Abstracts of Bell System Technical Papers* Not Published in This Journal

Mechanical Properties of Discrete Polymer Molecules. W. O. BAKER[1], W. P. MASON[1] and J. H. HEISS[1]. *J. Polymer Sci.*, **8,** pp. 129–155, Feb., 1952. (Monograph 1937).

Post-War Achievements of Bell Laboratories: II. O. E. BUCKLEY[1]. *Bell Tel. Mag.*, **30,** No. 4, pp. 224–237, 1951–1952.

A Portable, Direct-Reading Microwave Noise Generator. E. L. CHINNOCK[1]. *Proc. Inst. Radio Engrs.*, **40,** pp. 160–164, Feb., 1952. (Monograph 1939).

This paper discusses the factors which influenced the design of a directly calibrated portable microwave noise source, utilizing a fluorescent lamp. The variation of the noise power output and the impedance match as a function of the operating temperature are considered, and the portable unit is described.

The Quantum Theory. K. K. DARROW[1]. *Sci. Am.*, **186,** pp. 47–54, Mar., 1952. (Monograph 1940).

Concerning the early years of this fundamental concept of modern physics—how Max Planck formulated it at the turn of the century and how others enlarged it up to 1923.

Performance of Ultrasonic Vitreous Silica Delay Lines. M. D. FAGAN[1]. *Tele-Tech*, **11,** pp. 43–45, 138+, Mar., 1952. (Monograph 1951).

Results of tests at 10 and 60 mc with resistive terminations of 75 to 1000 ohms. Low terminating impedance values yield wide bands but involve higher insertion losses.

Phase Transition of $ND_4D_2PO_4$. B. T. MATTHIAS[1]. *Phys. Rev.*, v. **85,** p. 141, Jan. 1, 1952.

Engineering Local Television Facilities and Their Operation. B. D.

* Certain of these papers are available as Bell System Monographs and may be obtained on request to the Publication Department, Bell Telephone Laboratories, Inc., 463 West Street, New York 14, N. Y. For papers available in this form, the monograph number is given in parentheses following the date of publication, and this number should be given in all requests.

[1] Bell Telephone Laboratories.

WICKLINE[4] and J. E. FARLEY[4]. *Elec. Eng.*, **71**, pp. 252–257, Mar., 1952.

All the means of electrical communication are called into play when a city-wide coverage of an event is to be televised. How telephone and television facilities were utilized on the day that Chicago welcomed General MacArthur is explained in this article.

Echo Distortion in the FM Transmission of Frequency-Division Multiplex. W. J. ALBERSHEIM[1] and J. P. SCHAFER[1]. *Proc. Inst. Radio Engrs.*, **40**, pp. 316–328, March, 1952.

The composite multiplex signals generated by frequency-division methods long standard in telephone communication can be transmitted by the new transcontinental broad-band FM radio relays. Signal intermodulation by echoes must be minimized. Such intermodulation is investigated in this paper experimentally and analytically. Two types of echoes are considered: (1) weak echoes with delays exceeding 0.1 microseconds, caused mainly by mismatched long lines; and (2) powerful echoes with delays shorter than 0.01 microseconds, caused by multipath transmission, and leading to selective fading. By use of random noise signals, the distortion is evaluated as a function of various parameters of the echo, the base-band, and the rf modulation.

Motion of a Ferromagnetic Domain Wall in Fe_3O_4. J. K. GALT[1]. *Phys. Rev.*, **85**, pp. 664–669, Feb. 15, 1952.

Experiments have been made on a sample of Fe_3O_4 cut from a single crystal in such a way that its ferromagnetic domain pattern includes an individual domain wall whose motion can be studied. This sample has a permeability which is high (about 5000) at low frequencies and drops off rapidly above 1000 cycles. A hysteresis loop and data on wall velocity vs applied field were also taken. The data are discussed in terms of recent developments in the theory of the ferromagnetic domain wall. It appears that this theory explains our data satisfactorily, and that in using it to explain our data we determine some of the fundamental magnetic constants of Fe_3O_4. We are also able to gain some insight into domain wall motion in ferrites generally in this way.

The Drift Mobility of Electrons in Silicon. J. R. HAYNES[1] and W. C. WESTPHAL[1]. *Phys Rev.*, **85**, p. 680, Feb. 15, 1952.

Formulas for the Group Sequential Sampling of Attributes. H. L. JONES[4]. *Ann. Math. Statistics*, **23**, pp. 72–87, March, 1952.

Some Fundamental Properties of Transmission Systems. F. B. LLEWELLYN[1]. *Proc. Inst. Radio Engrs.*, **40**, pp. 271–283, March, 1952.

The problem of the minimum loss in relation to the singing point is investigated for generalized transmission systems that must be stable for any combina-

[1] Bell Telephone Laboratories.
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tion of passive terminating impedances. It is concluded that the loss may approach zero db only in those cases where the image impedances seen at the ends of the system are purely resistive. Moreover, in such cases, the method of overcoming the transmission loss, whether by conventional repeaters or by series and shunt negative impedance loading, or otherwise, is quite immaterial to the external behavior of the system as long as the image impedances are not changed. The use of impedance-correcting networks provides one means of insuring that the phase of the image impedance of the over-all system approaches zero. General relations are derived which connect the image impedance and the image gain of an active system with its over-all performance properties.

The Arithmetic of Ménage Numbers. J. Riordan[1]. *Duke Math. Jl.*, **19,** pp. 27–30, March, 1952.

A Recurrence Relation for Three-Line Latin Rectangles. J. Riordan[1]. *Am. Math. Monthly*, **59,** pp. 159–162, March, 1952.

Capacitors and Communications. Inductive Coordination of Lines. A. R. Waehner[5] and W. E. Bloecker[2]. *Elec. Light and Power*, **30,** pp. 105–108, 114, March, 1952.

Although the use of capacitors on power lines has been expanding, their use has caused relatively few cases of noise on communication lines and these have been satisfactorily corrected. The causes of trouble and remedial measures were the subject of a recent, joint E.E.I.-Bell System study described here.

Book Reviews

Antennas: Theory and Practice. By Sergei A. Schelkunoff and Harald T. Friis, 639 + xxii pages, John Wiley and Sons, Inc., New York (1952). Price: $10.00.

This is a recent addition to Wiley's Applied Mathematics Series edited by I. S. Sokolnikoff. It contains a thorough and balanced treatment of electromagnetic radiation and electrical properties of various types of antennas. In these days of rapid expansion of microwave engineering it would have been easy to neglect the older and less glamorous long-wave and short-wave antennas. The authors are to be congratulated on their impartiality. The exposition is lucid. While the entire quantitative theory of antennas is based on Maxwell's equations, unnecessary mathematics is conspicuous by its absence, and physical explanations are abundant.

The book begins with a long chapter on Physical Principles of Radiation. This chapter is almost a book within the book. It touches upon the most important ideas and problems of antenna analysis and contains a number of simple but useful formulas. Circuit and field concepts are compared, and the similarities as well as the differences between them are exhibited. Maxwell's equations are stated in a form which is particularly easy to understand. In this form, one

[1] Bell Telephone Laboratories.
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[5] Line Material Company.

equation expresses a relation between the average electric intensity tangential to a given curve and the time rate of change of the average magnetic intensity normal to a surface bounded by this curve. The other equation expresses a complementary relation. The reader will be impressed by a simple physical picture from which the authors are able to derive the expression for the radiation field of a short antenna. In this chapter they discuss the effect of heat loss and impedance mismatch on the efficiency of antennas. Among other topics will be found directive radiation and reception, large antenna arrays, horns, reflectors, and lenses.

After this extended general introduction a more detailed analysis of various problems begins. Chapter 2 is devoted to Maxwell's equations and Chapter 3 to plane waves on conductors and in free space. The main topic in Chapter 4 is the derivation of the expressions for the complete field surrounding a short antenna from Maxwell's equations. The authors have made a special effort to show the connection between this field and the oscillating charge in the antenna.

Applications of this basic theory begin with Chapter 5 devoted to directive radiation. This chapter is concerned with radiation patterns of various arrays and with calculation of radiated power. A novel method, the *method of momonts* (pp. 162–195), is likely to prove valuable when spatial distributions of antenna current are complicated (as in the case of shunt-fed antennas). Chapter 6 explains methods for calculating directivites and effective areas of antennas. Some ground effects are considered briefly in Chapter 7. In Chapter 8, the discussion of current distributions in antennas made up of thin wires is particularly thorough. First, simple approximations are developed; then the effects of various factors are carefully examined. Various reciprocity and circuit equivalence theorems, so useful in antenna analysis, are collected in Chapter 9.

Beginning with Chapter 10 the general theory is applied to specific antenna types. Thus, small antennas are treated in Chapter 10; quarter-wave, half-wave and full-wave antennas in Chapter 11; general dipole antennas in Chapters 12 and 13; rhombic antennas in Chapter 14; miscellaneous types of wire antennas in Chapter 15; horn antennas in Chapter 16; slot antennas in Chapter 17; reflectors in Chapter 18; and lenses in Chapter 19.

Practical engineers will be delighted with the appendices which contain in a compact form some of the most useful information about transmission lines, dipole antennas, antenna arrays, optimum horns, and lenses. Teachers will welcome the numerous problems scattered throughout the book.

ADVANCED ANTENNA THEORY. By Sergei A. Schelkunoff, 216 + xii pages, John Wiley and Sons, Inc., New York (1952). Price: $6.50.

This book is a recent addition to Wiley's Applied Mathematics Series edited by I. S. Sokolnikoff. It is concerned with recent advances in antenna theory and is divided into six chapters. General expressions in spherical coordinates are derived for electromagnetic fields in free space and in the presence of conducting cones and thin wires diverging from a common point. In Chapter 2 these expressions are applied to dipole antennas, vee antennas, end-fed antennas, etc. Chapter 3 gives an account of Stratton and Chu's theory of spheroidal antennas. Integral equations in antenna theory and Hallen's method of their solution are treated in Chapters 4 and 5. The book is concluded with a chapter on natural oscillations in antennas. A substantial number of problems and several interesting appendices will be found at the end.