What is an experimental error? Hertz's cathode ray experiment reconsidered

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Abstract

As many philosophers of science have pointed out, the reliability of the phenomena we test our theories against is pivotal (Bogen and Woodward, Galison, Mayo, Franklin). If our experimental evidence is 'in error', the rationality of our testing procedures is cast into doubt. Among the few philosophers who have dedicated their work to experimental errors, Deborah Mayo's and Giora Hon's work deserves special attention. Whereas Mayo defends a statistical notion of errors, Hon has argued for an 'epistemological' one. Neither of those conceptions, as I shall argue in this paper, provides a satisfactory account of the experimental error Heinrich Hertz committed in his cathode ray experiments, whose replication ultimately led to the discovery of electrons by J.J. Thomson. I shall claim that Hertz's 'error' resulted not from his clumsiness or the unavailability of sufficiently good vacuum pumps, but rather from his lack of knowledge about the gaseous ionisation effect that distorted his experimental findings about the electromagnetic properties of cathode rays. This has disturbing consequences. In a Pessimistic-Meta-Induction-like analogy, Hertz's error implies that all our current experiments are subject to the ' charge from error' given that phenomena we will discover in the future might figure as intervening effects in precisely those experiments, rendering 'erroneous' in retrospect. The conclusions reached in this paper about Hertz's 'error' also impinge on the three types of evidential relationships Achinstein (2002) has developed: only the type of evidential relationship which is sensitive to its epistemic context can be deemed to be appropriate for describing Hertz's experiments.

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