Empiricism Born Out of the Death of Realism: Isaac Newton's Role in the History of Science

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In the history of science, Isaac Newton (1643-1727) follows the revolutionary developments of Copernicus, Galileo, and Kepler. Their efforts were significant twofold: (1) in beginning the secularization of science against the dogma of the Church and (2) in legitimizing the role of mathematical abstraction in scientific explanation. Following in this vein, science adopted a greater focus on purely practical matters, thereby eschewing the erudite conception it was born out of. This development was aided by a return to "doing science" over merely "contemplating science" and accordingly developing scientific instruments to directly and tangibly investigate the natural universe.[1] Francis Bacon formalized this transformation in his *Novum Organum* by developing a novel methodological approach to science founded in experimentation rather than the former Aristotelian experientialism, which was then defended most notably by contemporary philosopher René Descartes. It is within this historical dialectic that Newton's achievements are to be understood. Though belonging to a broader tradition of empiricism, Isaac Newton specifically heralded the revolutionary conception of science as characterized by experimentation and prediction alone, lacking any explanatory power. Newton's critique appealed to and extended the mathematical abstraction dominating the contemporary sciences in order to subordinate the epistemological function of science beneath the revelatory capacity of religion. His developments thusly contributed to the demolition of the realist interpretation of science, which preceded him, and engendered the modern distinction between an understanding of the world versus intelligible theories about the world. Newton's correspondence with Richard Bentley is here analyzed as detailing his struggle with reconciling the utility of scientific reasoning with an objective understanding of nature,

1. Peter Dear, *Revolutionizing the Sciences*, 2nd ed. (Princeton University Press, 2009), 51.

ultimately forcing the aforementioned conclusion.

Crucial to Newton's final conclusion is a contemporary treatment of mathematics as epistemologically significant—evident in both his *Principia* and letters to Richard Bentley. The 16th-17th centuries broadly see the growing legitimacy of mathematical analysis and abstraction in scientific reasoning. This development is exemplified by the works of Galileo Galilei and Johannes Kepler. Galileo, in his seminal work *De Motu*, crucially utilizes a clever thought experiment, later reinforced by empirical data, to refute the common assumption (derived from Aristotle) that heavier bodies fall faster.[2] Another such refutation of Aristotle using mathematics is seen in Galileo's *Letters on Sunspots*. There, he utilized both mathematics and contemporary lens technology to identify changes on the surface of the Sun, thereby countering the Aristotelian proposition against corruption and generation in the heavens.[3] These discoveries are novel in two respects: (1) for their use of mathematics as an explanatory tool and (2) for their revolutionary overturning of long held conceptions regarding the basic reality of nature. Prior to Galileo, mathematics was seen as an interesting "game," which nevertheless must be supplemented by genuine natural philosophy in order to hold any connection to the real world. Lacking the developing mathematical sophistication of the 16th-17th centuries, such models understandably held little weight on their own. Thus, more concrete reasoning was needed to ascertain truth. It was precisely on this view that Copernicus' heliocentric theory could be disregarded (by some) as merely a thought experiment. Against this conception, Galileo's utilization of mathematics as a legitimate form of natural philosophy reconciled the two in what is known as "physico-mathematics."[4] Kepler furthered this transformation with his elliptical models for planetary orbits. Their incredible accuracy forced a greater appreciation for

2. Dear, *Revolutionizing the Sciences*, 67.
3. Ibid., 69.
4. Ibid., 71.

the evident explanatory power of mathematical reasoning. So, by the time of Newton, there is a general confidence in the legitimacy of mathematics in scientific understanding. It is with this assurance that Newton frequently utilizes mathematical reasoning in both his scientific works and correspondence with Bentley. In the *Principia*, Newton makes repeated reference to some abstract object called a "force" which is then somehow "impressed upon bodies to generate motion."[5] A physical explanation of this object is never provided nor even addressed at first. With similar nonchalance, Newton, in his first letter to Richard Bentley, considers a finite universe with evenly scattered matter. The slightest perturbation of form—seemingly a statistical necessity given the size of the universe—would thereby throw all matter into a cascading descent, where all matter attracts all other matter until the universe is collapsed into a single mass.[6] The folly in such reasoning lies in its conception of perfectly equal scattering. When challenged by Bentley on the intelligibility of such reasoning, Newton hesitates. At fist confused, he then realizes that he can't reconcile his mathematical theories with a sensible interpretation, ultimately resorting to ignorance. He claims that such phenomena are not "explicable by mere natural causes" and that he is thusly "forced to ascribe it to the counsel and contrivance of a voluntary Agent."[7] Exhorted by the inquiries of Bentley, Newton is made to grapple with the reconciliation of his mathematical models with an intelligible world. Newton's entire theory of gravity suggest the notion of action-at-a-distance—an utter physical absurdity. Whereas previously the physical absurdity of a mathematical model would have been attributed to the epistemological ineptitude of mathematical reasoning—such as with Copernicus' heliocentric model—the newfound legitimization of mathematical abstrac-

5. Sir Isaac Newton, *The Mathematical Principles of Natural Philosophy*, trans. Andrew Motte (45 Liberty Street: Daniel Adee, 1846), 80.

6. Richard Bentley, *The Works of Richard Bentley*, ed. Rev. Alexander Dyce (Robson, Levey, / Franklyn, 1838), 203-204.

7. Ibid., 204.

tion in scientific understanding presents a dilemma. Newton's resolution was to forego a realist interpretation of science and instead relegate its epistemic function to description alone.

Faced with the conflicting developments in mathematics and the absurdity entailed by his mathematical theories, Newton is forced to subordinate the epistemological power of scientific discovery, thereby expunging the optimism of his predecessors in exalting the explanatory power of mathematics. As seen above, this conclusion is prompted largely by his conversations with Richard Bentley. In his last letter, Newton even thanks Bentley for his inquiries, stating that he "had considered it very little before your letters put me upon it."[8] After struggling with the meaning of infinities in the second letter, the third letter finally expresses Newton's frustration with having to make his theories physically comprehensible. Here, he provides his famous rebuke: "...that one body may act upon another at a distance through a vacuum... is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into it."[9] It is with this realization that Newton abandons hope for understanding through *scientific reasoning alone*. Fed up with the criticisms from his contemporaries regarding the physical absurdity of his theories, Newton makes his other famous remark, "hypotheses non fingo [I frame no hypotheses]," in an addendum to the second edition of his *Principia*, entitled General Scholium.[10] By this, Newton means that he refrains from giving explanations (i.e. hypotheses), instead restricting himself to nevertheless rigorous *descriptions*, of natural phenomena. In this way, to refute Newton's theories on the basis of their incomprehensibility is to fundamentally misunderstand the nature of his theories. He is not offering a justification, merely a *useful* tool for prediction. By appealing to the utility

8. Bentley, *The Works of Richard Bentley*, 215.
9. Ibid., 212.
10. Newton, *The Mathematical Principles of Natural Philosophy*, 506.

of science, Newton is able to eschew the esoteric, often fallacious theories of his predecessors and rationalist contemporaries; to be more precise, an inconsistency between the model and reality can be corrected via a reinterpretation of the model without affecting one's foundational conception of reality. E. W. Strong mirrors these sentiments when he characterizes Newton's conclusion as declaring the "limits of his scientific inquiry and of scientific knowledge."[11] Any pursuit of explanation is thus outside of the realm of science and any mistake of science is irrelevant to the conclusions of philosophy. Strong's characterization is corroborated by George E. Smith where he formalizes the implications of Newton's conclusions: "On this approach, the demand that theory explain is subordinated to the role theory is to play in turning data into evidence."[12] This eminently modern conception of science is ultimately derived from Newton's conclusions regarding scientific epistemology. Exhorted by the interrogation from Bentley, Newton sold the intelligibility of the world in order to maintain the utility of science. This raises the question: Without science, from where is understanding to be derived? How does Newton respond to the apparent nihilism which his conclusions ostensibly entail?

Evident primarily in his correspondence with Bentley, Newton appeals to religion as a reconciliation for the loss of science as an epistemically sufficient approach to the understanding of nature and the world. Historically, science during the 16th-17th centuries is undergoing a broad secularization. This transformation is largely motivated by the schism between the dogma of the Church and the scientific progress of those like Copernicus and Galileo. A widespread focus on practical as opposed to purely speculative matters exacerbates the recessive influence religious reasoning still holds. However, the tension between religious and scientific institutions is greatly ameliorated by the affirmative hand

11. E. W. Strong, "Newton and God," *Journal of the History of Ideas* 13, no. 2 (April 1952): 151.
12. George E. Smith, "Comments on Ernan McMullin's "The Impact of Newton's Principia on the Philosophy of Science"," *Philosophy of Science* 68, no. 3 (September 2001): 336.

religious institutions then extend to the institutions of science. This shift is concisely characterized by the phrase “the religious utility of science.”[13] In this way, religious institutions begin to appeal to the objectivity of science “in salutary contrast to the warring factions of political or religious parties.”[14] Reminiscent of the arguments of the Medieval Aristotelian reconciliators—Bacon, Grosseteste, Aquinas—God’s role is seen as divine creator of natural laws, an understanding of which is nevertheless ascertainable through careful experimentation. With Newton’s subsequent rejection of this explanatory power of science, one sees a tentative return to the authority of religious reasoning. However, for Newton, this reconciliation is forced rather than willed. Newton hesitantly rejects the Catholic Trinity, though he restrains from expressing this publicly.[15] Furthermore, non-Catholic and even atheistic conceptions of science persist in Descartes and Edmond Halley. Nevertheless, there emerges a relatively harmonious relationship between science and religion at best and a healthy dialogue between the two at worst; e.g. the Boyle lectures, designed to counter the atheistic tendencies of science at the time. Indeed, it was in preparation for his lecture as the first Boyle lecturer that Richard Bentley queried Newton for a scientific defense of God. The primary role of God in Newton’s natural philosophy was in eschewing the unintelligibility of a mechanical theory for gravitation. It is in this way that Newton avoids the potential nihilism of his conclusions. J. H. Randall, Jr. summarizes this reconciliation: “Newton’s natural philosophy ultimately purported to describe a world, every element in which was inaccessible to observation, and cried aloud for such a mind to observe it.”[16] It is Newton’s God which takes the role of this “perfect mind.” At last, prompted by the inquiries of Richard Bentley, Newton formally

13. John Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge University Press, 1991), 152–63.

14. Ibid., 153.

15. Bentley, *The Works of Richard Bentley*, 207.

16. John Herman Randall Jr, “Newton’s Natural Philosphy: Its Problems and Consequences,” ed. Clarke and Nahm, *Philosphical Essays in Honor of Edgar Arthur Singer, Jr.*, 1942, 356–357.

overcomes the potential nihilism apparent in a rejection of the explanatory power of science by distinguishing the respective epistemological functions of science and religion and accordingly appealing to the necessary existence of a God.

Motivated by the desire to explain the apparent absurdity of his gravitational theories, Newton extended the empiricist tradition of his contemporary scientists by discrediting the explanatory power of science and appealing to the necessity of religion for understanding. Starting with Aristotle, Newton can reasonably be placed within the historical dialectic of a growing skepticism and empiricism towards rationalist approaches to understanding. His direct predecessors—Francis Bacon, Robert Boyle, Robert Hooke—exalted the utility of experimentation but nevertheless maintained the explanatory power of their discoveries. Newton went further in rejecting the epistemic capacity of scientific reasoning, thereby subordinating its role to description and promoting religious understanding as an alternative. Ultimately, Newton's conclusions have been incorporated into modern science, but ostensibly ignored. Realist interpretations dominate the common view of science, though their influence on methodology is minimal. Modern science is characterized primarily by technological progress, unhindered by the concern for comprehensibility. This is exemplified by the widespread use of discoveries in quantum physics in modern technology despite the lack of a coherent metaphysical interpretation. In this way, Newton helped to liberate science from the bonds of intelligibility and thrust scientific practice into its modern form, distinguished for its utility more so than for its understanding.

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