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Three principles of unity in Newton

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ABSTRACT

I discuss three principles of unity available in Newton's physics, appealing to space and time, causal interaction, and law-constitution respectively. I compare these three approaches with respect to aggregation (how a collection of entities can compose a whole) and multiplicity (how the world as a whole can contain a multiplicity of genuine unities), outlining the problems faced by the first two approaches and arguing that the third looks a promising candidate for further philosophical investigation.

1. Introduction

Does the world contain a multiplicity of genuine unities? If it does, how do they together form a *whole,* rather than being merely a collection? The division of the world into genuine unities, and conversely the stitching together of a collection of unities into a genuine whole, are problems of early modern philosophy which live on to figure prominently in Kant's work. Newton's physics offers three potential sources of unity, two familiar, one less so. The first grounds unity in space and time. The second grounds unity in causal interaction. The third, distinct from the second in ways I shall articulate, grounds unity in the laws. I will argue that this third option is the most successful *prima facie*. This is interesting when we consider how best to solve the problems we inherit from our philosophical predecessors, not least because it was not the route taken by philosophers in the period following Newton's work.

The first two approaches to unity are a well-known part of our philosophical inheritance from the early modern period. They come in a wide range of varieties, and the names of Leibniz, Spinoza, Locke, Hobbes, Hume—and of course Kant—among others, will come readily to mind at different points during the course of the following discussion. These connections will not be made explicitly in this paper because my purpose is to focus your attention elsewhere: on philosophical moves made but *not* taken up in the philosophy that we have inherited today.

Newton's *Principia* is a difficult book, as a mathematical text, as a text in physics, and as a philosophical text. Physics and philosophy parted company in important ways not long after its publication, and the *Principia* is not on today's list of compulsory reading for all philosophers, or even for those who specialize in early modern philosophy or who work on philosophers influenced by Newton and the Newtonian tradition. Indeed, only since the mid twentieth century have we begun to understand how to read the *Principia* as a philosophical text speaking to traditional problems of philosophy.[1] Even so, I believe that the text is far richer philosophically than has been appreciated to date: we have a long way to go. In this paper, I offer one example of a philosophical topic—unity—that we are forced to re-visit through paying careful attention to the moves Newton made in the *Principia*.[2]

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[1] Recall Burtt's early twentieth-century assessment of Newton ("In scientific discovery and formulation Newton was a marvellous genius; as a philosopher he was uncritical, sketchy, inconsistent, even second-rate"), and compare it with more recent efforts to understand the philosophical import of Newton's work (see Janiak & Schliesser, 2012, and references therein). The quotation is from (Burtt, 1954, p. 208); the first edition of this book was published in 1924. Much of the challenge in reading Newton as a philosopher is due to the difficulty of the mathematics and the physics, which has led philosophers to concentrate on the few paragraphs of the *Principia* that are explicitly philosophical, but the mathematics and physics must be mastered to a large degree in order to work with the complete text when reading the *Principia* as a contribution to philosophy. This we have now begun to do.

[2] The point, therefore, is not Newton exegesis as such. We have learned much about the *Principia* and its implications in the 350 plus years since its publication, and a great deal of what we have learned is relevant when we try to read the *Principia* today as a contribution to philosophy, which is the exercise of which this paper is a part.

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I begin (in Section 2) with a presentation of wholes and parts that sets up the problems of unity as I will treat them in this paper. I then discuss how space and time (Section 3) and causality (Section 4) can be understood as serving as principles of unity in Newton's physics, and the problems that these approaches to unity face. Section 5 brings me to the third approach, which I term "law-constitutive", and which I argue is the most successful of the three. I end with a two-part question: how, if at all, does the availability of this third option open up moves that Kant might have made but didn't, and what are the implications of this?[3]

2. Wholes and parts

Consider first the aggregation of a collection of entities into a unified whole. If the world contains entities that are really distinct from one another, in virtue of what does that collection of entities form a genuine whole? A necessary condition is that the entities stand in relations of some kind to one another. Failing this condition, we have a *mere* collection. (It makes no sense to say that the world as a whole is a *mere* collection: if the members stand in no relations to one another, then to call them members of the same world is to say nothing—one might just as well say each member is itself a world. So if the assertion that the members are part of the same world is to have content, it must be an assertion that the members stand in some relation or other to one another.) As a necessary condition, this is a weak claim: we have said nothing about the nature of these relations (perhaps they are logical, perhaps they are physical; perhaps they are real, perhaps they are ideal; we have not committed ourselves). But if the world is a collection of members, then it is no mere collection: the members stand in some relation or other to one another. Beyond this, if such a collection is to form a world then a stronger condition must also be met: the relations between the members must be *sufficient* for a world; the collection must form a genuine unity.

The converse of this problem—does the world *really* contain a multiplicity of entities?—finds vivid expression in the work of Descartes, where we seek in vain for the resources by which to divide indefinite extension into parts that are genuine unities. On the one hand, it seems we lack the metaphysical resources for real division at all; on the other hand, since extension is conceptually divisible *ad infinitum*, no part of extension seems a candidate for a genuine unity.[4] It seems, therefore, that the world does not contain a multiplicity of entities that are themselves genuine unities.[5]

In what follows, I describe three approaches to the aggregation and multiplicity problems found in Newton's physics. I will argue that only one has the potential to solve both problems.

3. Space and time as a principle of unity

On the first approach, space and time provide the framework within which everything that is material exists. In this way, they are the ground of the unity of the universe: what makes this material universe *one* universe is the unity of the space and time framework within which the matter is located. The collection of all material things is no *mere* collection because all material things stand in spatial and temporal relations to one another, and this is necessary and sufficient for the collection of material things to form a genuine unity. In Newton's physics, space and time can be understood as playing just this role. In Newton's *Principia*, absolute space and absolute time are the framework within which all material bodies exist. Moreover, in Newton's physics, space and time can be understood as playing the role of a *metaphysical* principle of unity, as follows.

The characteristics of absolute space and time are familiar from the scholium to the definitions of Book I of the *Principia*. By definition 1, bodies have volume, which means they take up space, and the place of a body is, according to Newton in the scholium, "the part of space that a body occupies" (Newton, 2004, p. 65). The motions of all bodies are with respect to this space. So there is a straightforward sense in which the physics is constructed with space and time as the principle of unity for the universe described in the *Principia*. If we turn our attention to the manuscript 'De Gravitatione,'[6] we can flesh out the metaphysical picture.[7] Here, space and time are emanations of God. Newton writes that space is neither substance nor accident, but has its own manner of existing: it is "as it were an emanative effect of God and an affection of every kind of being" (Newton, 2004, p. 21). Thus, it derives from God, and every kind of being is in some way spatiotemporal.

The first point—the emanation—is important because it tells us about the metaphysical status of space and time. Newton argues that the existence of space and time must follow directly from God's existence: they must do so in order for God to be present everywhere and everywhen, for otherwise when God created time and space he would either not be present in time and space, or he would have changed his own way of being such that he became present in time and space ("he created his own ubiquity," for example, Newton, 2004, p. 26). Moreover, certain features of this emanated space follow as a consequence of God's nature: Newton says that "space is eternal in duration and immutable in nature because it is the emanative effect of an eternal and immutable being." It remains distinct from God (it cannot act, it has no will, etc.), but is nevertheless a direct consequence of God's existence.[8]

The second point—the "affection"—tells us about the relationship of all things to space and time. Not only is God everywhere and everywhen, but *all* things are spatiotemporal, and are thus somewhere and somewhen.[9]

[3] A useful place to start is Eric Watkins' recent book, *Kant and the Metaphysics of Causality*: this book attempts to set out the logical space in which Kant was working, in the context of his predecessors, making it possible for us to pinpoint moments in the evolution of Kant's thought at which the availability of the law-constitutive approach puts an alternative on the table not considered by Kant.

[4] See (Holden, 2004) on the problem of matter's divisibility in the seventeenth century. By "conceptually divisible" I mean that, regardless of whether extended matter in fact has a spatially discrete structure, we can conceive of any such minima as having spatially extended parts. For my purposes here, I do not need the finer distinctions offered by Holden. There is a large literature on the topic of matter's divisibility specific to Descartes; for recent discussion see for example (Lennon, 2007), (Normore, 2008) and (Rozemond, 2008).

[5] In the preceding paragraphs and throughout this paper, I use the term "entity" in the most minimal sense, as a placeholder, free of metaphysical and logical commitments as to whether such entities must be individuals and so forth. Similarly, "collection" is being using minimally, in the sense of "mere collection" described in the preceding paragraph. Indeed, while the subject-matter under discussion here is the physical world, no commitment as to the physicality of the entities and collections considered is presupposed.

[6] This Newton manuscript was re-discovered in the mid-twentieth century and has now become very famous. Although untitled it is commonly referred to as "De Gravitatione." See (Newton, 2004).

[7] Newton's views on various things evolved between "De Grav" and *Principia*, and I am not excluding the following account from that evolution. However, for our purposes there is significant continuity, as the General Scholium of the *Principia* makes clear. Here, Newton writes about God's relation to space and time, and to the things in space and time, as follows (Newton, 2004, p. 91): "He is not eternity and infinity, but eternal and infinite; he is not duration and space, but endures and is present. ... God is one and the same God always and everywhere. He is omnipresent... In him all things are contained and move..."

[8] For further discussion of space as an emanative effect of God see (Slowik, 2009) and references therein.

[9] With respect to space, Newton writes (Newton, 2004, p. 25) that "Space is an affection of a being just as a being."