

The Green Lion's Preface

Maxwell's fate has been somewhat like Kepler's, in that posterity has boiled down his life's work into just four equations—magnificent equations, to be sure, but only a bit of the husk of what Maxwell offers. Far from proposing a mere extension of mathematical physics, Maxwell hoped that the *Treatise* would illustrate and exemplify a new and more revealing way of looking at the physical universe. In this regard, Maxwell still has much to teach us.

First, the *Treatise* (as Thomas Simpson has eloquently claimed*) is far more than an exposition of electromagnetic theory. Maxwell endeavors to show how the treatment of electricity and magnetism points the way to a new paradigm for mathematical physics as a whole. As an alternative to the rigid “Newtonian” style, he proposes the much more flexible and analogically rich Lagrangian mathematics, which operates upon “generalized quantities” rather than predetermined physical entities such as masses and forces. This feature of Maxwell's work remains insufficiently appreciated, and the present edition highlights Maxwell's efforts in the *Treatise* to commend this approach.

On a higher level, the *Treatise* provides a humane alternative to excessively formalistic views of mathematical physics and of science in general. Maxwell promotes scientific theory as driven by *thought* rather than by mere symbolic manipulation. Like his predecessor and source of inspiration, Michael Faraday, Maxwell's primary vehicle of inquiry and interpretation is English prose, even when presenting highly technical ideas. The present edition, accordingly, attends to Maxwell's vocabulary, prose style, and imagery as essential resources for defining and expressing the central concepts of electricity and magnetism.

In the ostensibly quixotic enterprise of offering Maxwell's text for study by ordinary mortals, we are not oblivious to the considerable difficulties and challenges that such a reader must confront. There are three chief sources of these difficulties, and the present edition provides ample assistance in overcoming them.

1. Maxwell's *Treatise* combines two disparate and even conflicting functions. On the one hand, Maxwell aimed to set the science of electricity and magnetism on a firm experimental as well as theoretical basis—a task calling for concise, logical organization of essential

* See *Figures of Thought* (Green Lion Press, 2005) and *Maxwell's Mathematical Rhetoric* (Green Lion Press, 2010).

material. On the other hand, he had to produce a textbook for the Cavendish Laboratory program and mathematical tripos examinations at Cambridge University. This charge required him to treat a hefty repertory of then-timely topics and practical techniques; however, the range and variety of these subjects tend to obscure the unity of Maxwell's argument. The selections in this edition follow the *Treatise's* central line of argument as indicated by Maxwell himself in his prefatory remarks, bypassing the distractions.

2. Maxwell employs a mathematical formalism that may be unfamiliar to modern readers. The *Treatise* is famous (or infamous) for its use of quaternions, but even when Maxwell does not utilize quaternion forms, he follows notational conventions that have by now been largely abandoned. This edition, while retaining all of Maxwell's mathematical forms, provides access to their meaning by offering modern equivalents in a running commentary.

3. The sheer quantity of mathematics in the *Treatise* can be daunting, especially since Maxwell's mathematical demonstrations often leave intermediate steps unexpressed. Though the mathematics in the *Treatise* is indeed copious, it is for the most part not really hard: Maxwell seldom demands much beyond elementary calculus from his readers. This edition strives to clarify his analyses and to supply missing steps where necessary.

Anyone who has read Fisher's guide to Faraday* knows how helpful his comments are: one reviewer describes them as "readable, informative, illuminating," and concludes, "to experience Faraday with Fisher is a delight." Fisher brings the same spirit of friendly guidance to his treatment of Maxwell, and the result lends us a sure hand in rising to the Olympian heights of Maxwell's culminating work.

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* *Faraday's Experimental Researches in Electricity: Guide to a First Reading* (Green Lion Press, 2001).

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I have been indebted over many years to Thomas K. Simpson's writings and conversations. It was he who helped me understand that my initial "physicist's reading" of the *Treatise* overlooked Maxwell's broad and humane vision for science and human knowing. I have tried to clear the way for Maxwell's larger voice in this book.

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HJF