

The Method of Analogy as Hermeneutic Tool: How to overcome Biases in the Interpretation of Newton's Experimental Philosophy

Keywords: Experimental Philosophy, Newton, Method of Analogy

Newton claimed to have proved the propositions of his *Opticks* by experiment. In particular, he claimed to have proved the heterogeneity of sunlight through his famous *experimentum crucis*. However, Newton's contemporaries such as Hooke, Pardies and Lucas questioned his claim. They argued that experiments can only falsify hypotheses, and so Newton's statements were merely hypotheses that had not been falsified but allow for alternatives. The modern understanding of *experimenti cruci* in the philosophy of science, as well as many interpreters of Newton in the history of science (for example Goethe or Sabra), argued in a similar way. They see in experimental reasoning no other argument than the hypothetical-deductive one.

This criticism of Newton's reasoning stands in stark contrast to Newton's own understanding. Not only did Newton object to any hypothetical-deductive reasoning in his experimental proofs, he also claimed to conclude his propositions "by deriving [them] from Experiments concluding positively & directly" (Newton, 1959, p. 209). This is incomprehensible as long as proving propositions from some primary propositions is the only paradigm of scientific proof. However, such a view is biased by a prior conception of proof that does not do justice to Newton. With his Experimental Philosophy, Newton envisaged a new methodology based on induction, deriving its propositions not from axioms but from experiments.

To understand Newton's way of reasoning, it is helpful to first look for an alternative conception of scientific proof, and then to ask how Newton's experimental proofs can be explained within that conception. Recently, diagrammatic reasoning has been studied in detail for its own sake in the fields of logic and mathematics. This reasoning does not start with propositions in the form of axioms that end in theorems. Diagrammatic reasoning also follows rules, but its rules are not the deductive rules of a logical calculus, but rules that start from a question at stake and convert that question into a diagrammatic representation that allows one to answer the initial question. For example, the question of the validity of an Aristotelian syllogism is answered by representing it within a Venn diagram, which answers the initial questions by its property, namely the fact that the conclusion is represented by the representation of its premises. Likewise an Euclidean problem, for example the construction of an equilateral triangle, is answered by the property of constructing the figure in question by compass and straight-edge, and reading off the property in question, for example the equality of the sides of a triangle, according to rules based on the construction from the drawn diagram.

This kind of reasoning is not universal and topic-neutral like logical reasoning. It is not based on general rules of deduction, but on rules specific to the domain of the questions. These rules serve to answer those questions by referring to properties of specific diagrams. Newton's method has a striking analogy with this kind of scientific proof, if one replaces diagrams with experiments. Newton also answers an initial question, such as the cause of different refractions of light, by designing experiments that allow the question to be answered by the properties of the experiment itself. His *experimentum crucis*, for example, is designed to create a difference situation on a second prism in which rays from different parts of the spectrum refract differently even though they hit the prism at the same angle. This experimental property of a difference under homogeneous conditions allows Newton to draw his conclusion that different properties of rays cause differences in refraction by applying the principle of causation and generalizing from experiments by induction. This is best practice in experimental science, but it is not properly understood as a kind of hypothetical-deductive proof, but rather as a kind of reasoning analogous to diagrammatic reasoning, in that it answers a proposition or problem in question by a particular way of

representing the proposition or problem in question, and a particular method of reading off the answer from the specific properties of the representation. In this way, Newton's Experimental Philosophy can be understood by drawing the correct analogy to a paradigm of scientific proof.

References

Newton, I. (1959), *The Correspondence of Isaac Newton*, Vol.1. H.W. Turnbull (ed.), Cambridge: Cambridge University Press.