



History and scientific practice in the construction of an adequate philosophy of science: revisiting a Whewell/Mill debate

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ABSTRACT

William Whewell raised a series of objections concerning John Stuart Mill's philosophy of science which suggested that Mill's views were not properly informed by the history of science or by adequate reflection on scientific practices. The aim of this paper is to revisit and evaluate this incisive Whewellian criticism of Mill's views by assessing Mill's account of Michael Faraday's discovery of electrical induction. The historical evidence demonstrates that Mill's reconstruction is an inadequate reconstruction of this historical episode and the scientific practices Faraday employed. But a study of Faraday's research also raises some questions about Whewell's characterization of this discovery. Thus, this example provides an opportunity to reconsider the debate between Whewell and Mill concerning the role of the sciences in the development of an adequate philosophy of scientific methodology.

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1. Introduction

An underlying source of disagreement in the debates between William Whewell and John Stuart Mill concerned their conceptions of the role of the history of science and scientific practice in the construction of an adequate philosophy of science.¹ Whewell's approach reflected an understanding of science he derived from "a connected and systematic survey of the whole range of Physical Science and its History" (Whewell 1847, v.1, 8). His *History of the Inductive Sciences* (Whewell, 1857 [1837]) presented the foundations for his philosophical conclusions concerning scientific inquiry. And Whewell contrasted this approach with the common, and to his mind specious, use of detached examples from various scientific domains to illustrate a preconceived philosophical framework.

Mill, for his part, claimed to be following a similar methodological goal in the introduction to his *System of Logic*. Mill (1963,

v.7, cxii) maintained that his task "was that of generalizing the modes of investigating truth and estimating evidence, by which so many important and recondite laws of nature have, in the various sciences, been aggregated to the stock of human knowledge."² His explicit declarations notwithstanding, the fact that Mill lacked a direct awareness of the history of the science and scientific practices gives good reason to doubt whether Mill was the proper person to draw these generalizations.³ But there is evidence that Mill recognized his limitations and took steps to insure that there was adequate evidence from the sciences to confirm his philosophy of scientific method. First, he intentionally delayed writing Book III ('Of Induction') of his *System of Logic* so that he could foster a deeper acquaintance with the history of science—an achievement he acknowledged could not have occurred without reading Whewell's *History*.⁴ Second, he revised the manuscript of the *System of Logic* so that he could incorporate numerous examples, the descriptions

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¹ For some discussion of these issues see, in particular, John Losee (1983) and Laura J. Snyder (2002, 2006, 2008).

² For a related claim see John Stuart Mill (1963, v.7, 284).

³ Whewell, who raised these concerns first in a letter to John F. W. Herschel (see Isaac Todhunter 1876, v.2, 315), writes the following: "Mill agrees with you more than with me in the parts where we differ, but he does not appear to me an ally to set much store by; for though acute and able, he is ignorant of science and still entangled in the prejudices of a bad school." I would like to thank several anonymous referees for this journal who drew my attention to the need to emphasize this point more explicitly.

⁴ Mill (1963, v.7, cxii). For further discussion of Mill's use of Whewell's and Herschel's works see John M. Robson's textual introduction to Mill (1963, v.7, lxiii).

of which he borrowed from his friend Alexander Bain, to provide evidence confirming his philosophy of science.⁵

But Whewell argued that Mill's views were not adequately informed by the history of science or by adequate reflection on scientific practices.⁶ In a systematic and highly critical review of Mill's *System of Logic*, Whewell (1849) maintained that Mill failed to account for the historical progression of various scientific domains and to show that his methods were applicable to obvious, undoubted examples of scientific discovery extending throughout the history of the sciences. And Mill also invoked examples to confirm his views that Whewell claimed were too recent to admit of adequate development and sufficient understanding, or unsubstantiated as genuine discoveries, or misinterpreted as instances of inductive discovery when, in fact, they were extensions of known laws by deduction. Finally, Whewell argued that Mill failed to provide guidance concerning the use of scientific methods to those actually engaged in research. Whewell's primary complaint here was that nature did not present antecedent and consequent phenomena in the precise manner required for the proper use of Mill's methods. But he also expressed concerns about the process of distinguishing those antecedent conditions that factored in a genuine causal relation from those that were merely coincidentally connected with consequent phenomena. Making this distinction was necessary for establishing laws of physical causation—the ultimate goal of inductive inquiry according to Mill.

Laura J. Snyder (2002, 2006, 2008) maintains that Whewell's concern was not simply Mill's failure to infer his methods from historically significant scientific examples but that Mill's methods were not such that they could be inferred from the sciences. Snyder (2008, 153–154) contends that Whewell “showed us in his works—through numerous apt examples—that his philosophy has been embodied in the practice of science throughout its history” but “Mill was unable to do so.”

The aim of this paper is to revisit and evaluate this incisive Whewellian critique of Mill's philosophy of scientific method by evaluating Mill's use of a concrete example to illustrate of his understanding of experimental methodology—Michael Faraday's discovery of electrical induction.⁷ Although it does not have a central place in Mill's *System of Logic*, there are several reasons to focus on this example. First, Mill appropriated this example to illustrate the most powerful of his experimental methods—the Method of Difference. Evaluating this example will provide a clear instance of the kind of work Mill believed was central to achieving the aims of scientific inquiry. Second, Faraday's experimental work was widely recognized as exhibiting the highest standards of excellence in scientific inquiry. As such, it has direct bearing on the debates between Whewell and Mill about the proper way to understand scientific practice. Third, the discovery itself was very important for understanding developments in the domain of electromagnetism. Given the aims of this paper concerning the role of the sciences in the development of an adequate philosophy of science, reflection on this episode as a context for assessing the differences between Whewell and Mill is both instructive and fruitful.

The historical evidence concerning this discovery shows that Mill's account of Faraday's discovery is inadequate for a number of reasons. In short, Mill fails (i) to describe the historical origins of Faraday's research adequately, (ii) to understand the importance of the scientific theories generating and motivating this experimental research, and (iii) to grasp the significance of Faraday's experimentation in the arguments he advances in his published work. At the same time, however, Faraday's published discussion of his research also raises some questions about Whewell's reconstruction of this discovery. Although Whewell clearly grasps the historical context essential to understanding Faraday's research, he places greater weight upon this context and the theoretical implications of Faraday's discovery than Faraday himself. This emphasis may divert attention from the epistemic significance of Faraday's experimental methods as such. Thus, Faraday's research provides an opportunity to revisit the debate between Whewell and Mill concerning the role of the sciences in the development of an adequate philosophy of scientific method.

The structure of this paper is as follows. In Section 2, I provide an account of Faraday's experimental research and its historical context. In Section 3, I discuss Mill's appropriation of Faraday's discovery within the context of his *System of Logic*. In Section 4, I explicate Whewell's criticisms of Mill's reconstruction and show that Faraday's published discussion confirms Whewell's concerns. In Section 5, I raise some concerns about Whewell's discussion of Faraday's discovery. In Section 6, I conclude by reflecting on the implications of this discussion for the debates between Whewell and Mill about the normative role of the sciences in the construction of an adequate philosophy of science.

2. Faraday's Discovery of Electrical Induction

In 1831 Faraday discovered that electrical currents, magnets, and electromagnets induce corresponding electrical currents in adjacent bodies.⁸ Although this was not the full extent of his discovery, the importance of this particular aspect of his research for the history of electromagnetism should not be underestimated. Electromagnetism emerged as a distinct scientific domain following Hans Christian Oersted's (1820) discovery that electrical currents generated by a primitive kind of battery—the voltaic pile—caused deflections of a magnetic needle in its immediate vicinity.⁹ Following Oersted's announcement of this discovery, many scientists expected to discover the reciprocal effect—that magnets could produce electrical currents. But their experiments failed to produce any results recognized as evidence of the reality of this effect.¹⁰ In his first series of *Experimental Researches in Electricity* (hereafter, “First Series”) Faraday published an account of the experiments establishing the induction of electrical currents by means of a voltaic apparatus, ordinary magnets, and electromagnets.¹¹ After nearly a decade of failed experimental research throughout various scientific communities in Europe, Faraday demonstrated conclusively that magnets could produce electrical currents. The central, and unexpected, feature of this discovery was the fact that induced electrical currents were

⁵ Mill (1963, v. 1, 255).

⁶ See William Whewell (1849, 44–54).

⁷ All citations are from Michael Faraday (1956, v. 1, 1–41).

⁸ For more on this discovery and its historical significance see Bern Dibner (1949), L. Pearce Williams (1965), William Berkson (1974), and Geoffrey Cantor (1991).

⁹ For some helpful discussions of Oersted's discovery see R. C. Stauffer (1953, 1957), L. Pearce Williams (1965), David Gooding (1990), and Roberto De Andrade Martens (2003).

¹⁰ For a thorough discussion of the experiments conducted during this time and the failure to recognize specific results as indicative of electrical induction see Sydney Ross (1965).

¹¹ As David Gooding (1990) notes, the differences between the published account and the actual discovery process can obscure the real epistemic difficulties associated with discovering and communicating novel experimental findings. Thus, evidence from Faraday's *Diary* is relevant to understanding this discovery and Faraday's methodology. Although I agree generally that Faraday's published account does not provide evidence of the actual discovery process, I would argue that his “First Series” represents Faraday's own understanding of the evidential relations between his experimental discoveries and the conclusions of his research. Thus, for the purposes of this paper, I follow Faraday's published account. Furthermore, given that Faraday's contemporaries would not have had access to Faraday's *Diary*, to appreciate their interpretations of Faraday's work, the published account is a much more reliable source.

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