Reviews and Abstracts

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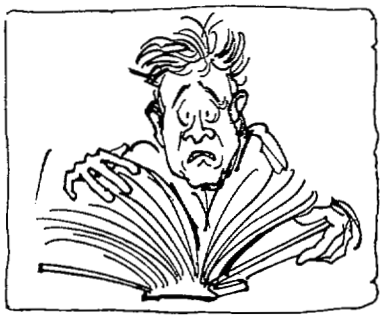

Book Reviews

Handbook of Atmospherics, edited by Hans Volland, CRC Press, Inc., Boca Raton, Florida, Vol. 1, 377 pages, Vol. 2, 327 pages; each volume is $94 in USA and $104 elsewhere - 1982.

In the context of this "handbook" offering, atmospherics refer to electromagnetic signals that radiate or are produced by lightning and related electrical discharge phenomena. Sometimes these signals are called sferics and their existence was known since the early days of radio. The energy of the observed signal may contain frequencies all the way from 1 hertz to above 100 Mhz. Needless to say, the presence of such atmospheric energy in our environment needs to be understood. In spite of observational research spanning half a century, we really do not have a clear picture of what is going on not to mention our lack of theoretical insight. More recently, investigators have examined the subject in the context of the electromagnetic signals that can be produced indirectly from the prompt gamma radiation associated with nuclear detonations.

This two volume "handbook" is a collection of multiauthored articles on the general subject. The editor has solicited contributions from various investigators who have been active in recent years. Thus in a sense the result is a good progress report of the state of the art. Topics such as the physics of thunderclouds, thunder, global atmospheric electric currents, biological aspects, and various space techniques for satellite detection are included. These subjects certainly have high current interest but the coverage is rather uneven; the reader could do much better by consulting the excellent 2 volume book Lightning edited by R. H. Golde (Academic Press, 1977) for an overall viewpoint.

Some of the more substantive chapters deal with charge structure of thunder clouds and the lightning discharge mechanisms, the earth ionosphere Schumann cavity resonances, effects of the atmospheric noise on telecommunication systems included related man-made noise, whistlers which are sferics that have traveled in the magnetosphere at planetary distances, and acoustic radiation from lightning. These particular topics are discussed in considerable depth and could stand on their own merit as excellent review papers in a journal such as the Proc. IEEE where more people would see them.

There are several chapters on related propagation theory (by Polk and Harth). These are fairly detailed but they do not contain any new material that is not in the antecedent papers that are liberally cited. But possibly they serve a useful purpose in collecting the results in a convenient place for the atmospheric electricity community to see. My only complaint is that the authors are not sufficiently careful to specify where the quoted formulas can be used and what their limitations are. For example, on page 120 of Vol. 1, the condition for the validity of the Debye representation of spherical Bessel functions is misquoted from Wait (Ref 13) and the Airy function forms used on pg. 155 in Vol. 2 need to be clarified in view of the author's assumption of an Exp ($-i\omega t$) time factor that seems inconsistent with Wait (Ref. 43) where exp ($i\omega t$) is used.

The 2 Vol. set of books, hardly a handbook, will find itself in specialized libraries who have funds from sponsored military research and other well endowed grantors. It is doubtful if any individual could afford to pay such an astronomical price for a collection of review articles in spite of their overall higher than average quality.

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The following book has already been reviewed by Bill Croswell in the December, 1982 issue of the Newsletter; the present review is by Rajeev Bansel of the University of Connecticut, and evaluates the book from a teacher's perspective.

Antenna Theory; Analysis and Design, by C. A. Balanis, Harper and Row, Inc., 10 East 53rd Street, New York, NY, 10022, 1982, 790 pages, $39.50.

Since last year three new books have become available to educators searching for an up-to-date text on antennas for senior and graduate students of electrical engineering. My remarks here are confined to Prof. Balanis' entry in this field. (The interested reader is referred to the October 1981 and the February 1982 issues of the Newsletter for reviews of the other two textbooks.) This review stems from my recent experience with Antenna Theory as the primary textbook in a graduate course that I taught at the University of Connecticut. Before a chapter-by-chapter analysis is undertaken, a few preliminary remarks seem to be in order. As Prof. Balanis states in his preface, the text is intended primarily for a two-semester sequence in antenna theory. Fortunately, however, the material in each chapter has been neatly organized into sections and subsections so that, by omitting the most difficult sections, the teacher can provide sufficient breadth of topics even in a one-semester course without loss of continuity. Making the reasonable assumption that the intended audience

would possess the necessary background in basic electromagnetic theory and vector calculus, Prof. Balanis has devoted his book solely to a treatment of antennas right from page 1.

Having succinctly introduced the subject matter in Chapter 1, the author proceeds to define in Chapter 2 the various terms used by antenna engineers. IEEE standard definitions have been quoted throughout. The chapter concludes with interpretations of Friis transmission equation, the radar range equation, and antenna temperature. The derivation of the effective antenna temperature is a little too short for beginners to follow. Also, since even the Hertzian dipole is not formally introduced till Chapter 4, students may have some difficulty in immediately relating the various definitions to the parameters of an actual antenna.

Chapter 3 presents the basic mathematical development leading to general expressions for the electromagnetic field of known current distributions. The reciprocity theorem is derived and its implications for the pattern of a receiving antenna are discussed.

Chapters 4 and 5 are devoted respectively to a treatment of linear wire antennas and loops. For the advanced student (or practicing engineer), both chapters include considerable material on ground effects.

Chapter 6 is a more or less standard development of array theory. A distinguishing feature is the inclusion of a concise section on superdirectivity.

Chapter 7 derives self- and mutual-impedances of dipoles based on the somewhat dated induced emf method. The chapter concludes with a short introduction to the moment method.

Chapters 8 through 10 introduce the student to a variety of antenna configurations suited for broadband applications. Step-by-step design procedures are given for Yagi-Uda arrays and log-periodic dipole arrays which should prove very useful to the practicing engineer as well. In addition, Chapter 8 incorporates much valuable information on practical matching techniques such as baluns and transformers, and T-, gamma, and omega matches. It is extremely difficult, if not impossible, to keep a book of such scope free from occasional errors. In Chapter 9, when describing the operation of a helical antenna in axial mode, the author gives the correct expression for the far field but incorrectly attributes the cos θ dependence of the field to a "uniform current" in each turn. Another regrettable lapse occurs in Chapter 10 in specifying the geometry of an LPDA. The definitions of the usual parameters σ and α (Eqns. 10-26a and 10-28) are clearly incompatible.

Chapters 11 through 13 deal with aperture antennas. After illustrating the usefulness of the field equivalence principle through simple examples, the author discusses various horns, reflectors and lens antennas. An elementary introduction to microstrip antennas is included as is a brief treatment of the geometric theory of diffraction.

Antenna pattern synthesis is the topic of Chapter 14. The classical synthesis techniques such as Schelkunoff polynomial method, Fourier transform method, Woodward method, etc. are illustrated with suitable examples.

The final chapter of the book is a helpful introduction to the methods used in basic antenna measurements. Antenna ranges and the associated instrumentation are described and the fundamentals of scale model measurements are presented. The descriptions of current and impedance measurements are rather superficial but considering that most other antenna texts omit the subject of measurements altogether, the brevity of the treatment is understandable.

The inclusion of extensive tables, curves and eight useful appendices enhances the value of the text as a handy reference book. Computer programs are included at the end of many of the chapters, and both analytical and design problems are incorporated throughout the book. Another valuable aid to the student is the three-dimensional graphical illustrations for displaying radiation patterns. All things considered, the book should be a strong contender as a senior or graduate text on antennas.

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Report Abstracts

The following EMP-related notes have been recently published and distributed:

IN 407 - Michalski, K. A., Pearson, Wilson L., Synthesis Methods Applicable to SEM Pole-Pair Admittances, December 1979.

IN 408 - Pond, J. M., Senior, T. B. A., Determination of SEM Poles From Frequency Responses, July 1981.

SSN 272 - Granzow, K. D., Martinez, J. P., Casey, K. F., Quasi-Field EMP Simulator Design Study, August 26, 1981.

TN 315 - Mallon C., Denson R., Leadon R. E., Flanagan T. M., "Low-Field Electrical Characteristics of Soil", JAYCOR, San Diego, California 92138, 12 January 1981.

TN 316 - Mallon C., Denson R., Leadon R. E., Flanagan T. M., "Electrical Breakdown Characteristics of Soil Samples", JAYCOR, San Diego, California 92138, 12 January 1981.

TN 317 - Mallon C., Denson R., Leadon R. E., Flanagan T. M., "Coaxial Geometry Experiments", JAYCOR, San Diego, California 92138, 12 January 1981.

IN 409 - Lin C. A., Cordaro J. T., "Singularity Expansion Method Parameter Measurement", The University of New Mexico, Albuquerque, NM 87131, May 1981.

IN 410 - Cabayan H. S., Zicker J., Deadirck S. J., Candy J., Gavel D., Bogdan E. J., "Surface Field Measurements on Scale Models In The Time Domain", Lawrence Livermore National Laboratory, Livermore, CA 94550, February 1981

LPN 2 - Baum C. E., "Properties of Lightning-Leader Pulses", Air Force Weapons Laboratory, Albuquerque, New Mexico 87117, 22 December 1981.

SSN 273 - Tesche F. M., Liu T. K., Mei K. K., "Theoretical Basis for the Hardness