Abstracts of Technical Articles from Bell System Sources

In January, 1932, a series of seven lectures by representatives of the Bell Telephone System was given before the Lowell Institute of Boston, Massachusetts. The general title of the series was "The Application of Science in Electrical Communication."

The lectures were as follows:

"An Introduction to Research in the Communication Field," by H. D. Arnold, Ph.D., Sc.D., Director of Research, Bell Telephone Laboratories.*

"Research in Speech and Hearing," by Harvey Fletcher, Ph.D., Acoustical Research Director, Bell Telephone Laboratories.

"Transoceanic Radio Telephony," by Ralph Bown, Ph.D., Department of Development and Research, American Telephone and Telegraph Company.*

"Picture Transmission and Television," by Herbert E. Ives, Ph.D., Sc.D., Electro-Optical Research Director, Bell Telephone Laboratories.*

"Talking Motion Pictures and Other By-Products of Communication Research," by John E. Otterson, President, Electrical Research Products, Inc.

"Utilizing the Results of Fundamental Research in the Communication Field," by Frank B. Jewett, Ph.D., D.Sc., Vice President, American Telephone and Telegraph Company, President, Bell Telephone Laboratories.*

"Social Aspects of Communication Development," by Arthur W. Page, A.B., Vice President, American Telephone and Telegraph Company.*

Further Notes on the Detection of Two Modulated Waves Which Differ Slightly in Carrier Frequency.[1] C. B. AIKEN. The present paper deals with the analysis of the detection of two modulated waves of slightly different carrier frequency under the conditions that the carrier amplitude of one wave is much smaller than that of the other and that the modulation of the larger wave is low. These conditions apply in determining the interference which arises during the operation of two broadcast stations on the same frequency assignment when the

* Published in the April 1932 *Bell Telephone Quarterly.*

[1] *Proc. I. R. E.*, March, 1932.

stations are nonisochronous and transmit different programs. A discussion of the characteristics of shared channel interference is given, and it is shown that there are only two important components of this interference, one being the carrier beat note and the other being what has been designated as side band noise. This latter consists of two frequency spectra, one of which is similar to the spectrum of the modulating frequencies of the undesired station but is shifted upward by a constant amount equal to the difference between the carrier frequencies. The other spectrum is of a similar type but is shifted downward in frequency by the same amount.

The Use of Thermionics in the Study of Adsorption of Vapours and Gases.[2] JOSEPH A. BECKER Thermionic emission can be very useful in the study of adsorption phenomena. The primary reason is that very minute amounts of electropositive elements, such as cæsium, barium, or thorium, or electronegative gases, such as oxygen, change the thermionic emission from surfaces of tungsten, platinum, molybdenum, etc., by very large factors and in a characteristic manner. They do this by changing the work function of the surface. This effect, as well as other surface effects, can be best explained by the adion grid theory: The adsorbed particles can exist on the surface either as adions (adsorbed ions) or as adatoms; the adions act like a positively charged, open meshed grid placed very close to the surface. From this theory and the experimental facts it follows: (1) That the ratio of adions to adatoms decreases as the surface concentration increases (Table I); (2) that the work required to remove an adion from the surface increases while the work to remove an adatom decreases as the surface concentration increases; (3) the mean life of an adsorbed particle depends on the surface concentration as well as on the temperature (Table II); (4) the rate of diffusion from the surface into the interior depends upon the temperature and on the amount by which the surface concentration exceeds its equilibrium value. Thermionic experiments show the existence of surface migration and can be used to make a quantitative study of this phenomenon. The techniques involved in these various experiments are described and references given to previous publications.

Electrical Phenomena in Gases.[3] KARL K. DARROW. This treatise of 500 pages is concerned with one of the most important, instructive, and intensively studied fields of modern physics. Its scope embraces, first of all, the elementary processes through the action of which a gas

[2] *Transactions of the Faraday Society*, March, 1932.
[3] Published by Williams and Wilkins Company, Baltimore, Maryland, 1932.

becomes and remains capable of conducting electricity, and acquires and retains other interesting qualities. Such are: "ionization," the detachment of electrons from atoms and molecules by electron-impact, light, impact of positive ions, and other agencies; "excitation," the transfer of atoms and molecules, by these same agencies, into abnormal or excited states in which they possess extra energy and various peculiar powers—the return of excited atoms to their normal condition, with emission of light or with other modes of energy-surrender; "interception," the deflection and slowing-down of electrons and positive ions by collisions with molecules and atoms. After the four chapters devoted to these elementary processes, come four concerned with the drift and diffusion of electrons and more massive ions through dense gases, and with allied topics: material often classified under such names as "mobility," "diffusion," "recombination" and "capture of electrons." The following chapter is assigned to the drifting of ions through dense gases under fields so strong that these ions themselves produce extra ionization, and to the phenomena of "breakdown" which is sometimes sparkover, sometimes the establishment of a discharge such as a glow or an arc. After a chapter on the distortion of electric fields by space-charge, essential to what follows, there comes a treatment of the properties of highly ionized and luminous gases such as the mercury-vapor arc exemplifies, and of space-charge sheaths, as clarified of recent years by newly developed probe-methods. The final chapters are descriptions of the important types of discharge known as self-sustaining glow and self-sustaining arc. The book is thus so arranged as to proceed from the fundamental atomic phenomena, through the intermediate topics of drift and diffusion of ions through gases, to the most intricate discharges. In the later parts, especial attention has been paid to such phenomena as have been made at least partially intelligible in terms of the processes described in the earlier; nevertheless, those which have not been interpreted are given due place and emphasis.

Electrical Phenomena in Gases is Dr. Darrow's second book. *Introduction to Contemporary Physics* was published by D. Van Nostrand Company in 1926.

Application of Quartz Plates to Radio Transmitters.[4] O. M. HOVGAARD. This paper discusses the disturbing elements encountered in the application of quartz plates to broadcast and aircraft radio transmitters. A general procedure for minimizing such effects is considered from a circuit standpoint as well as in the light of practical experience.

[4] *Proc. I. R. E.*, May, 1932.

The degree to which maintenance may affect performance and the necessity for automatic equipment are shown by data obtained in the field. Apparatus and systems which enable the operating staff to meet modern frequency stability requirements by monitoring the emitted carrier are also described.

Tape Armored Telephone Toll Cable.[5] C. W. NYSTROM. Toll cables buried directly in the earth are coming into increased use. Such cables are not installed in the usual clay conduit but are protected by layers of paper, jute, and steel tapes. Complete equipment for laying this cable has been developed.

Some Effects of Topography and Ground on Short-Wave Reception.[6] R. K. POTTER and H. T. FRIIS. This paper contains some results of an experimental study of the effects which ground and ground irregularities have upon short-wave signal reception. The results illustrate the signal strength advantage to be gained in the selection of suitable ground or topographical conditions and show the influence of antenna types, and vertical angle of signal arrival, upon such an advantage. Although the tests were confined to reception, the conclusions are probably applicable in general to the case of transmission. The agreement between measurement data and theory seems to justify the application of plane wave optical theory to the calculation of vertical plane directivity of antennas. Such an application suggests, according to the data obtained, that signals from South America are normally received at much lower vertical angles than those from England.

Western Electric Noiseless Recording.[7] H. C. SILENT and J. G. FRAYNE. The Western Electric method of noiseless recording with the light valve is described. The general principles are discussed, the circuit diagram is explained, and the method of adjusting the device for service described. The photographic characteristics of film are considered, and their application in noiseless recording is shown in some detail.

The Acoustics of Large Auditoriums.[8] S. K. WOLF. Extremely large auditoriums present acoustical difficulties which do not readily yield to the customary methods of analysis and correction. This is illustrated by measurements of the time of reverberation, made in

[5] *Electrical Engineering*, March, 1932.
[6] *Proc. I. R. E.*, April, 1932.
[7] *Jour. S. M. P. E.*, May, 1932.
[8] *Jour. S. M. P. E.*, April, 1932.

the Madison Square Garden, New York, N. Y., which revealed a considerable discrepancy between theoretical expectations and the times actually measured throughout the frequency range. At 500 cycles, for example, analysis of the auditorium indicated a decay period of 35.5 seconds, whereas the time actually measured by the spark chronograph reverberation meter was only 7.6 seconds. On the basis of the measured time, 47,000 square feet of one-inch rock wool were installed. This material was distributed in a manner calculated to suppress undesirable discrete reflections as well as to reduce the general reverberation time. The result was a reduction in the measured time to 3.5 seconds and the complete elimination of acoustic difficulties. Present reverberation formulas do not possess sufficient generality to justify application to enclosures which are extremely atypical in size or shape. Until such formulas are developed, reliance must be placed on actual measurements.