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**Baltimore lectures on molecular dynamics and the wave  
theory of light**

**Kelvin William Thomson**

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**Author: Kelvin William Thomson**

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*Alexander Powell 8.*  
**BALTIMORE LECTURES**

ON

**MOLECULAR DYNAMICS**

AND

**THE WAVE THEORY OF LIGHT**

FOUNDED ON MR A. S. HATHAWAY'S STENOGRAPHIC REPORT OF  
TWENTY LECTURES DELIVERED IN JOHNS HOPKINS  
UNIVERSITY, BALTIMORE, IN OCTOBER 1884:  
FOLLOWED BY TWELVE APPENDICES ON ALLIED SUBJECTS

*William Thomson*  
BY

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## PREFACE.

**H**AVING been invited by President Gilman to deliver a course of lectures in the Johns Hopkins University after the meeting of the British Association in Montreal in 1884, on a subject in Physical Science to be chosen by myself, I gladly accepted the invitation. I chose as subject the Wave Theory of Light with the intention of accentuating its failures; rather than of setting forth to junior students the admirable success with which this beautiful theory had explained all that was known of light before the time of Fresnel and Thomas Young, and had produced floods of new knowledge splendidly enriching the whole domain of physical science. My audience was to consist of Professorial fellow-students in physical science; and from the beginning I felt that our meetings were to be conferences of coefficients, in endeavours to advance science, rather than teachings of my comrades by myself. I spoke with absolute freedom, and had never the slightest fear of undermining their perfect faith in ether and its light-giving waves: by anything I could tell them of the imperfection of our mathematics; of the insufficiency or faultiness of our views regarding the dynamical qualities of ether; and of the overwhelmingly great difficulty of finding a field of action for ether among the atoms of ponderable matter. We all felt that difficulties were to be faced and not to be evaded; were to be taken to heart *with the hope of solving them if possible*; but at all events with the certain assurance that there is an explanation of every difficulty though we may never succeed in finding it.



It is in some measure satisfactory to me, and I hope it will be satisfactory to all my Baltimore coefficients still alive in our world of science, when this volume reaches their hands; to find in it dynamical explanations of every one of the difficulties with which we were concerned from the first to the last of our twenty lectures of 1884. All of us will, I am sure, feel sympathetically interested in knowing that two of ourselves, Michelson and Morley, have by their great experimental work on the motion of ether relatively to the earth, raised the one and only serious objection\* against our dynamical explanations; because they involve the assumption that ether, in the space traversed by the earth and other bodies of the solar system, is at rest absolutely except in so far as it is moved by waves of light or radiant heat or variations of magnetic force. It is to be hoped that farther experiments will be made; to answer decisively the great question:—is, or is not, ether at rest absolutely throughout the universe, except in so far as it is moved by waves generated by motions of ponderable matter? I cannot but feel that the true answer to this question is in the affirmative, in all probability: and provisionally, I assume that it is so, but always bear in mind that experimental proof or disproof is waited for. As far as we can be contented with this position, we may feel satisfied that all the difficulties of 1884, set forth in Lectures I, X, and XV, are thoroughly explained in Lectures XVIII, XIX, and XX, as written afresh in 1902 and 1903.

It seems to me that the next real advances to be looked for in the dynamics of ether are:—

(I) An explanation of its condition in the neighbourhood of a steel magnet or of an electromagnet; in virtue of which mutual static force acts between two magnets whether in void ether or in space occupied also by gaseous, liquid, or solid, ponderable matter.

(II) An investigation of the mutual force between two moving electrions, modified from purely Boscovichian repulsion; as it must be by the composition, with that force, of a force due to the inertia

\* See Appendix A § 18 and Appendix B § 10.

of the ether set in motion by the motion of each of the electrions. It seems to me that, of these, (II) may be at present fairly within our reach; but that (I) needs a property of ether not included in the mere elastic-solid-theory worked out in the present volume. My object in undertaking the Baltimore Lectures was to find how much of the phenomena of light can be explained without going beyond the elastic-solid-theory. We have now our answer: *every thing non-magnetic; nothing magnetic*. The so-called "electromagnetic theory of light" has not helped us hitherto: but the grand object is fully before us of finding a comprehensive dynamics of ether, electricity, and ponderable matter, which shall include electrostatic force, magnetostatic force, electromagnetism, electrochemistry, and the wave theory of light.

I take this opportunity of expressing the gratitude with which I remember the hearty and genial cooperation of my coefficients in our meetings of 19 years ago in Baltimore, and particularly the active help given me by the late Prof. Rowland, from day to day all through our work.

I desire also to specially thank one of our number, Mr A. S. Hathaway, for the care and fidelity with which he stenographically recorded my lectures, and gave his report to the Johns Hopkins University in the papyrograph volume published in December 1884. The first eleven lectures, as they appear in the present volume, have been printed from the papyrograph, with but little of even verbal correction; and with a few short additions duly dated.

Thirteen and a half years after the delivery of the lectures, some large additions were inserted in Lecture XII. In Lectures XIII, XIV, XV, freshly written additions supersede larger and larger portions of the papyrograph report, which still formed the foundation of each Lecture. Lectures XVI—XX have been written afresh during 1901, 1902, 1903.

In my work of the last five years for the present volume I have received valuable assistance successively from Mr W. Craig Henderson, Mr W. Anderson, and Mr G. A. Witherington; not

only in secretarial affairs, but frequently also in severe mathematical calculation and drawing; and I feel very grateful to them for all they have done for me.

The printing of the present volume began in August, 1885; and it has gone on at irregular intervals during the 19 years since that time; in a manner which I am afraid must have been exceedingly inconvenient to the printers.

I desire to thank Messrs J. and C. F. Clay and the Cambridge University Press for their never-failing obligingness and efficiency in working for me in such trying circumstances, and for the admirable care with which they have done everything that could be done to secure accuracy and typographical perfection.

KELVIN.

NETHERHALL,  
*January, 1904.*

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