Abstracts of Technical Articles by Bell System Authors

Pulse Echo Measurements on Telephone and Television Facilities.[1] L. G. Abraham, A. W. Lebert, J. B. Maggio, and J. T. Schott. Pulse echo measurements have been used on telephone and television facilities since 1940 to locate impedance irregularities and control quality in manufacture and installation. These sets send a pulse into a line and observe on an oscilloscope the echoes returned from irregularities. The shape and width of the pulse, the rate at which it is repeated and the pulse magnitude are important in determining the accuracy of the results and the requirements of the measuring apparatus. The "coaxial pulse echo set" is used for factory and field testing of coaxial cables. The "Lookator" was developed for use on much narrower band systems such as spiral-four field cable and open wire lines.

Television Network Facilities.[2] L. G. Abraham and H. I. Romnes. This paper describes television network facilities which are needed to connect studios and other pickup points to transmitters in the same and in distant cities, and discusses their transmission characteristics. Short-haul television circuits may be by microwave radio or over wire circuits. Long-haul television connections may be by radio relay or over coaxial systems of the type originally developed for carrier telephone circuits. Transmission requirements include adequate frequency band, accurate gain and phase equalization, and freedom from interference resulting from excessive noise, crosstalk, or modulation. Radio and wire systems are under development to provide extensive high-quality television networks.

A Carrier Telephone System for Rural Service.[3] J. M. Barstow. The M1 carrier telephone system was designed for the purpose of extending telephone service into areas served by rural power lines, but not served by co-existing rural telephone lines. To the local office operator and to a carrier subscriber the service provided is the same, so far as procedures involved in establishing a connection are concerned, as a voice-frequency line.

At the office end of the system a telephone wire line extends from the office to a point near the power line. Here is located a converter (called common terminal) which converts the voice-frequency signal to be transmitted to the subscriber to an amplitude-modulated double-sideband carrier signal. This signal is coupled to the power line through a coupling unit

[1] *Trans., A. I. E. E.*, vol. 66, 1947 (pp. 541–548).
[2] *Transactions, A. I. E. E.*, vol. 66, 1947 (pp. 459–464).
[3] *Trans. A. I. E. E.*, vol. 66, 1947 (pp. 501–507).

and high-voltage capacitor. At the subscriber's location the signal is taken off by similar means and led by separate wires to the subscriber premises, where it is reconverted to voice frequency by means of a subscriber terminal. A signal transmitted from the subscriber to the central office goes through similar conversions.

The usual number of parties per two-way channel may be assigned according to local custom, and divided-code or full-code ringing is provided. Equipment is available for five two-way channels over a single-power line employing frequencies in the range 150 to 425 kilocycles. A sixth channel has been discontinued because of radio interference.

A description is given of the manner in which the power line should be treated in order to reduce reflection effects. The power line treatment does not affect its capabilities in regard to power transmission.

Application of Rural Carrier Telephone System.[4] E. H. B. Bartelink, L. E. Cook, F. A. Cowan,* and G. R. Messmer. This paper deals with the application of a carrier system developed primarily for providing rural telephone service over power distribution circuits in areas where this means of extending telephone service may be more attractive than other available methods. The modifications required in the power circuits to permit carrier frequency transmission are described, including the effect of these modifications on the operation of the power system. Construction features also are discussed. The use of the rural carrier telephone system over open wire telephone pairs is discussed briefly.

An Improved Cable Carrier System.[5] H. S. Black, F. A. Brooks, A. J. Wier and I. G. Wilson. A new 12-channel cable carrier system is described which is suitable for transcontinental communications. Important features are negative feedback amplifiers of improved design, new arrangements for accurate equalization of the cable loss, and automatic thermistor regulators which continuously control the transmission of each system.

Joint Use of Pole Lines for Rural Power and Telephone Services.[6] J. W. Campbell,* L. W. Hill, L. M. Moore, and H. J. Scholz. The use of poles to carry both power and communication circuits is not new, having been employed before 1890. There are today more than 6,000,000 poles used jointly by power and telephone organizations in the United States. The great bulk of these poles are located in urban areas where the voltages of the power circuits concerned are generally less than 5,000 volts and the span lengths between poles generally do not exceed about 150 feet.

As power and telephone lines were extended into rural territory, new

[4] *Trans. A. I. E. E.*, vol. 66, 1947 (pp. 511–517).
[5] *Trans. A. I. E. E.*, vol. 66, 1947 (pp. 741–746).
[6] *Trans. A. I. E. E.*, vol. 66, 1947 (pp. 519–524).
* Of Bell Tel. Labs.

problems were encountered in the application of joint construction because of the use of longer spans and higher voltages for the power circuits and the increased noise induction in the necessarily longer exposures. However, progress in the art through cooperation of the telephone industry with the Edison Electric Institute and the Rural Electrification Administration has brought about the developments reviewed in this paper which now make long span higher voltage rural joint use feasible where conditions are favorable.

Atomic Energy.[7] KARL K. DARROW. (*The 1947 Norman Wait Harris Lectures at Northwestern University.*) This little book, which reproduces four lectures substantially as they were given, is at once a very readable and a very accurate account of enough of the facts of nuclear physics to convey a good understanding of the atomic bomb and the possibilities of atomic power. The scientific accuracy of the presentation is instanced by the author's apologies for his title; he emphasizes that in reality his subject is *nuclear* energy, but that on the day of Hiroshima somebody wrote of an *atomic* bomb and the misusage spread like a chain reaction.

The role of electrons, protons and neutrons in atom building is told in a simple and entertaining style (but with a degree of ornamentation that may disturb some readers), and the discussion of rest mass and the Einstein relation between mass and energy is pointed up by well-chosen numerical illustrations beginning with the lightest composite nuclei. The role of fast-particle bombardment in increasing and decreasing the size of nuclei is also explained. The reader thus acquires a clear understanding of the basic phenomena for which nuclear fission is famed. The text is augmented by well-chosen cloud chamber photographs.

Though the author's treatment is accurate, his style and marshalling of facts are very readable. This is well illustrated by the closing paragraph of the third lecture, which follows immediately upon the author's development of the idea of the chain reaction:

> Here is the climax of my lectures, and here is where you should be frightened; and, if I had an orchestral accompaniment, here is where the orchestra would have mounted to a tumultuous fortissimo, with the drums rolling and the trumpets blaring and the tuba groaning and the strings in a frenzy, and whatever else a Richard Wagner could contrive to cause a sense of Götterdämmerung; for, let there be no doubt of it, this *is* something that could bring on the twilight of civilization. But at this crucial juncture I have only words to serve me, and all the words are spoiled. We speak of an awful headache, a dreadful cold, a frightful bore, and an appalling storm; and now when something comes along that is really awful and dreadful and frightful and appalling, all these words have been devaluated and have no terror in them. I have to fall back on the saying, of unknown origin and dubious value, that the strongest emphasis is understatement. Let then this picture, with its circles and its symbols and its numbers, be considered an emphatic understatement of the most terrific thing yet known to man.

[7] Publishedby John Wiley & Sons,Inc., New York, and Chapman & Hall, Ltd., London. 80 pages. $2.00.

The book will be welcomed particularly by those who at one time or another have had a general acquaintance with radio-activity, cosmic rays and the results of cloud chamber research, but whose vocational activities have forced such special knowledge well into the nebulous regions of their memories.

Network Theory Comes of Age.[8] R. L. DIETZOLD. The third decade in the growth of modern network theory, the decade of maturity, is considered in this review of the advances in network theory evolved over the past ten years. New types of networks developed during the war are included.

Thermistors as Components Open Product Design Horizons.[9] K. P. DOWELL. These thermally sensitive resistors with high negative temperature coefficients have come a long way since they were laboratory curiosities and are now available in a wide range of types with diverse and stable characteristics. You may be able to transfer to your own problems some of the unusual design ideas described here.

Gas Pressure for Telephone Cables.[10] R. C. GIESE. Communication cables consist of a number of electric conductors insulated from one another and encased in a metal sheath. This encasement is subjected to numerous hazards, such as those caused by electrolysis, crystallization, various kinds of mechanical damage, and lightning burns. Any damage to the sheath which will permit water to enter the cable will decrease the effectiveness of the insulation material and thus cause an impairment or an interruption to the service. The entrance of moisture through small openings in the sheath can be materially retarded when the space inside the cable, not occupied by the conductors or insulation, is filled with a gas maintained under controlled conditions. Nitrogen is the gas usually used for this purpose because it is inert and does not combine chemically with the conductors or insulation. In addition the use of the gas provides a method of locating openings in the sheath by means of a pressure gradient, which is a material aid in cable maintenance.

Rural Radiotelephone Experiment at Cheyenne Wells, Colo.[11] J. HAROLD MOORE, PAUL K. SEYLER and S. B. WRIGHT. The first rural party-line telephone service by radio installations operating on the subscribers' premises was inaugurated August 20, 1946. This paper describes the equipment used, how it operates, and the results obtained during the preliminary testing and the initial period of regular operation. Radio is one of several new methods which the Bell System is exploring in its program for extension of telephone service in rural areas. It is expected that experience gained in

[8] *Electrical Engineering*, September 1948 (pp. 895–899).
[9] *Elec'l. Mfg.*, August 1948 (pp. 84–91).
[10] *Transactions, A. I. E. E.*, vol. 66, 1947 (pp. 471–478).
[11] *Trans. A. I. E. E.*, vol. 66, 1947 (pp. 525–528).

this experiment will aid in developing a standard rural radiotelephone system.

Effect of Passive Modes in Traveling-Wave Tubes.[12] J. R. PIERCE. As the beam current in a traveling-wave tube is increased, the local fields due to the bunched beam become appreciable compared with the fields propagating along the circuit. The effect is to reduce gain, to increase the electron speed for optimum gain, to introduce a lower limit to the range of electron speeds for which gain is obtained, and to change the initial loss.

New Test Equipment and Testing Methods for Cable Carrier Systems.[13] W. H. TIDD, S. ROSEN and H. A. WENK. Three portable test sets developed for the improved cable carrier telephone system are described: A high sensitivity selective transmission measuring set covering 10 to 150 kc, a decade oscillator for frequencies from 2 to 79 kc, and a tube test set.

A New Microwave Television System.[14] J. F. WENTZ and K. D. SMITH. A microwave point-to-point radio system is described which is designed for the transmission of television programs. This system is intended to supplement wire facilities for local distribution of television signals from pickup points to studios or from studios to broadcast transmitters and to long distance network terminals. The circuits and equipment are described in detail. Performance obtained in tests during 1946 is given.

[12] *Proc. I. R. E.*, August 1948 (pp. 993–997).
[13] *Trans. A. I. E. E.*, vol. 66, 1947 (pp. 726–730).
[14] *Transactions, A. I. E. E.*, vol. 66, 1947 (pp. 465–470).

Contributors to this Issue

W. J. Albersheim, Technical Colleges, Aachen and Munich, Germany; B.Sc., Aachen, 1920; E.E., Aachen, 1922; Doctor of Engineering, Aachen, 1924; Professional Engineer, University of State of New York, 1937. Electrical Research Products, Inc., 1929–41; Bell Telephone Laboratories, 1941–. Dr. Albersheim was concerned with radar and jamming work during the war; he is now engaged in broadband FM transmission problems.

W. B. Hebenstreit, A.A., University of Chicago, 1935; B.S., California Institute of Technology, 1941. Bell Telephone Laboratories, 1941–47. While at the Bell Telephone Laboratories Mr. Hebenstreit worked on various microwave vacuum tubes including magnetrons, traveling wave tubes and the new double stream amplifier. He is now with the Hughes Aircraft Company.

A. V. Hollenberg, A.B., Willamette University, 1931; M.S., 1933, Ph.D., 1938, New York University; Instructor in Physics, Queens College, 1938–42. Columbia Radiation Laboratory, 1942–45; Bell Telephone Laboratories, 1946–. Dr. Hollenberg was engaged in research and development work on microwave magnetrons at the Columbia Radiation Laboratory. At Bell Telephone Laboratories he has been concerned with traveling wave amplifiers.

J. R. Pierce, B.S. in Electrical Engineering, California Institute of Technology, 1933; Ph.D., 1936. Bell Telephone Laboratories, 1936–. Engaged in study of vacuum tubes.

S. O. Rice, B.S. in Electrical Engineering, Oregon State College, 1929; California Institute of Technology, 1929–30, 1934–35. Bell Telephone Laboratories, 1930–. Mr. Rice has been concerned with various theoretical investigations relating to telephone transmission theory.

Sloan D. Robertson, B.E.E., University of Dayton, 1936; M.Sc., Ohio State University, 1938, Ph.D., 1941; Instructor of Electrical Engineering, University of Dayton, 1940. Bell Telephone Laboratories, 1940–. Dr. Robertson was engaged in microwave radar work in the Radio Research Department during the war. He is now engaged in fundamental microwave radio research.

Claude E. Shannon, B.S. in Electrical Engineering, University of Michigan, 1936; S.M. in Electrical Engineering and Ph.D. in Mathematics, M.I.T., 1940. National Research Fellow, 1940. Bell Telephone Laboratories, 1941–. Dr. Shannon has been engaged in mathematical research principally in the use of Boolean Algebra in switching, the theory of communication, and cryptography.