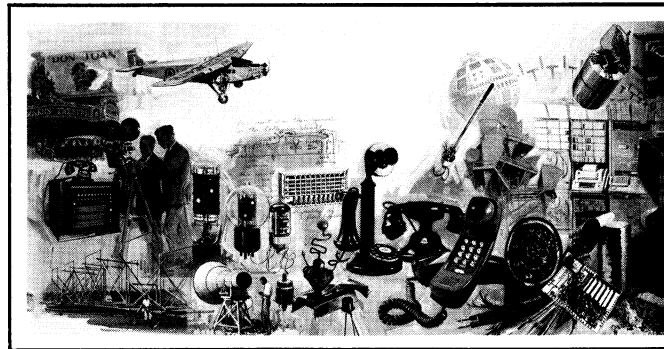


BELL LABORATORIES
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Contents

● Introduction / p. 2

● The Network: Forging Nationwide Telephone Links / p. 4

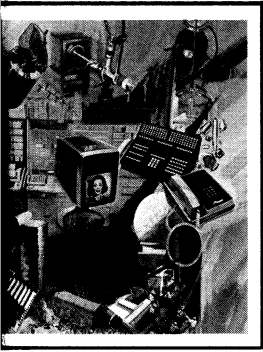
William B. Macurdy and Alistair E. Ritchie

In a very real sense, the American telephone network constitutes a national resource. Composed of all the transmission and switching facilities connecting residential and business telephones in the United States, this network has been carefully planned, developed, and expanded over the years, so that today there exists a hierarchy of switching offices and interconnecting paths over which calls are routed automatically and efficiently. Today's network also offers direct nationwide dialing for almost all Bell System customers, automatic recording of billing information, and computerized collecting and analysis of network data.

● Alpha and Omega of the Network: Customer Products / p. 16

J. W. Schaefer

Where we are, how we got here, where we're going: This article surveys Bell Laboratories' role in the development of a line of customer products that spans PBXs, key telephone systems, data sets, residential sets—in fact, the full complement of equipment that the Bell System offers the public. The origins of these products, the reasons for bringing them into being, and a look at our plans for the future—for both the American business community and our residential customers—are interwoven into a pattern of commitment to ever-improving service.



About the cover — In this artist's conception of achievements by Bell Labs since its founding in 1925, we see in the discoveries and techniques of the early years (back cover) the beginnings of our telephone system as we know it today and expect it to evolve (front cover and overleaf). Through the years, continuing developments have changed our ways of talking

with one another—shrinking the earth to a global village, bringing business associates and friends into our homes and offices, and exploding into a thousand new technologies that project us into the future. At Bell Laboratories we speak not of the "past" 50 years but of the "first" 50 years.

● **Switching / p. 30**

Amos E. Joel, Jr.

Switching technology at Bell Labs has kept step with—and often anticipated—the needs of the American telecommunications network. Thus, the step-by-step system brought automatic switching to towns, the panel system brought automatic switching to large cities, and No. 4 ESS is bringing electronic switching to long-distance calls. This increasing technological sophistication reflects the growing demand for telephone services—a demand that is growing in kind as well as in quantity. Switching devices, too, have evolved from electromechanical units with large motion to miniature relays to compact, densely packed solid-state devices. The evolution in switching has been accompanied by advances in related areas, for example, in Automatic Message Accounting (AMA) and signaling by tones.

● **Exchange Area and Local Loop Transmission / p. 40**

Warren E. Danielson

Highlights of progress in exchange area and local loop transmission include extension of the analytical approach to engineering of loops and trunks, taking into account the full array of transmission-affecting factors; more accurate measuring techniques; more economical materials and equipment; widely usable carrier and repeater techniques (made possible by the economies of solid-state electronics); digital transmission; centralized testing and maintenance (aided by minicomputers). For the future, equally far-reaching developments can be expected. For example, optical transmission over glass fibers appears to be a real possibility.

● **Radio and Long-Haul Transmission / p. 50**

Eugene F. O'Neill

Bell Labs' work in long-distance telephony has followed two directions: (1) exploitation of old media to increase capacity and reduce costs; (2) exploration of new, completely different media. Highlights of the work in the first direction are the use of ever higher frequencies, the invention of the feedback amplifier with its ultralinity and stability, and the use of new modulation techniques. Our efforts in the second direction have yielded broadband coaxial cable, microwave radio, and waveguide transmission. The future promises domestic communications satellites and progress in such media as optical fibers.

● **Materials / p. 60**

William P. Slichter

The importance of the mastery of materials to the Bell System can hardly be overemphasized. Not only does the performance of the Bell System's incredibly complex equipment depend upon this mastery, but so does the ongoing potential for making things better and cheaper, and for satisfying completely new demands. Bell Laboratories, since its inception, has striven to ensure that the Bell System has available to it all the benefits of modern materials research and engineering.

● **Device Development / p. 70**

Willard S. Boyle

A major trend of our technological age—spotlighted by Bell Labs' invention and development of the transistor—is that technical progress comes from

teamwork and from new fundamental understanding of nature. In particular, the development of electronic devices—from their conception to final systems application—depends on the coordinated efforts of specialists in basic science, development, manufacture, and application. The power of this approach has been demonstrated most vividly at Bell Laboratories.

● **Theory and Principles:
The Intellectual Framework / p. 82**

Brockway McMillan

Underlying the network of cables, switches, and telephone sets is another network basic to the telecommunications industry—the network of theory and principles that helps engineers explore the contours of physical reality and define the limits of the possible. Bell Labs scientists played a prominent role in creating this body of theory, without which the telephone network as we know it would be impossible. Their contributions include the analysis of inductive loading, Harold Black's principle of negative feedback, Nyquist's and Bode's criteria and laws, and the now-classical statistical techniques of quality control and traffic theory.

● **Computers and Computer-
Based Systems / p. 90**

Victor A. Vyssotsky

For 30 years, Bell Laboratories has been one of the major contributors to computing science and technology. In recent years, Bell Labs has focused much of its efforts on computer-based systems to help Bell System Companies in their day-to-day operations—by improving service, increasing the efficiency of the work force and the utilization of

plant, and providing better information to management. Computerized record-keeping systems and facility-assignment programs are just two products of those efforts. Additional systems are under development or in use. Goals for the future: computer systems of diverse types that can communicate with each other; better understanding of computer theory; more "robust" software; and greater productivity in software development.

● **In Defense of the Nation / p. 96**
Clifford A. Warren

The Bell System has responded in times of national emergency as a responsibility owed to the country. Thus, during World War II the Bell Laboratories/Western Electric team supplied, among other things, over half of all U. S. radar, a highly effective acoustic torpedo, and a computer-controlled anti-aircraft gun director. In the postwar years the same team developed missile defense systems, from the early AJAX to the current SAFEGUARD series, and also a command-guidance system which was used for the TITAN ICBM, for launching the Echo and Telstar™ satellites, and for many other peacetime space shots. Defense activities are today only a small part of Bell Labs' total effort, and future projects will depend on international relations.

**Highlights of Bell Labs'
Contributions to Early Radio / p. 108**

Some Notable Achievements / p. 110

The Authors / p. 112