gold stars shine in an artificial sky on the ceiling. This is the larger room of his suite in the after section of the aircraft.

At the end of his table a tiny red light glows. The President picks up a white telephone.

"Hello there, Senator," he says. "Are you all going to vote today on the bill I called you about from Texas last night?"

Conversation ends quickly and the President says to an aide, "Have the White House send us the roll call on that bill before we refuel in Hawaii. Now I would like to talk to Secretary Rusk in London."

The aide picks up another telephone in the cabin and gives instructions to the communications center in the forward area of Air Force One next to the control bridge. In less than a minute, Rusk is on the radio-telephone and instructions to transmit the Senate roll call are received back at the White House by radio-teletype.

Futuristic science fiction, a Strangelove dream of the Presidency in 2000 A.D.? No, a routine moment

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*Mr. Smith has been the White House Correspondent for United Press International since 1941. For his eye-witness coverage of the assassination of President Kennedy, Mr. Smith received the 1964 Pulitzer Prize for Distinguished Reporting in National Affairs.* 

of 1967, albeit difficult for the uninitiated to comprehend. And even more amazing when regarded alongside relatively recent history. As late as 1929, there was no telephone in the President's White House office. In the spring of that year, however, Herbert Hoover had a telephone installed at his desk. Until that time, *the* presidential telephone had been in a hallway booth outside the office — a blissful arrangement dating back to Dec. 1, 1878, and President Rutherford B. Hayes.

Since March 27, 1929, when Mr. Hoover brought the black stand-up instrument out of the hallway and onto his desk, each succeeding President has had progressively better communications.

## Better communications help free President

Improving communications plus marked advances in transportation have freed American chief executives to move about the earth. Today it seems almost silly, but as recently as 1947, the legality of official papers signed by President Harry S. Truman was challenged because he affixed his signature to these documents while visiting Brazil.

In 1967, President Lyndon B. Johnson could sign important legislation 40,000 feet above Kuala Lumpur without causing the slightest legal ripple among constitutional purists on Capital Hill.

Moreover, effects of continuously improving and expanding communications are wider by far, socially, economically and politically, than their application at the White House. The earth shrinks daily under a network of cables, wires, radio channels and satellites.

A shot fired in Vietnam literally is heard around the world within a matter of minutes. An oil tanker slams aground in a foamy storm off a European beach and the owners learn of it instantly a thousand miles away. A Black Power advocate's street-corner oratory on the Eastern shore of Maryland booms from television screens simultaneously across not only the country, but the world — as do Arabs hot-footing it over Sinai peninsula sands in front of Israeli tanks.

Rapid advances in telecommunications are not without negative aspects. For one thing, they have shortened the line between cause and effect. This cuts into allowable reaction time for governments and their chiefs.

Also, people of every land know more about each other than ever before. Such knowledge is not always pleasant. In newly emerging countries, newly acquired facts do not equate with understanding, for our scientists are many time-miles, possibly light years, ahead of the growth rate in other areas of human progress.

High-speed communications available to a President today may improve his functional ability, but somewhat in ratio to the added number of problems with which he must deal. During the 1965 crisis in the Dominican Republic, U. S. Ambassador Tapley Bennett was on the telephone to the White House and State Department, giving a running account of streetfighting as bullets ripped into the building from which he spoke.

As recently as the late Thirties, it would have been many hours, even days, before such on-the-spot diplomatic information would have been available to the Washington decision-makers. This may be a plus for national welfare, but it is hard on the men who must decide what to do about crises, particularly when they draft messages for the "Hot Line" Teletype to the Kremlin.

## The promise of communications

Quite aside from the personal hardship on a President being awakened at 3:30 a.m. by a telephone report on new race riots in a distant American city or by a call from the Pentagon about a deadly fire aboard a U. S. aircraft carrier in the Gulf of Tonkin, it could be that the wizardry of modern communications has more promise of holding another World War in abeyance than many of the other, more conventional diplomatic efforts.

The problem is one of understanding the torrent of words and pictures flashing from nation to nation. International understanding is bound to improve as information flows into heretofore blind areas, but there remains a question: will understanding improve with the speed which is needed to convince others that modern warfare is a depleting and self-defeating answer to differences among men?

The weight of being the focal point of a world-wide communications system may be an onerous chore for a future American chief executive, but Lyndon B. Johnson is fortunate — he grew up as a political leader in an era of enlarging communications. Thus he is not only at home with the lights of a Call Director blinking beside him, but he insists on constant communications capability.

## LBJ in constant touch

His practice of being able to keep in touch goes far beyond the conventional telephone. While he is away from his ranch home and office, he is in constant touch with the rest of the world through a highly sophisticated radio system over which telephone calls can be patched as necessary. It is startling at first to be riding with him when he picks up the microphone of a radio transceiver beneath the dashboard to ask, "Is Mrs. Johnson around?"

"One moment, sir," comes the crisp voice of a secretary.

Then only moments later, "Yes, dear."

"Bird, we're 22 minutes away from the house and I'll be bringing four of the boys to lunch."

"Fine, dear, everything's ready."

Another Johnson auto trip might be interspersed with this sort of radio traffic:

Voice suddenly from out of nowhere (actually one of his special assistants back at the ranch office): "Sir, Secretary Wirtz is calling about that emergency board. Do you want him put through?"

President: "Tell him I have the names from Washington by Teletype and I'll sign the order this afternoon. I'm about 30 minutes from the house and unless it is urgent, I'll talk to him then."

(short pause)

Voice: "Nothing urgent, sir. He'll call again at 2:30."

The circuit is of such quality that there is no added shortwave lingo to establish that the message was understandable and received. The President merely puts the microphone back in its socket, flips a switch and the car fills with soft tape-recorded music.

Presidential communications are more impressive when he is away from the White House simply because they are more visible, more noticeable. For example, on a typical speaking trip to New York or San Francisco, the White House party may take along as many as 100 shortwave handi-talkie radios, plus one or more base stations operated by the Army Signal Agency. When needed, these hand-sized, miniaturized transceivers are connectable with telephone land-lines. If the trip involves several cities, it is quite common, for example, to hear one of the President's assistants using a handi-talkie to the travelling White House switchboard, operated in conjunction with the radio base station, to check plans with a White House advance man several hundred miles away.

## President and press inseparable

While the marriage often has shotgun aspects, a modern President and the press are inseparable, be it on the island of Samoa or the great banquet hall of the Waldorf Astoria Hotel in New York. From 30 to more than a hundred correspondents, photographers, broadcasters and their technicians with thousands of pounds of equipment move with a chief executive. The size of the party depends on the trip. A White House press chartered plane for a routine weekend trip to Texas usually involves 40 to 60 media representatives plus White House travel and communications personnel of which a representative of AT&T is a permanent adjunct.

The demands of this group rank only a shade below those of the White House since it benefits a President nothing to sow his oratorical ideas on barren ground. And nothing can be more barren than a piece of deserted real estate on which a President may make a spontaneous but momentous remark. Experienced White House road reporters look around overhead for telephone wires, then for nearby buildings. If the landscape is blank, the story keeps until the next stop but this rarely happens these days.

I still recall a dismal day an eternity ago when Presidents still travelled by train. We were with President Harry S. Truman in the Pacific Northwest. The train halted on an isolated siding outside Eugene, Oregon, for servicing. Reporters back in the press car put aside their copies of "War and Peace" to stroll along the tracks to the rear car where Mr. Truman was certain to come out on his observation platform for fresh air.

## Telephone men with the President

There was no crowd for this was solely a service stop to re-ice the big bunkers required in those days for rolling air conditioning systems and to check the axle boxes for lubrication. Mr. Truman's only spectators consisted of his travelling companions, railroad workers and two telephone men who routinely hooked up a long distance circuit for the White House at each stop in case the President wanted to make or receive calls.

Since the President had no telephone business to transact, the two technicians were ready to disconnect the circuit after the train pulled out.

As the icing equipment was being rolled away, a reporter asked H. S. T. what he thought of a recent statement by Soviet Premier Josef V. Stalin. It was at this moment that Mr. Truman said in public for the first time that while he "liked old Joe," the Soviet leader was "a prisoner of the Politburo" and said only what his wardens wanted him to say.

The reporters flushed as a covey of quail before a pointer. They were torn by deep conflict — possession of a major news story and the gnawing knowledge that the train would depart in moments, leaving them in one of America's larger nowheres.

One intrepid reporter spotted a small dwelling about 200 yards away and sprinted for it. I knew there could not possibly be more than one telephone in the house, if any at all, and was about to accept complete defeat tempered only by sinful anticipation that this brash competitor would miss the train.

By some divine guidance, I looked at the two telephone men standing beside the train. One of them had the end of a wire in one hand, a telephone in the other. I pounced and pleaded. Within seconds he had the instrument connected again, got the Eugene operator and I was babbling the basic news details to the San Francisco bureau of my press association.

I dictated no more than a bare-bones outline of the facts when I heard the crunching metallic strain of the train about to start. Handing the phone back to the men with deep gratitude, I raced afoot along the train behind most of my colleagues and pulled up at the first open Pullman door. We could see the lucky man who had gone to the small house breaking all records for open-field running as he made for the train. I felt smug, but only second-place smug until the runner stumbled into the car, badly out of breath from his dash.

"There was a phone in the house," he gasped, "but just as I got my office, I heard the train start."

## Press expects good service

The White House press of 1967 would be shocked by such communications. AT&T would be expected routinely to have at least 20 long distance lines connected in the same open field, complete with tables and chairs and other facilities for the press.

The inter-locking relationship between the President, the media, the public and communications facilities becomes tighter and more essential with each year. Aside from scientific and technical progress involved, distribution of news is now so much a part of the presidency that if a chief executive drops from public view for very long, readers, listeners and viewers here and abroad begin to ask disturbing questions.

Critics may say it is self-serving, but no President has been quite as conscious of media technical requirements as L. B. J. And there is reason to believe his successor will be even more aware of the need to get his story across.

## Communications seem effortless

Mr. Johnson may not be expertly aware at times of communications difficulties and perhaps this, to put it plainly, is because his own access to telephone and Teletype, plus sophisticated radio, seems so effortless that he takes such technical aids for granted.

Seated in his office beside a Call Director that can route his calls through four different White House switchboards which have the capability of preempting any busy line in an emergency, a few feet away from the desk, two press association teletypewriters, operating 24 hours a day in soundproof housings, and three TV screens to monitor each of the networks, it is small wonder that a President comes to accept this sort of arrangement as a norm.

He sees press association reporters lugging 10-watt walkie-talkies and assumes that if he can reach the rest of the world in seconds, we can do the same. For example, he thought sufficient communications equipment for the world could be installed overnight at Glassboro, New Jersey, for his meeting with Soviet Premier Alexei N. Kosygin in the early summer of 1967. After all, AT&T and the Signal Corps were able to provide the White House and the Soviet party with all the circuits *they* needed.

This comforting attitude did not take into consideration such factors as White House priorities, marshalling an army of installers and tons of equipment, provision of extra power and a simple but unrelenting thing called the clock. Operating in darkness and intermittently heavy rain, thousands of technicians could not have met the requirements in the few hours allotted them. But they came close. By the second day of the meeting there were hundreds of circuits operating virtually from the front yard of "Hollybush," the graceful old house where the Big Two met on the campus of Southeast New Jersey State College.

## What the future may hold

What of the future for presidential communications? An entirely portable radiotelephone about the size of a small book with secure frequencies linked to the nearest mobile operator. Vestpocket shortwave transceivers working with powerful base relays, fixed and mobile, to keep not only White House staff members but all key government officials available to the President and each other around the clock.

And just over the horizon, highly miniaturized television sets as portable as today's transistor radios, face-to-face conferences between heads of state thousands of miles apart as they talk over voice-picture circuits.

Add to these developments the upcoming supersonic transport aircraft which will be able to take a President and his entire travel party across the Atlantic for lunch and back to Washington by nightfall, to the Far East for an evening meeting and back to the White House the next day.

There will be new human requirements, too. Of necessity, future Presidents must have more knowledge of geography, as well as geopolitics. There will be greater pressure on them to have at least minimal working knowledge of languages other than English. In short, their knowledge of the world must enlarge as the world grows smaller. ▢

# The Pervasive Influence of Chemistry

**by James C. G. Conniff**

Do-it-yourself clothes, 25-cent bicycles, harnessed sunshine and harmless suds are real possibilities resulting from the systems approach to innovation and providing researchers the freedom to explore.

Today's man can truly be identified as a chemical animal.

In the years since 1774 when the French chemist Antoine Lavoisier explained the phenomenon of combustion and thereby sired what we now call modern chemistry, the research chemist has become involved in just about all aspects of modern man's life: the food he eats, the drugs he takes, the clothing he wears, the house he lives in and the office where he works, the vehicles he rides and the fuels that power them, and the many methods he uses to communicate with his fellows.

Much of this progress can be attributed to the fact that a large number of chemists now live the interdisciplinary life, practicing their art with knowledge gained from colleagues in adjoining scientific fields and approaching their problems with a new "systems" point of view.

Many chemists — largely in universities — are studying matter in the traditional way: by looking at individual atoms and molecules and the reactions and bonds between them. But chemists in industry, confronted by the pressures of competition and the need to produce utilitarian things, find they must cope with the "real world" of their science. This means they have to study large aggregates of atoms and molecules in all their complexity and interactions with their *environment*.

Industrial chemists find they must now look at overall *chemical systems* in addition to the individual components. It is this "chemical systems approach" that has had profound effects on medicine, health services, agriculture, water resources, environmental control, housing, construction, transportation, communications, and information handling. And as this approach becomes more widespread, it promises to give birth to new and even broader chemical systems applications.

Since today there are workers in more than 30 branches of chemistry — many of them interacting

*Mr. Conniff, an assignment writer specializing in medical subjects, won the American Heart Association's Howard W. Blakeslee Award for national magazine reporting on progress in the diagnosis and treatment of strokes.*

*Research at Bell Telephone Laboratories, like this photochemistry experiment at left, has broad impact on modern life.*

*Pervasive influence of chemistry is demonstrated at this meeting of Dr. O. G. Selfridge of MIT, Dr. William O. Baker of Bell Labs, A. Russell Ash of the White House staff, and Dr. John W. Tukey of Bell Labs and Princeton. Below, Dr. Baker confers with aides.*

with one another and their kinsmen in such related fields as physics, metallurgy, electronics, biology, and medicine — chemistry has matured into a truly interdisciplinary science. Consequently, no one individual can serve as the spokesman for all chemistry. There are many who are highly qualified and articulate. But one who speaks with particular eloquence on many aspects of chemistry's all-pervading influence on our lives is William O. Baker, vice president for research at Bell Telephone Laboratories.

His credentials include a doctorate in physical chemistry from Princeton in 1938 (at age 23), membership on many of the nation's highest scientific bodies, a prolific career as an inventor and researcher in chemistry at Bell Laboratories since 1939, and holder of numerous awards, including American chemistry's highest honor — the American Chemical Society's Priestley Medal (in 1966).

Dr. Baker is a principal articulator of the systems approach to chemistry. It's his belief that concepts stemming from this approach "are re-integrating fragmented scientific disciplines in universities and are benefitting a wide range of technically-based industries." The result, he asserts, will be a vastly enlarged

common base of knowledge that will give chemists "great opportunities for advancing the well-being of man."

In a recent interview, Dr. Baker discussed some important areas where chemistry, much of it based on a systems approach, presently does — or some day will — enhance the quality of the total environment in which we live.

The chemically-derived miniaturized sophistication of integrated circuitry inspires Dr. Baker to envision from its application such future boons as tiny chemo-electronic micro-sensors that may:

. . . Be installed in cars to improve the coordination of moving parts and accessory equipment and bring about more efficient fuel combustion, which is presently at a level that "makes the automobile's role in air pollution inevitable."

. . . Improve health by stabilizing home and office temperature-control and humidity.

. . . Make possible the production of rugged but precise instruments for handling mass diagnoses to combat heart disease, cancer, and stroke.

. . . Enable both commercial processor and housewife to reduce drastically the waste of food, while greatly improving its color, taste, texture, and nutritional content.

. . . Help revolutionize the chemical industry itself (a revolution which Dr. Baker says the sensors have already started) by eliminating many human variables that affect the quality of production and freeing people to "exercise imagination and creative thinking."

Dr. Baker is optimistic about chemistry's role in finding a lasting and clean power source for the automobile and the resulting favorable impact on the petroleum industry. He points out that such a power source, from petroleum itself, "could well be based on hydrocarbon oxidation, not as now to produce volume change from explosion in a car's cylinders, but to produce ions — charged particles of one kind or another — which could then be collected in a fuel cell to give an electric current.

"Up to now we've emphasized the gas pressure-volume changes in power conversion. There is also ionic oxidation, which is the basis of a very pesky kind of oxidation — the corrosion of metals. There is no reason why we cannot equally emphasize the electrical-charge changes in combustion. What is involved in this approach to the utilization of the fuel cell is what you could call, if you wanted to be quaint about it, a 'controlled corrosion' of gasoline."

The result could be a marked reduction in auto-caused air pollution.

Dr. Baker expects that advances now under way in polymer chemistry will one day empower technology to use such recently wasted materials as the olefins in the gaseous effluvia from wells and refining to construct "throw-away factories" of polymers and inorganic composites. In these intentionally fly-by-night structures, industry will be able to make, from the same kind of raw materials, vast quantities of the consumer goods for which people the world over yearn daily. Industry will do it, he predicts, so economically that there is sober prospect some day of "the wholly-extruded 25-cent bicycle."

Moreover, this approach offers the solution to industrial slums, whereby the factories themselves would be discarded, once their planned production orgies are over. The polymers used to build such disposable structures would not be all wasted. They could be partly reduced to their original raw form and re-utilized, saving both money and resources.

## "Do-it-yourself clothes"

Today's surge of interest in throw-away paper clothing is a sign, Dr. Baker maintains, of an imminent upheaval in human attire which research on the polymer molecule practically guarantees. To him, that means relief for the human spirit in being able to throw out a suit, shirt, tie, dress, or sweater before one tires of it — because it will be so cheap.

He also sees the possibility of a breathing, automatically heat-adjusting, strippable "polymer salve" — a self-moldable type of clothing — which we could apply to our bodies for both protection and adornment, much as birds have feathers and beasts have fur. Such a plastic coating, summoning up people's latent instinct for design and self-expression, is an aspect of the contributions that chemistry will make to the new leisure.

In this connection, chemistry is contributing to easily workable materials for home projects, to do-it-yourself casting compounds for works of art, to more direct control over the chemistry of photography, to small personal video communications links that will give direct visual access to world art centers and libraries, and to information resources for the enrichment of the mind — including the means to make inexpensive copies of just about anything.

## The battle against detergents

Chemistry is already winning the battle against detergents as a source of water pollution and as a skin irritant, Dr. Baker declares. "Chemists have given us the bio-degradable detergents, which can be decomposed by bacterial organisms even though the detergents are derivatives of paraffin which, in turn, is a derivative of petroleum.

"In the laboratory we've found just the right chain-like molecular arrangements that enable the micro-organisms in water to eat and destroy detergents by ordinary bacterial cycles. We've also applied control to the penetration of skin tissues by the detergents' chain-like links and electrically polar ends. By learning how to measure much of the diffusion and absorption characteristics of various structures in the protein-like tissue of the skin, chemists have managed to minimize irritation from detergents.

"This 'transport effect,' by the way, is a good example of 'chemical system studies' — the movement of molecules in a surrounding chemical medium — and constitutes one of the most challenging basic scientific fields we have," asserts Dr. Baker. "It applies across the board: whether we're talking about dispersion and absorption of carbon dioxide and its affect on earth's atmosphere or the movement of detergents through cutaneous tissue."

Dr. Baker foresees a bright future for the Bell Labs-developed silicon solar cell which converts the sun's rays into usable electric power. This method of tapping the 16 trillion kilowatt hours of energy the sun pours on the earth each day — equal to the energy stored in the earth's total reserves of coal, oil and natural gas — is already 12 percent efficient, as against six to eight percent efficiency for other means of generating electric power, such as gasoline engines.

Because nuclear power plants combine efficiency with economy for central distribution, he doesn't see much application for the solar cell in that area. But he does feel there is a big future for it in the rooftop installation, especially in power-starved emerging countries with their great need to heat and air condition buildings and to mount manufacturing programs. There is one hitch: the present high cost of the silicon solar cell — consisting of two ultra-thin layers of a crystalline element as common as the sand it constitutes. The layers have to be delicately and expensively put together to induce a voltage at the all-important "p-n (positive-negative) junction" between the layers.

"We can afford to make these cells in the laboratory," says Dr. Baker, "and to use them by the thousands in communications satellites, but we have yet to find a way to produce them by the acre, economically. When that day comes — and it will — look for the rooftop solar cell unit to make any sunny place on earth habitable and productive."

## Metals more pure, more useful

A Bell Labs metallurgical-chemical achievement even more esoteric than the solar cell is already working important changes in our environment, but of a very subtle kind. It's a method of ultra-refining metals discovered by William G. Pfann and known as "zone refining." Manufacturers of heavy equipment for the electrical industry are using the technique to get corrosion-causing impurities out of the metallic crystals of copper. With pure enough copper, they can produce the blades for heavy-duty switches and the circuit breakers for the big grids needed to transfer huge blocks of power, under peak-load demand or in emergency, without the risk of electrical blackouts arising from the use of less pure metals equipment.

The technique consists of passing intense heat along a crystalline structure to purify it in zones by what amounts to a "flowing melt," followed by rapid re-crystallization. Purity of the crystal improves at each pass of the heating coil along its length. Dr. Baker is confident that zone refining will have many other applications, not the least being to enable the pharmaceutical industry to work with basic chemicals of far greater purity and eventually produce drugs with minimized side effects.

The way in which Bell Laboratories' fundamental chemistry research radiates into nearly every conceivable domain of existence sometimes amazes even Dr. Baker. For instance, one member of his research staff is working on, of all things, the nature of the "well known" water molecule. The Bell System has to fight an endless battle against moisture in its cables and equipment. But more important, Dr. Baker says, is the fact that "water is so interesting and enters into a host of molecular situations, yet we know far too little about it and its combining capabilities."

Another Bell Labs researcher is running an intensive study on ozone, which in certain higher atmospheric concentrations makes rubber and other insulating materials crack at right angles to the line of stress. This is a natural problem for telephone people, but it pales before the significance of Bell Labs ozone research in the war on air pollution: six to eight parts of ozone per hundred million constitutes breathable air, but when the concentration soars to 50 and as high as 90 parts per hundred million — as in the Los Angeles area during a bad smog — human lung tissue undergoes changes comparable to those which destroy insulation, and emphysema victims can die.

Taking an even broader view, Dr. Baker makes this suggestion: "The young chemist ought to be especially interested in chemical systems, so that he can understand the superstructure of matter and look forward to becoming an expert on, say, the carbon dioxide molecule — not as a heat engineer or mete-

WILLIAM O. BAKER COMMENTS

### On Depersonalized Science:

The age of science is young. In its sturdy infancy it offers the greatest change man has yet had to express himself, to be truly personal. We can avoid over-planning and the mob assaults on hot issues of the fashionable science of our time by the wisdom of seeing that science is for people.

### On Genius and Research:

A remarkable thing is the high consistency with which genius in science seems over and over to take unerringly the right path from among many, avoiding those choices of paths which would lead him into areas or tasks presently unfeasible or overwhelming. We must somehow present to the gifted researcher situations in which he will feel no inhibition toward the free travel of the pathways of his mind.

### The Joy of Science:

Our Echo satellite should have been a joyful experience for all men. It was in many places. In Sweden they played the orchestra every time it came over. In Spain they gave drinks on the house. But in this country, the scientific community has not managed to convey the gaiety, the excitement of such an event. This we must do, along with recognizing the other human qualities of science — particularly its fallibility. The notion that science is infallible is one of the greatest, most disastrous errors of our time.

### On Theory and Planning:

Freewheeling individual researchers know that they cannot trace in advance, step by step, the measures necessary to invade a problem. It is a foolish conceit to believe that step-by-step charting of a course into the unknown can be done.

### Individual Minds:

In the search for new knowledge and understanding, experience shows that the best scholar does just what he wants to do when and how he wants to do it. He is disciplined, of course, by his own will. The single human mind is where ideas come from, and where the coherence is in their use. Although hundreds of minds may seize upon the same or a similar problem, each does not contribute a hundredth of a crucial insight or concept.

orologist, but *in detail.* He should understand how $CO_2$ will be dissolved in the ocean, how much absorbed by plants, how much retained in the atmosphere to influence the climate. It's vital to understand the transport system by which $CO_2$ moves through matter, because all plants grow by absorbing it, all people grow by getting rid of it. A grasp of that molecule's transport through any environment will also advance air pollution control by revealing the way it gets through the muffler of a car, or out of a factory chimney.

"The interaction of molecules on chemical surfaces is a whole new realm of chemistry that involves hundred of billions of individual processes which the modern chemist will be able to specify by new knowledge and computers, and by calculations based on models which were absolutely inconceivable even 10 years ago."

## Joyous pre-emption

Throughout Bell Lab's equipment-crammed honeycomb of research cubicles, researchers are single-mindedly at work on far-out studies to determine, by instrumentation-*cum*-computer techniques, the configuration of heretofore unexplorable molecules — not necessarily because there is an identifiable communications value in such studies, but because "it would be interesting to know" as well.

Many exhibit an unusually high degree of commitment to their work; and Dr. Baker calls this "a natural pre-emption of life activity" for the research chemist. However, he observes, the pre-emption is more mental than physical nowadays because of sophisticated instrumentation for conducting experiments, and computers for analyzing the data the instruments accumulate — two chores that formerly chained a man to the bench.

"You can get the answer — the peculiarly human, the 'intuitive gap' or Archimedes' *'Eureka!'* kind of answer — to a problem these days while attending the opera, or playing with the children, or out pushing a cart through the supermarket with your wife," Dr. Baker says. "The actual chemical knowledge a man has to acquire has doubled since 1950—and I thought it was too much to learn even then. But once he has that knowledge, it is no longer necessary for pre-emption by research to affect family life by keeping father at work in the attic all night. We now have instruments to take care of the drudgery, and computers to sift out what the instruments come up with."

Further, Dr. Baker believes wholeheartedly in giving educationally qualified young men "a full-fledged opportunity to start tearing ahead on what they *want* to do."

## A liberal approach

At the same time, Dr. Baker holds unshakably to the belief that anyone who is going to specialize in science must get close to the humanities: "Somehow he must find a way, despite the crushing body of scientific knowledge which gets more overwhelming every day."

Dr. Baker will have no truck with what he regards as over-organized, utilitarian efforts to get science to produce at the practical level for the here and now, just to oblige "the forced-feeding mentality." He makes an eloquent plea whenever he can against this hurry-up approach — "which just doesn't work. Let us take time to do it right, to educate for it, to maintain the warmth and kindness of the human spirit in our raising of this sturdy infant.

"With all its beauty and power," Dr. Baker says, "the age of science is in no way old enough to tell us what to do or what to think, but only sometimes what to ask. By having those with the ablest and most creative minds use their intellects in basic research by following up the undirected, uncontrolled, unspecified, unprogrammed and certainly the unknown courses revealed as work goes on, science and all mankind flourish." ▢

# BELL reports

## Long Distance Rates Reduced

Long distance telephone rates, which have been dropping steadily over the years, became even more of a bargain for telephone users when new rate schedules for interstate calls went into effect November 1.

The latest rate reductions will benefit telephone users in three ways: through lower charges on many calls, longer time periods and added days (Saturdays and certain holidays) when low rates apply, and a new "Midnight to 7" special dial rate with a 75-cent maximum within the continental U.S. The total package features major reductions, but has small increases for some interstate calls under 24 miles. Overall, it provides a saving to customers of $100 million.

The rate changes represent the 22nd major reduction since coast-to-coast service began in 1915. During this period, the consumer price index has tripled, but the lowest rate for a transcontinental call is now less than 1/20 of the 1915 level.

The latest changes include extending the present 8½ hour span for night rates to 12 hours; the new "After 7 and Weekend" rates apply from 7 p.m. to 7 a.m. each weekday, plus all day Saturday and Sunday. At the longest distance, the rate is $1 for a three-minute station-to-station call. The evening rate period, in which the maximum rate is $1.25, is now in effect from 5 p.m. to 7 p.m. each weekday.

The new "Midnight to 7" special dial rate features a 75-cent maximum for a transcontinental call. In effect every day from midnight to 7 a.m., the rate applies only to station-to-station calls dialed by the customer from non-coin phones. Credit card, collect, or other calls needing operator assistance are not included. The special dial rate, as well as the extended night rate, will be of particular benefit to residence and business users on the Pacific Coast who place calls to the East Coast.

Other reduced rates effective November 1 included lower Wide Area Telephone Service (WATS) rates and reductions on some overseas calls.

## CCTV Aids Medical Education

The largest closed-circuit television network in the nation devoted entirely to medical education has been installed in Louisiana by the Southern Bell Telephone Company. Combining two-way video and audio channels, the system links three New Orleans locations — the medical schools of Louisiana State University and Tulane University, and the Oschner Foundation and Charity Hospital — with the State Department of Hospitals in Baton Rouge. Expansion of the network to hospitals in six additional cities is expected later this year.

## Bell Network to Expand

In a blanket construction application filed with the Federal Communications Commission, the Bell System has proposed adding about 40 million channel miles of telephone facilities for message, private-line, and other services, and some two million miles of telegraph facilities. The application covers major interstate projects planned for 1968.

About two-thirds of the new circuits which will be added by the proposed construction are required for anticipated growth of Long Lines messages. The growth rate is expected to be in the range of 11 to 12 percent.

Estimated cost of the new facilities is more than $100 million and will be shared by AT&T and 19 associated Bell System companies.

## Picturephone Trials Scheduled

The Westinghouse Electric Corporation will participate in a three-to-four-month product trial of Picturephone* see-as-you-talk telephone service starting next September.

Westinghouse will be the second company to test Picturephone service under actual business conditions. The Union Carbide Corporation took part in a similar trial in 1965 with service between their New York and Chicago offices. For the new product trial, about 20 Picturephone sets will be installed in Westinghouse's headquarters location in Pittsburgh and another 20 sets in New York City.

The system planned for Westinghouse will have some significant design changes that resulted from the 1965 trial. The proposed system will operate at a higher frequency and will permit the dialing of both intra- and intercity calls. The appearance of the Picturephone sets has also been modified to incorporate a number of new features such as a zoom capability.

Depending on the outcome of the Westinghouse product trial and a market trial still to be scheduled, AT&T plans a limited general offering of Picturephone service in the early 1970's. Commercial service, meanwhile, is available between Picturephone centers in New York, Chicago, and Washington, D.C.

## Overseas DDD Trial Successful

Overseas direct distance dialing may be available to the general public by 1970. A highly successful trial — recently concluded between New York, Paris, and London — indicated that customers experienced little difficulty in dialing an international access code or in understanding different ringing and busy signals, foreign speech, and foreign recorded announcements.

About 70 Manhattan business firms participated in the four-month market trial and dialed their London and Paris associates and customers without the assistance of an overseas operator. The time saved in dialing direct was cited as the greatest advantage of the service, which will ultimately result in an international DDD system based on a worldwide numbering plan.

The international DDD system is being designed to handle a calling volume between the U.S. and overseas points which has been increasing at a rate of 20 percent annually for the past several years. More than 10 million such calls were made last year, and by the 1980's the volume is expected to exceed 70 million.

## Bell System Task Force in Vietnam

A Bell System task force of engineers and technicians attached to the Saigon regional office of the Defense Communications Agency is working closely with U.S. armed forces in an effort to improve and expand the military communications system in South Vietnam. Managed by Western Electric, the 27-man contingent is primarily engaged in circuit layout and systems engineering for the SAM (Southeast Asia Mainland) network.

The task force also trains military personnel in the use of telephone equipment and provides advice on transmission facilities at such distant points as Japan, Okinawa, the Philippines, and Formosa. Members of the group are currently working to upgrade the dependability of the complex military telecommunications set-up which includes microwave towers, land and submarine cables, and high frequency radio and satellite circuits.

## New Satellite Circuits Leased

AT&T, already the world's largest user of satellite facilities, plans to nearly double the number of its satellite circuits to Europe by the end of the year. The Federal Communications Commission has authorized AT&T to acquire 80 transatlantic circuits from the Communications Satellite Corporation. The new telephone channels will be routed through the Early Bird and Atlantic II satellites. AT&T presently has 90 transatlantic satellite circuits in operation.

AT&T also plans to expand its Pacific facilities this year by acquiring telephone circuits in the recently-launched Pacific II satellite when it becomes operational. It now has 50 circuits in Pacific I. The continued growth of telephone traffic across the Atlantic, as well as the Pacific and Caribbean oceans, will require even greater use of satellite circuits in the future.

## New Disneyland Pavilion

A colorful filmed voyage through the United States on a mammoth 360° screen highlights the Bell System's all-new "America the Beautiful" Pavilion at Disneyland near Anaheim, California. Up to 3,000 guests per hour can view the Walt Disney Studios film on the circular screen which measures 18 feet in height and 80 feet in diameter.

Dozens of states are represented in the presentation, including New York, Hawaii, Alaska, Florida, Illinois, and Massachusetts. Guests are welcomed by a Pacific Telephone hostess who uses a series of wall panels to tell the story of the Bell System's evolution. The 34,000 square-foot pavilion also features an extensive display of the latest developments in telephony.

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## INDEX

VOLUME XLVI 1967



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BELL TELEPHONE MAGAZINE

VOLUME XLVI 1967

TABLE OF CONTENTS

## JANUARY/FEBRUARY 1967

Cover: Capsule Images Drawn From Five of the Feature Articles in This Issue.



## MARCH/APRIL 1967

Cover: Ray Garcia of P.T.& T., expresses his views on the involvement of business and the individual in the problems of the city, p. 38.



## MAY/JUNE 1967

Cover: Frank Minardi, W.E. and Bob Moore, B.T.L., pool Skills To Get Integrated Circuits Into Production, p. 18.

## JULY/AUGUST 1967

Cover: Virgil Johannes, Bell Telephone Laboratories, peers through fanned-out ends of cable conductors, p. 20.



## SEPTEMBER/OCTOBER 1967

Cover: Operation Sea Plow, launched last summer to increase the reliability of international communications, p. 2.



## NOVEMBER/DECEMBER 1967

Cover: Dyes emitting light due to excitation of their molecules by long-wave ultraviolet, or "black light."

BELL TELEPHONE MAGAZINE

VOLUME XLVI 1967

INDEX

A

C

S

T