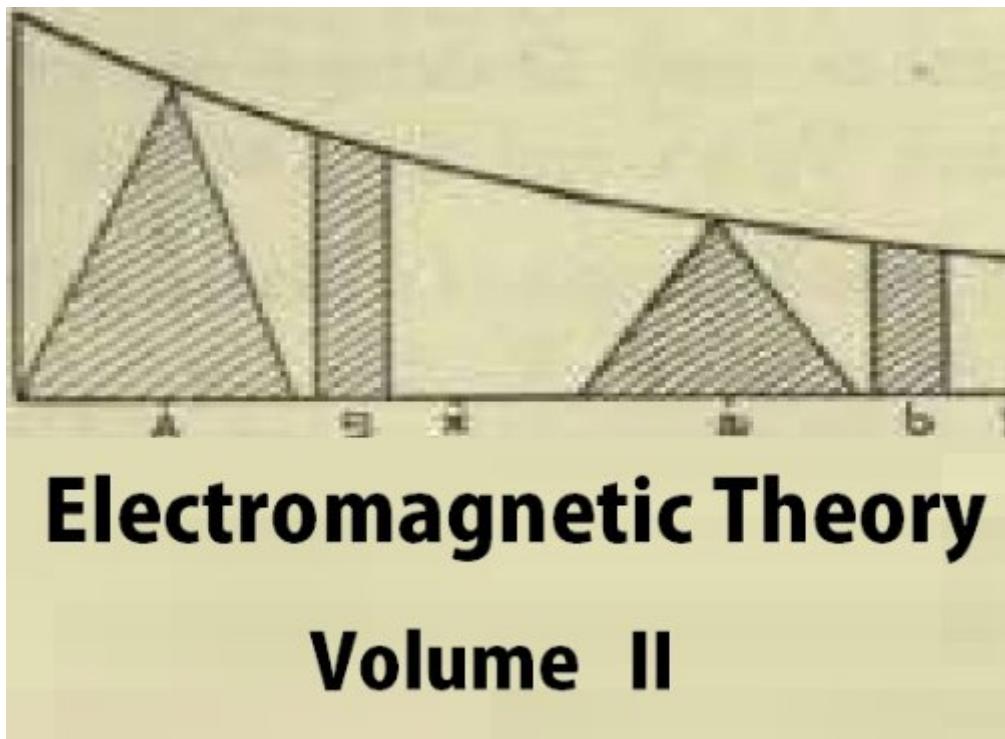


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# Electromagnetic Theory: Volume 2



## Synopsis

PREFACE TO VOL. II. FROM one point of view the present volume consists essentially of a detailed development of the mathematical theory of the propagation of plane electromagnetic waves in conducting dielectrics, according to Maxwell's theory, somewhat extended. From another point of view, it is the development of the theory of the propagation of waves along wires. The connection of the two subjects was thoroughly explained in Chapter IV. of Volume I., which should be understood. But on account of the important applications, ranging from Atlantic telegraphy, through ordinary telegraphy and telephony, to Hertzian waves along wires, I have usually preferred to express results in terms of the concrete voltage and current, rather than the specific electric and magnetic forces belonging to a single tube of flux of energy. The translation from one form to the other is quite easy, when understood. As far as space would permit, I have tried to develop the theory as thoroughly as possible, considering every kind of wave, and including the calculation of the waves produced by multiple reflections. Even the theory of the latest kind of so-called wireless telegraphy (Lodge, Marconi, etc.) has been somewhat anticipated, since the waves sent up the vertical wire are hemispherical, with their equatorial bases on the ground or sea, which they run along in expanding. (See  $\S$ 60, Vol. I.; also  $\S$ 393 in this volume.) The investigations are based upon those in my "Electrical Papers," with considerable extensions. My old predictions relating to skin conduction, and to the possibilities of longdistance telephony have been abundantly verified in advancing practice ; and my old predictions relating to the behaviour of approximately distortionless circuits have also received fair support in the quantitative observation of Hertzian waves along wires. The reader need not therefore fear that he may be muddling himself over fantastic theories void of practical significance, whatever the scientificalist may say. The mathematical methods employed are those which have proved themselves to me by practice to be those best suited to obtaining new results and advancing natural knowledge. The general idea is to make the differential equations themselves perfectly definite, so that the differential equation of a problem is actually its full solution, the operational or differential solution, though it may not be in obvious quantitative form. The process of algebrisation, or conversion from differential to algebraical form admitting of numerical treatment is, of course, very important. Though it may be easy when the proper way of treatment has been found, yet there has been a good deal of exploring work which makes no appearance. In Chapter VIII, I have given a condensed account of my researches on generalised differentiation and series, a subject that grows naturally out of the operational way of working. Although I think this subject has a large future, yet I must warn the reader that there is no pretence of logical rigour, and that much of the matter was rejected some years ago by persons who ought to be good judges. The

several appendices relate to electromagnetic waves in general, save the one on rational units. There is some progress to report. Of the three stages to Salvation, two have been safely passed through, namely the Awakening and the Repentance. I am not alone in thinking that the third stage, the Reformation, is bound to come. I have good reason to be satisfied with the reception given to the first volume of this work. Nearly all parts of it, the outline of general theory, the nomenclature, the rational units, the vector analysis, and the waves and their application, have been approved in this and other countries. But I regret that I have been able to make so little impression upon British official science as expressed by its late leader. It is true that the "K.E. law," which set such unnecessary and unwarrantable restrictions upon ...

## **Book Information**

File Size: 1558 KB

Print Length: 592 pages

Simultaneous Device Usage: Unlimited

Publication Date: February 13, 2012

Sold by: Digital Services LLC

Language: English

ASIN: B0078YKAOM

Text-to-Speech: Enabled

X-Ray: Not Enabled

Word Wise: Enabled

Lending: Not Enabled

Screen Reader: Supported

Enhanced Typesetting: Enabled

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