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Newton's "satis est": A new explanatory role for laws ☆

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ABSTRACT

In this paper I argue that Newton's stance on explanation in physics was enabled by his overall methodology and that it neither committed him to embrace action at a distance nor to set aside philosophical and metaphysical questions. Rather his methodology allowed him to embrace a non-causal, yet non-inferior, kind of explanation. I suggest that Newton holds that the theory developed in the *Principia* provides a genuine explanation, namely a law-based one, but that we also lack something explanatory, namely a causal account of the explanandum. Finally, I argue that examining what it takes to have law-based explanation in the face of agnosticism about the causal process makes it possible to recast the debate over action at a distance between Leibniz and Newton as empirically and methodologically motivated on both sides.

1. Introduction

There are several different schools of thought about Newton's approach to physics. The suggestions have ranged from readings of Newton's work that makes him (at least in the *Principia*) set aside metaphysical considerations of gravity altogether (or at least largely and in the scientific parts of his work) to those who argue that he is concerned with a metaphysical project, but one where the question of the legitimacy of non-mechanistic conceptions of causal interactions more broadly, and action at a distance in particular, is answered by empirical methods.[1]

Between these views we find several middle ground suggestions. For example, Smith (2012, p. 371) argues that Newton proposes "...an intermediate level of theory, between mere description of observed regularities in the manner of Galileo's *Two New Sciences*, on the one hand, and laying out full mechanisms in the manner of Descartes' *Principia*, on the other." The suggestion that Smith makes here is, in part, that Newton's *Principia* was novel in proposing the acceptability of this intermediate level theory where we lack a mechanical causal explanation, but where Newton "...answered questions about the physical species of celestial orbital forces—they are one in kind with terrestrial gravity—and questions about their physical proportions—the law of gravity..." (Smith, 2012, p. 370).

Smith does not develop an account of explanation to fit this intermediate level theory where we have some information about causes, but not mechanical causal explanation. However, McMullin (1989, 2001, 2002) does so and takes there to also be an explanatory middle ground by emphasising the common cause postulated as giving rise to a kind of explanation that he calls dynamic explanation. In Section 4 I will argue that this leaves Newton's account explanatorily inadequate.

Recently, Janiak (2008) has argued that there is a kind of explanation available and moreover that it is a *causal* one. On his view

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[1] I put, for example, Jammer (1999/1957, p. 125, 141) in the first camp and, for example, DiSalle (2002, p. 52) in the second. For a much more detailed discussion see Janiak (2008, chap. 2).

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"...Newton's mathematical treatment is intended to identify an existing force, a genuine cause of motion, and not merely to employ a calculating device. What the mathematical treatment of force leaves for future research is not the discovery of causes,...but rather the discovery of the complete physical characterization of the force it has identified" (Janiak, 2008, p. 57). This should not be taken to be an inferior sort of explanation on Janiak's view, but one of an unusual sort where the term "gravity" "...refers to a physical quantity that non-mechanically causes various motions of bodies...." (Janiak, 2008, pp. 76–77). I will be in agreement with much of Janiak's analysis, but I will argue that the choice between taking Newton's treatment of force to be that of postulating a genuine cause or to be the postulation of a calculation device sets up a false dilemma by neglecting the explanatory role of laws without the aid of causal underpinnings.

To cast the issue as mainly about Newton's negative responses to the questions of

- whether a certain kind of explanation is available in the *Principia* when it comes to gravitational phenomena and
- whether a particular kind of explanation is required for an acceptable scientific account

is particularly tempting on the assumption that Newton is responding to opponents with simply an a priori commitment to mechanistic explanation and rejecting that commitment.[2] In Section 5 I will argue that Newton's responses and their repeated appeal to methodology are easier to understand once we loosen the hold of this view, even though the argument is one about what kinds of scientific explanations we should countenance. I will argue that it is possible to understand this debate as one that is largely driven by empirically grounded methodological concerns on *both* sides. Finally, I will argue that a new style of explanation becomes tenable with the methodology of the *Principia* and that in Newton's writings we do not simply see a rejection of an old style of explanation, but a positive development of a new explanatory possibility. If we accept this understanding of the debate then we can make room for a reading where Newton rejects action at a distance without having to take him to have quarantined those views when it comes to his scientific practice.[3]

2. A mathematical or a physical treatment?

Before I go into more details about the interpretation that I will favour, let me briefly summarize one of the core interpretative challenges. Newton employs seemingly causal language in several places in the *Principia* and we find him making claims about *attraction*, what *keeps* the planets in their orbits, etc.

> Hitherto we have called "centripetal" that force by which celestial bodies are kept in their orbits. It is now established that this force is gravity, and therefore we shall call it gravity from now on. (Newton, 1999, Book III, scholium to proposition 5, p. 806)

However, Newton also claims to have given a mathematical, not a physical, treatment of forces.

> ...I use interchangeably and indiscriminately words signifying attraction, impulse, or any sort of propensity towards a center, considering these forces not from a physical but only from a mathematical point of view. (Newton, 1999, Book I, definition 8, p. 408)

This makes it tempting to take Newton to have given a purely mathematical account of gravity. However, this does not fit well with the causal claims made about gravity, nor with the insistence that "...it is enough that gravity does really exist..." and the claims to have explained the phenomena of the heavens and the sea in the General Scholium.

> Hitherto we have explained the phenomena of the heavens and of our sea by the power of gravity, but have not yet assigned the cause of this power....Hitherto I have not been able to discover the cause of those properties of gravity from phenomena, and I frame no hypotheses....And to us it is enough that gravity does really exist, and act according to the laws which we have explained, and abundantly serves to account for all the motions of the celestial bodies, and of our sea. (Newton, 1995/1729, General Scholium, pp. 442–443)[4]

Moreover, in a correspondence in 1693 Leibniz (2008/1961, p. 258) suggests to Newton that the value of his work does not hinge on having a physical account. Newton's response to Leibniz forcefully rejects the suggestion that he is providing an instrumentalist account of gravitational motion.

> For since celestial motions are more regular than if they arose from vortices and observe other laws, so much so that vortices contribute not to the regulation but to the disturbance of the motions of planets and comets; and since all phenomena of the heavens and of the sea follow precisely, so far as I am aware, from nothing but gravity acting in accordance with the laws described by me; and since nature is very simple, *I have myself concluded that all other causes are to be rejected* and that the heavens are to be stripped as far as may be of all matter, lest the motions of planets and comets be hindered or rendered irregular. (Newton, 2008/1961b, p. 287, my emphasis)

3. First interpretative step: a common cause, but not a causal explanation

When tackling the challenge of Section 2 we can start by distinguishing between having found the cause of the motion from gravity and having found that seemingly disparate phenomena should be assigned the same cause. Newton is clear in identifying the cause of gravitational motion on earth with whatever the cause of planetary motion is.[5] Janiak (2008, p. 74), Harper (2002, p. 183) (as a common cause), and Smith (2002b, p. 150) (as falling under the same law) all include versions of this in how they understand Newton's claim that gravity really exists (or it being enough that it should exist).

The question is whether we have reason to take the causal commitment to be one that goes beyond the assignment of a common, but unknown, cause. When looking at Newton's reply to Leibniz that I quoted in Section 2 it is tempting to read Newton's rejection of "...all other causes..." as committing him to take gravity itself to be a cause. However, we also find language that parallels that of rule 1. We are first given the reason for why Leibniz's theory will not be able to account for the motion and then we are told that *since nature is very simple* we should rule out all other causes but gravity (as presented by Newton). In rule 1 we see a similar expression leading to the assignment of a common cause since "...nature

[2] I am using the term "a priori" in its contemporary sense throughout.

[3] Even though the view that I will defend allows for a wholesale rejection of action at a distance, I will not argue for that view in this paper.

[4] I have opted for the Motte translation instead of the Cohen and Whitman one, since I will be closely concerned with explanation here and I wish to avoid basing my argument on the translation that inserts an extra explanatory claim that Smith (2008, note 2 and 3) objects to. On page 7 I will address the general objection to using "explain" rather than "explicate."

[5] See for example Book III, propositions I–V and the General Scholium.