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A SURVEY OF
THE PRINCIPLES & PRACTICE
OF WAVE GUIDES
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BY

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PREFACE

Although the propagation of electromagnetic waves in metal tubes—or wave guides as they are now called—has been studied for some fifty years, until recently the subject was in the main of theoretical, rather than of practical, interest. However, with the development of the first microwave radar equipment during 1940–1 the subject was suddenly transformed to one of prime practical importance, and in the following years was developed at a phenomenal rate, both in Britain and the United States. This book is written to provide an introductory survey of these recent developments.

The treatment in the first six chapters is based on courses on microwave techniques which were given during the war at the Radar School of the Telecommunications Research Establishment (T.R.E.), and it is believed that the book has lost nothing of importance in content and rigour through this elementary and physical approach to the subject. Chapter 7 has been included for those readers who may prefer a more formal treatment.

The physical interpretation, given in §5.4, of the normalized admittance or impedance of an obstacle or other discontinuity in a wave guide, in terms of scattering coefficient, has the advantage of relating these quantities immediately to the experimental data obtained with a standing wave indicator. It was the subject of a paper that I read before a technical colloquium at T.R.E. during the war. The treatment of Babinet’s Principle in Chapter 7 is also believed to be original.

When this book was written, the greater proportion of the technical developments described were hidden in secret reports and memoranda which are not available to the general reader. No reference is made to this literature, and very few of the many contributors to the development of the subject have been mentioned by name. Accounts of confidential work done during the war are
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PREFACE

now appearing in technical journals, and the reader can obtain more detailed information on particular matters from these. Attention is drawn in particular to The Proceedings of the Radio-location Convention, March–May 1946, J. Instn Elect. Engrs, vol. 93, part III A, nos. 1, 3 and 4, 1946.

I welcome this opportunity of expressing my appreciation of the considerable assistance that I received from numerous colleagues at the Telecommunications Research Establishment without which this book could not have been written, but I wish to record in particular my indebtedness to Dr G. G. Macfarlane and Dr W. Cochrane with whom I engaged in many stimulating discussions on the subject of wave guides. I am also indebted to Mr J. A. Ratcliffe, who first aroused my interest in the subject, for helpful criticism of the text.

I wish also to express my thanks to the Director-General of Scientific Research (Air), Ministry of Supply, for permission to publish this book, which follows closely a monograph written by me as a contribution to the Scientific War Records of the Ministry of Supply (Air).

It is recorded, in conclusion, that, although the book has received official scrutiny before publication, I accept full responsibility for all opinions and statements in it. Further, I acknowledge Crown Copyright in respect of all illustrations in the book.

L. G. H. HUXLEY

DEPARTMENT OF ELECTRICAL ENGINEERING
THE UNIVERSITY, EDBASTON
BIRMINGHAM 15

28 June 1946
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CORRIGENDA

p. 4, equation (3).  For $10^{-6}$ read $10^6$.
p. 5, 1·3, line 8.  For $E/q$ read $F/q$.
p. 10, equation (7).  Omit 2 under radical.
p. 18, line 16.  For smallest read largest.
p. 22, line 22.  For $D$ read $B$.
p. 61, 6 lines from bottom.  For fig. 4·29 (c) read fig. 4·29 (a).
p. 70, line 3 from bottom.  Cadmium plating is used externally, not internally.
p. 83, line 6 from bottom.  For not used read not extensively used.
p. 87, lines 8 and 13.  For $G$ read $C$.
p. 88.  In the account of choke couplings and plungers, it should have been mentioned that lose contacts between the wall and the plunger or between the two portions of the coupler, are rendered innocuous since they are placed at a node of current in the half wave recess.
p. 93, line 22.  For (a) read (c).
p. 115, line 5 from bottom.  For 5·2·2 (1) and (2) read of 5·2·2.
p. 119, line 6.  For § 7·16 read § 7·17.
p. 133, line 3 from bottom.  For 10 (a) read 5·10 (a).
p. 137.  Equation (2) should read

$$y_1 = jh_1 = -j \frac{\lambda_s}{W} \cot^2 \left( \frac{\pi c}{2W} \right).$$

It is given correctly on the following page.
p. 141, fig. 5·16 (9).  Include term $-2$ within the square bracket.
p. 141, fig. 5·16 (10).  For $R$ read $r$ and for $2n - 1 \lambda$ read $(2n - 1) \lambda$.
p. 145, fig. 5·18 (a).  Reflected components should read $(E_r, H_r)$.
p. 146.  In formula following (1) read $(1 - \rho)$.
p. 146, line 14 from bottom.  For $Z_H$ read $(Z_H)_{x}$.
p. 148, line 21.  For fig. 5·16 read fig. 5·14.
p. 155, fig. 5·26 (a).  For $\frac{1}{2}$ read $\frac{3}{2}$. 
CORRIGENDA

pp. 164, 165, near bottom of page. \[ \frac{j(1+jf_a)}{f_a} \text{ read } \frac{j(1+jf_a)}{2f_a}; \]
also make corresponding correction on fig. 5·30 (a).
p. 167, line 5. For right-hand read left-hand.
p. 179, line 23. For DE read BE.
p. 181, line 2. For DCHR read DCHK.
p. 190, line 9. For cell read cells.
p. 191, line 2 from bottom. For mean read peak.
p. 192, bottom line. For power read peak power.
p. 196. For intrinsic impedance read everywhere total impedance. (Ref. p. 119.)

p. 198, line 3 from bottom. For \( v = \sqrt{\frac{L}{C}} \) read \( v = \frac{1}{\sqrt{LC}} \).
p. 202, line 5 from bottom. For Cuttler read Cutler.
p. 203, first formula. For D read d within the round bracket.
p. 214, line 4. For (e) read (a).
p. 224. The \( E \)-mode with the lowest frequency is the \( E_{110} \) not the \( E_{111} \) as stated. This correction is required also on p. 258. The component \( U \) of the Hertz vector for the \( E_{110} \) mode is

\[ U = \sin \left( \frac{\pi x}{a} \right) \sin \left( \frac{\pi y}{b} \right) e^{jat}. \]

p. 229, line 2. Omit words C opposite to B.
p. 235, centre of page, paragraph beginning ‘the input impedance...’.
Cause and effect are interchanged.

p. 248, § 7·3. In equation above (3) for \( eE \) read \( e\hat{E} \).

p. 253, equation (3). For \( \frac{\partial}{\partial \mu_a} \) read \( \frac{\partial}{\partial \mu_a} \) for first symbol within square bracket.

p. 275, end of § 7·10·7. The correct values of the roots are:
\( \rho_{11} = 4·49, \rho_{12} = 5·8, \rho_{12} = 7·64, \sigma_{11} = 2·75. \)
p. 276, second line from bottom. For electric read magnetic.

p. 291, bottom line. For \( v \) read \( \sigma \).

Huxley: Wave Guides.