Theory of electricity and magnetism

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THEORY OF ELECTRICITY AND MAGNETISM.
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BY

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WITH A PREFACE BY

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PREFACE BY LUDWIG BOLTZMANN.

INVITED by my German students I wrote a book* giving an extract of some of my lectures on Electricity and Magnetism, held at the University of Munich during the winter and summer terms of 1892-93. I omitted in this book for the sake of brevity most of the illustrations and examples and made the deductions as short as possible, so that I did not give a complete treatise but rather only marked the points, where my ideas of treating the subject differed from those of other scientists.

Dr. Curry thought that this book translated into English might be useful to English and American students, but he has found it better to offer them a more elaborate and complete treatise; in this he has retained more or less the method of treatment and the order of my verbal lectures, has supplied the necessary examples and more elaborate deductions for illustrating the subject-matter, and lastly has inserted not only those of my verbal lectures, which found no place in my book, as the theory of the electric (Hertzian) oscillations, Maxwell's equations for moving bodies, etc., but several

new articles (§§ 19, 21, etc.), so that the present treatise
differs in many respects from both my own book and my
verbal lectures.

This treatise, the manuscript of which I have revised,
gives a very clear and concise exposition not only of all
my lectures on Electricity and Magnetism but especially
of the conceptions and principles embodied in the foun-
dation of the electro-magnetic theory of light.

LUDWIG BOLTZMANN.

VIENNA, 1897.
GENERAL PREFACE.

It has been my desire to embody in the present treatise not only the standpoint, from which the theory of electricity and magnetism is studied on the continent, but also the general methods of treatment in vogue; hereby I naturally include an interpretation of the views set forth in Maxwell's treatise. In starting from given fundamental expressions, in forming certain conceptions and making various assumptions concerning the ether, in formulating thus the theory of electricity and magnetism and in seeking then to derive therefrom and explain thereby all electric and magnetic phenomena, I may be following too closely in the footsteps of the ancient philosophers, who attempted to treat all problems each according to his own system of philosophy; I admit however that this has been my constant aim—for this reason it would perhaps have been more appropriate to have entitled this treatise the *philosophy* of electricity and magnetism. In endeavouring to attain this end I have found it necessary to maintain a sharp distinction between the ether—its real nature and given properties—that is, between Maxwell's equations of action, which define the state of the ether, and the several mechanical or dynamical analogies constantly employed to illustrate vii
the manifold phenomena and properties expressed by certain particular integrals of these equations. These dynamical illustrations united under the name of our concrete representation have often nothing in common with our conceptions of the ether itself; the very conception or definition of so-called real electricity belongs indeed to the former class (cf. p. 47). On the other hand, the fact that our concrete representation contains so many different features not only justifies our avoiding any attempt to form a more definite conception of the ether, but, conversely, it offers an explanation for the difficulty encountered in grasping the ether-agent itself. The analogy between the different states of the ether and the vibrating elastic band of § 11 does not strictly belong to our concrete representation; it has merely been introduced for the purpose of offering a means of classifying given states of the ether or classes of particular integrals corresponding to these states.

The acceptance of Ampère's assumption of molecular currents as an explanation of magnetic phenomena and of the new definition for $\alpha, \beta, \gamma$, thereby necessary, has been required by the fundamental expressions and conceptions of the first chapter.

Lastly, I have inserted two rather long chapters on von Helmholtz's theory of electricity and magnetism in order that the student might become acquainted with a more general theory than Maxwell's, to which he could have recourse, in case it ever became necessary to abandon the latter on account of its failure to explain phenomena that might be discovered in the future; the universal interest taken in all ether-oscillations since the discovery of the Röntgen rays instigated here a short