

MR4466837 01A55 00A71 78-03

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Maxwell's role in turning the concept of model into the methodology of modeling. (English summary)

Stud. Hist. Philos. Sci. **88** (2021), 321–333.

In 1873, James Clerk Maxwell published *A treatise on electricity and magnetism* [Clarendon Press, Oxford, 1873; third edition, reprint, Dover, New York, 1954; [MR0063293](#)], a major work on electromagnetism. Maxwell adopted a field-theoretic approach based on a conception of a continuous ethereal medium in which electromagnetic effects occur. For readers interested in the mathematical development of Maxwellian electromagnetism and its reception on the Continent, a valuable historical study is J. Z. Buchwald's *From Maxwell to microphysics* [Univ. Chicago Press, Chicago, IL, 1985; [MR0806132](#)]. The tale is one of a macroscopic ether theory that was transformed on the Continent into a microphysical theory based on the mutual action of discrete moving charges.

The article under review develops a different perspective on Maxwell and British electromagnetism, one that does not directly involve mathematics. Indeed, no knowledge of mathematics is required to follow the narrative. The central notion is that of the model, a notion that has been the subject of much analysis and discussion in the philosophy and history of science over the past fifty years. A section of the article provides a perceptive discussion of an essay on models that Ludwig Boltzmann wrote in 1902 [in *Encyclopædia Britannica*, tenth edition, Vol. XXX, 788–791, Adam & Charles Black, Edinburgh, 1902; reprinted in eleventh edition, Vol. XVIII, 638–640, Cambridge Univ. Press, Cambridge, 1911].

The authors have written extensively on Maxwell and modelling (most notably in their book *Reflections on the practice of physics: James Clerk Maxwell's methodological odyssey in electromagnetism* [Routledge, New York, 2020]). Maxwell's treatise was the product of a line of theorizing in his earlier work that evolved from an understanding of models as mere illustrations into an “ontologically feasible” or realistic conception of these constructions. Maxwell's work was in turn reinterpreted, first by Oliver Lodge and then more radically by George F. FitzGerald. Lodge and FitzGerald were attracted to models of the ether, and FitzGerald even built a device consisting of rotating wheels geared with elastic bands, where the stretched bands were analogous to electric forces in the ether. He believed that the phenomena of electromagnetic induction and even light propagation could be replicated in such a model. Nevertheless, for FitzGerald the model was in some sense an instrument rather than a scaled representation of physical reality. Information deduced from the operations of the model could be used to modify the core theory and thus to refine predictions about the phenomena. According to the authors, FitzGerald took the concept of a model and developed around it a methodology of modelling; in so doing, he inaugurated a new way of carrying out research on the subject.

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