*Substance and Action in Descartes and Newton*

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Since the publication of Newton’s optical papers in the 1670s, and the appearance of *Principia mathematica* in 1687, his work has been associated with what was then called the “experimental philosophy,” and later termed “British empiricism.”[[1]](#endnote-1) Many twentieth-century interpreters and expositors of Newton have associated him in one way or another with the tradition of British empiricism stretching from Bacon, Boyle and Locke in the seventeenth century to Berkeley and Hume in the eighteenth (McMullin 1985). Perhaps the most influential recent interpreter to place Newton within the empiricist tradition is Howard Stein, whose work on Newton first appeared in the late 1960s and who has been one of his most important expositors in the intervening four decades. Stein’s work on Newton, like his interpretations of Christiaan Huygens and other early modern thinkers, represents an illuminating method of employing philosophical concepts and problems to probe questions in the history of modern science.[[2]](#endnote-2) From Stein’s point of view, in particular, Newton’s rejection of the traditional concept of substance is a hallmark of his commitment to philosophical empiricism, which itself represents a key aspect of his break from Cartesian ideas in both metaphysics and natural philosophy. Stein has helped to indicate that Newton’s broadly empiricist critique of Cartesianism in the famous unpublished tract, *De Gravitatione*, is continuous with—and sheds light on—his published work, especially *Principia mathematica* (Steinle 1991). This connection between Descartes’s natural philosophy and Newton’s has been tremendously fruitful for contemporary research (Stein 2002).

It is appropriate, then, to probe the depths of Newton’s commitment to philosophical empiricism by focusing precisely on his employment of the concept *substance* (cf. Kochiras 2009). This concept, of course, is not only absolutely central to the canonical rationalist philosophy of the seventeenth century, but also to the critique of rationalism found in the works of empiricists such as John Locke, who Newton knew personally (in general, see Broackes (2006)). My principal disagreement with Stein will be that there is a crucial *limit* to Newton’s philosophical empiricism, a limit centered (ironically) on his use of the concept of substance. Although I disagree with Stein on these particulars, I will also argue that Newton’s concept of substance, which limits his empiricism, actually helps to deepen our appreciation for the idea that Newton’s work in the *Principia* is continuous with the great metaphysical tradition of the seventeenth century, a conclusion Stein emphasizes. This episode gives us a first approximation as to what a philosophical history of modern science might involve.

**(1) Howard Stein’s Newton: the philosophical empiricist**

Empiricism, of course, can mean many things. If we employ actor’s categories to characterize philosophical empiricism, we may have two views in mind, broadly speaking. First, *the denial of innate ideas*, or the view that a proper theory of ideas will indicate an empirical or experiential origin for any simple idea (where complex ideas are conglomerations of simple ones). Second, following some recent work (Della Rocca 2008), we may mean that an empiricist rejects the principle of sufficient reason, or at any rate, endorses some articulation of the principle that is consistent with the admission of *brute facts in nature*, where the physical laws themselves may be numbered among such brute facts. Stein’s Newton, however, apparently holds a third view: any conclusion we reach about nature, in philosophy or physical theory, must be seen as having a merely empirical warrant, such that we might be in a position to revise or ultimately to reject that conclusion. On this articulation, Newton’s empiricism is obviously continuous with twentieth-century views.

According to Stein, this third characterization of philosophical empiricism can be expanded into a fully general epistemological principle, such that *any conclusion we reach on any subject bears an empirical warrant.* From Stein’s point of view, this Newtonian principle covers even our views of God and the creation. Having described Descartes’s famous tree of knowledge, where the roots of the tree are metaphysics and natural philosophy is its trunk, Stein writes:

Taking Descartes as the first point of comparison, a radical difference between his view of metaphysics and Newton’s lies in the fact that for Newton metaphysics is *not* the “root” or foundation of natural philosophy. . . His position may rather be said to agree with that of Aristotle—a conception symbolized by the fact that the followers of Aristotle placed his treaties on first philosophy “after the physical ones.” Aristotle, distinguishing between what is “first and better known to nature” and what is “first and better known to us,” regards the most basic principles—“prior,” *in nature*, to those of the special sciences—as *to be known* only *after* the special sciences themselves have been established. An indication that Newton thought similarly is to be seen in the fact that his chief published discussions of the metaphysics of nature, and of his views concerning God in relation to nature, occur *at the end* of his two great treatises . . . [*Principia* and *Opticks*]. In both places the views put forward are thus expressed as, in point of knowledge, *a posteriori*; and in the latter place, the view is explicitly described as *probable* (this is a lower degree of confidence than Newton attaches to his principal results in physics). (Stein 2002, 261-2)

Stein is perfectly well aware that some of Newton’s more famous remarks about the divine being, especially concerning God’s omnipresence throughout infinite Euclidean space, are difficult to square with this commitment to philosophical empiricism.

It might well be asked how *experience* could be said to ground Newton’s assertion that “God is everywhere.” But first—although the claim that God is everywhere *present in space* was a controversial one, and even somewhat dangerous to advocate—Newton thought the doctrine of the *ubiquity* or *omnipresence* of God amply founded in the tradition of revealed truth; and second, he clearly thought experience shows that *minds* can act only *where they are*; so the doctrine of God’s omnipotence (likewise founded in revelation) itself entails his omnipresence. (Stein 2002, 270)

In buttressing the interpretation that Newton takes God’s omnipotence to entail God’s omnipresence (on analogy with human minds), Stein appeals to Newton’s remarks in the General Scholium, added to the second edition of the text in 1713 under the editorship of Roger Cotes. Yet when we look at the General Scholium, we find an apparently distinct view, one that hinges not on an analogy with the mind, but rather on a particular construal of substances and their actions:

Every sentient soul, at different times and in different organs of senses and motions, is the same individual person. There are parts that are successive in duration and coexistent in space, but neither of these exist in the person of man or in his thinking principle, and much less in the thinking substance of God. Every man, insofar as he is a thing that has senses, is one and the same man throughout his lifetime in each and every organ of his senses. God is one and the same God always and everywhere. He is omnipresent not only in power, but in substance: for power cannot subsist without substance. [Omnipraesens est non per *virtutem* solam, sed etiam per *substantiam*: nam virus sine substantia subsistere non potest.] In him all things are contained and move, but he does not act on them nor they on him. God experiences nothing from the motions of bodies; the bodies feel no resistance from God’s omnipresence.[[3]](#endnote-3)

What does Newton’s inference in this passage, which ties the notion of God’s omnipresence to the concept of a substance, indicate about Newton’s commitment to the philosophical empiricism Stein attributes to him?

1. **Substance and action in Newton**

When discussing the relation between God’s omnipotence and omnipresence in the General Scholium, as we have seen, Newton argues: “He is omnipresent not only in power, but in substance: for power cannot subsist without substance.” That is, God’s active omnipresence entails God’s substantial omnipresence, for action requires substance. This inference calls out for clarification. Why should a substance be substantially omnipresent just because its *action* is omnipresent? Couldn’t we have a substance that is located in one place and that acts somewhere else? After all, in the *Principia*, the theory of gravity articulated in the first seven propositions of Book III suggests that ordinary physical substances, such as a rock, the moon, or the earth, are located in one place but act on other physical substances a great distance away. Hence there seems to be an invalid inference here: from the fact that God’s power is located everywhere, it should not follow that God is substantially located everywhere. More specifically, from the fact that God’s power is located everywhere, it follows that God’s power is located at any arbitrary point P; but from the fact that God’s power is located at P—or if you like, that God acts at P, or acts on an object at P—it need not follow that *God* is at P.

If we are to find an interpretation of Newton’s inference that renders it valid, it seems to me that we must take it to have a hidden premise, viz. *a substance cannot act where it is not substantially present*. If we add that premise, we get a nice argument:

1. a substance, S, acts at point P
2. a substance cannot act where it is not substantially present
3. therefore, S is substantially present at P.

We can then apply this argument to God, obtaining:

1. a substance, G, acts everywhere
2. a substance cannot act where it is not substantially present
3. therefore, G is substantially present everywhere.

So now the question is this: can the conception of substances and their action presented by this inference be viewed as having empiricist credentials (it presumably must have such credentials if we are to buttress Stein’s reading of Newton)? Now one might say that if we consider the substances around us—the tables, the rocks, the people—we do in fact find that a substance cannot act where it is not. My hand can’t knock over a glass without touching it, water can’t wet a cloth without running over it, a rock can’t break a window without striking it, and so on. But this would be to privilege the very kind of impact-causation trumpeted by the mechanical philosophy, which Newton appears to challenge in the *Principia*, and which the mechanists took him to challenge (Janiak 2008). The mechanists sought to convince us that all natural change is due to impacts of material bodies on one another. But Newton has no such belief. In Book III of the *Principia*, we conclude that all material bodies gravitate toward one another in proportion to their masses and in inverse proportion to the square of the distance between them, and we do so at least partly on empirical grounds. Hence the sun and the earth gravitate towards one another, where gravity is understood, of course, to be a centripetal force, which is to say, one kind of impressed force. Hence *the sun impresses a force on the earth*, and vice versa. This seems to be an empirically-warranted picture of a case in which a substance acts *where it is not*.[[4]](#endnote-4) And yet in the second and third editions of the *Principia*, Newton continues to resist this suggestion of his own theory. He in fact makes the argument from the General Scholium quoted above, which presupposes the hidden premise that *a substance cannot act where it is not.* It would be a stretch to conceive of this premise as an empirical view, for it is in tension with the very best empirical theory of Newton’s day (viz., *his*).

Stein might reasonably reply that Newton’s physical theory is not operative here, since our concern is not material bodies *per se*, but rather substances in general, including *immaterial* substances such as the mind. And as we saw above, according to Stein, the basis for Newton’s inference is the following empirical fact: “experience shows that *minds* can act only *where they are*” (Stein 2002, 270). We then endorse an analogy between our finite minds and God’s infinite mind.

But there are at least two problems with this response. *First*, leaving aside the analogy between the divine and the human case, there is an obvious prior puzzle here: is it an empirical view that our minds *are somewhere*? As Newton himself notes in *De Gravitatione*, the Cartesian *res cogitans* is evidently *nowhere*, so for Descartes, it is presumably true that my mind can act only on my body, and perhaps as a corollary, that my mind can act through my body only on substances present to my body, but that does not entail the claim that my mind can act *only where it is*, for *it isn’t anywhere*. Newton fully rejects Cartesian dualism, the Cartesian identification of body and extension, and various allied notions, but he does not argue that we can give an *empirical argument against dualism*—he does not appeal to any empirical evidence to suggest that *we know our minds are located in space*. We may in fact know that the mind can act only on our bodies, for we *experience* *that*; and we may be said to experience the effects of the mind’s actions within a given location; but do we experience the mind’s *located-ness* in space? That is unclear, and Newton does not seem to endorse it.[[5]](#endnote-5)

The second problem concerns the analogy itself. As Newton himself insists in the General Scholium, God obviously is not corporeal, so presumably the divine case must be distinguished from the human case, for our minds are clearly bound-up with our bodies. Since God lacks any body, there is no reason to think that the causal situation of our minds gives us any information about the divine being. And as we have seen, in the General Scholium Newton does not provide an argument by analogy.

Finally, we cannot say, à la Stein, that we have another empirical source for this principle of substantial action, namely revelation. For even if revelation, or a tradition of interpreting revealed truth, or even Scripture itself, is empirical, Newton makes no appeal to such sources here. Instead, he buttresses his conception of the divine with a general conception of substance, noting that action requires substance. This general conception canbe traced to a source within the metaphysical tradition that stretches from Aristotle through the late medieval period to early modernity (Reid 2008). The irony is that it is not Aristotelian-style empiricism that Newton adopts, but rather an outgrowth of Aristotle’s concept of substance. Or so I will argue in what follows.

1. **Substance & action in Descartes**

There is a long tradition, usually thought to stretch back to Aristotle, of thinking that every substance must be located somewhere, and of thinking that a substance cannot act where it is not, or that a substance acts only where it is located. Many medievals—and some early moderns—cite Book IV of Aristotle’s *Physica* for the former idea, and Book VII for the latter. For instance, these Aristotelian principles were taken by Thomas Aquinas to have a very wide scope, reaching even the case of the infinite substance.[[6]](#endnote-6) Aquinas encapsulates what I will call a “neo-Aristotelian” concept of substance in the *Summa* as follows (cf. Reid 2008, 95):

God is in all things; not, indeed, as part of their essence, nor as an accident; but as an agent is present to that upon which it works. For an agent must be joined to that wherein it acts immediately, and touch it by its power; hence it is proved in *Physic* vii. that the thing moved and the mover must be joined together. . . No action of an agent, however powerful it may be, acts at a distance, except through a medium. But it belongs to the great power of God that he acts immediately in all things. Hence nothing is distant from him, as if it could be without God in itself. . . Hence, as the soul is whole in every part of the body, so is God whole in all things and in each one. . .God is said to be in all things by essence, not indeed by the essence of the things themselves, as if he were of their essence; but by his own essence; because his substance is present to all things as the cause of their being. [*Summa theol.*, pt. 1, qu. 8, arts. 1—3]

Since God acts immediately on every material being, requiring no medium, and since action at a distance is impossible even for the divine, it follows, according to Thomas, that God’s substance is *present* to all things. It is fair to say that this neo-Aristotelian conception of *substantial action*, with its Aristotelian roots and later medieval offshoots, was well known in the early modern period, and would certainly have been known to Descartes.[[7]](#endnote-7) Since Descartes’s views are now widely recognized as forming the essential philosophical background to Newton’s work, in part due to Stein’s influence (1970, 2002; cf. Gabbey 1980 and Cohen 1990), the first question is whether Descartes accepts these notions.

According to a common reading of Descartes, he would have had no truck with the neo-Aristotelian prohibition against action at a distance, for the Cartesian *res cogitans* has no spatial location, and so its causal interactions with the body violate the principle in question.[[8]](#endnote-8) Similarly, the Cartesian God has no spatial location, and therefore is presumably not present to bodies, despite God’s action on them. We can render this last point neutral with respect to the question of whether Descartes is genuinely an occasionalist: even if Descartes does not think that all causal interactions or causal work must ultimately be attributed to God, nonetheless he clearly does think that God has the power to intervene in natural affairs, and does so (or has done so) from time to time.

This basic interpretation of Descartes, however, does not represent his considered views on these interrelated subjects. In the canonical texts—especially the *Meditations* and the *Principles*, both of which Newton read carefully—Descartes brackets the traditional question of God’s presence to extended being. As with the mind-body problem, which Descartes discusses most fully in his celebrated correspondence with Princess Elisabeth, the most extensive discussion of God’s presence can be found in Descartes’s correspondence with the Cambridge Platonist Henry More, whose status as Newton’s acquaintance and early supporter enables him to serve as the connective tissue here.[[9]](#endnote-9)

In his first letter to Descartes, written in December of 1648, More argues that we have good reason to regard God as extended *in some sense*. Appealing in part to a kind of Thomist view of substances and their actions, he writes:

And, indeed, I judge that the fact that God is extended in his own way follows from the fact that he is omnipresent and intimately occupies the universal machine of the world and each of its parts. For how could he have impressed motion on matter, which he did once and which you think he does even now, unless he, as it were, immediately touches the matter of the universe, or at least did so once? This never could have happened unless he were everywhere and occupied every single place. Therefore, God is extended in his own way and spread out; and so God is an extended thing [*res extensa*].[[10]](#endnote-10)

More seems to presuppose the neo-Aristotelian view that a substance must be present wherever it acts within space, for even God could not act on material bodies from a distance.

In his reply, written in February 1649, Descartes begins by quoting from More, and then makes an intriguing concession:

“But,” you say, “God, or an angel, or any other self-subsistent thing is extended, and so your definition is too broad.” It is not my custom to argue about words, and so if someone wants to say that God is in a sense extended, since he is everywhere, I have no objection. But I deny that true extension as commonly conceived is to be found in God or in angels or in our mind or in any substance which is not a body. Commonly when people talk of an extended being, they mean something imaginable. In this being—I leave on one side the question whether it is conceptual or real—they can distinguish by the imagination various parts of determinate size and shape, each non-identical with the others. Some of these parts can be imagined as transferred to the place of others, but no two can be imagined simultaneously in one and the same place. Nothing of this kind can be said about God or about our mind; they cannot be apprehended by the imagination, but only by the intellect; nor can they be distinguished into parts, and certainly not into parts which have determinate sizes and shapes . . . Some people do indeed confuse the notion of substance with that of extended thing. This is because of the false preconceived opinion which makes them believe that nothing can exist or be intelligible without being also imaginable, and because it is indeed true that nothing falls within the scope of the imagination without being in some way extended. [Descartes to More, 5 Feb. 1649; Descartes 1985 3: 361; AT V: 269-70][[11]](#endnote-11)

From Descartes’s point of view, we cannot think of God as extended because God lacks geometric properties, unlike ordinary material bodies, which have shapes, and whose parts have various shapes; we also cannot have a clear and distinct idea of God through our imagination. Descartes can also be read as rejecting the neo-Aristotelian idea that every entity must be somewhere, for that view involves what Descartes regards as a conflation of *substance* with *extended thing*, a view he wishes to reject not merely to clarify God’s essence, but also to clarify the mind’s essence.

But Descartes does think that God can *act* on any material body anywhere, so God’s *power* must bear some relation to extended things. In reply to More’s letter of March 5th, 1649, Descartes wrote a detailed letter about one month later that tackles this issue. More had argued that “God is positively infinite, that is, exists everywhere,” to which Descartes retorted:

I do not agree with this ‘everywhere.’ You seem here to make God’s infinity consist in his existing everywhere, which is an opinion I cannot agree with. I think that God is everywhere in virtue of his power; yet in virtue of his essence he has no relation to place at all. But since in God there is no distinction between essence and power, I think it is better to argue in such cases about our own mind or about angels, which are more on the scale of our own perception, rather than to argue about God. [Descartes to More, 15 April 1649; Descartes 1985 3: 373; AT 5: 343]

But More would not let Descartes rest with this statement, since it intersects with the traditional view (mentioned in passing by Descartes) that we cannot distinguish between God’s essence and God’s power. Aware of this point, Descartes penned a final reply to More, in August of 1649:

I said that God is extended in power, because that power manifests itself, or can manifest itself, in extended being. It is certain that God’s essence must be present everywhere for his power to be able to manifest itself everywhere; but I deny that it is there in the manner of extended being, that is, in the way in which I just described an extended thing [.] [Descartes to More, August 1649, Descartes 1985 3: 381; AT 5: 403]

Here we see More painting Descartes into a corner: since Descartes acknowledges the traditional view that God’s power is one with God’s essence, he must admit that the omnipresence of divine power ensures the omnipresence of the divine essence. Since God’s essence *just is* God’s substance, this means that God is substantially omnipresent. So More and Descartes take distinct routes to similar destinations. Both believe that God is omnipresent in power. For his part, More thinks that this belief, along with the neo-Aristotelian view of substances and their actions, entails that God is substantially omnipresent; for his part, Descartes thinks that this belief, along with the unity of God’s essence and power, entails divine substantial omnipresence.[[12]](#endnote-12)

There are other philosophical concerns that separate Descartes and More, despite their surprising level of agreement. For Descartes, as we have seen, there are two senses in which God is *not* extended: (1) we cannot represent God using ideas generated from the senses or from the imagination; (2) God no has parts of any kind.[[13]](#endnote-13) More acknowledges these two points.[[14]](#endnote-14) Yet Descartes has at least *four other* reasons for denying that God is extended, properly speaking, which distance him from More. First, Descartes obviously believes that extension and body are *identical*—hence for Descartes to say that God is extended is for him to say that God is corporeal; in Descartes’s world, *there is nothing to being corporeal beyond being extended*. Second, the classic Cartesian relationalist conception of space is crucial here: Descartes sought to avoid the idea that God is *essentially omnipresent* because that would render God’s essence dependent upon the existence of bodies. That is, from the Cartesian point of view, God could not be omnipresent until the creation of the world, which provides the origin of space, and that would obviously be problematic. The third point follows from the second: since Descartes thinks of space and body as identical, we cannot capture Descartes’s view that God is actually infinite within the context of taking God to be extended unless we say *also* that extension is actually, rather than merely potentially, infinite. And as is well known, Descartes wishes to avoid the idea that anything other than God is actually infinite.[[15]](#endnote-15) Fourth, Descartes might drive a wedge between God’s actions and God’s power, arguing that if consider God independently of the creation, then there is no pressure to say that God’s power has any location, for it would not have a location vis-à-vis any material being, and would therefore lack any relationship to space. God would still presumably have the *power* to create the material world, but that *power* would lack any location, so it is not the case that God’s powers *per se* must bear a location; rather, God’s actions vis-à-vis the creation must bear a location. In sum, for Descartes, *God’s essence is present to extension, God is extended by analogy, but God is not essentially extended*.[[16]](#endnote-16)

What is the relevant philosophical upshot of this intriguing epistolary episode? Interpreting it places us in a position to *very briefly* indicate the locus of disagreement between Descartes and Newton. Not surprisingly, Newton follows More in thinking that there are *two ways of being extended*. First, material substances are extended in the sense that they have spatial locations (as do their powers, and the effects of their actions); they have parts; they are impenetrable; and they can be perceptually represented. Second, immaterial substances like God are extended in the sense that they have spatial locations (as do their powers, and the effects of their actions); they lack parts; they are penetrable (“the bodies feel no resistance from God’s omnipresence”); and therefore they cannot be perceptually represented (they do not reflect light or sound, etc.). Newton also believes that God creates material bodies but *does* *not* *create space*, which obviously presupposes the anti-Cartesian view that body and extension are distinct. And he adds that all substances bear *some relation to space*, including God (Newton 2004, 25-7). These views indicate that for Newton, God is extended *per se*—God bears a relation to space *per se*—and not merely when considered in relation to matter. Newton’s rejection of Descartes’s identification of body and extension, and his view that infinite space exists independently of matter, secures an arena for God’s omnipresence without relying on matter’s existence. Hence Descartes and Newton concur that *God’s substance is omnipresent*; the locus of their disagreement is that Descartes denies, and Newton affirms, that God is *essentially* extended.

This leaves us with Descartes’s view of the mind. In a remarkable passage in *De Gravitatione*, Newton explicitly indicates that Cartesian dualism, at least on its canonical formulation, has the consequence that the mind is not substantially present to the body, or indeed to extension more generally. After criticizing, once again, Descartes’s view that extension is identical to body, Newton adds:

Nor is the distinction between mind and body in his philosophy intelligible, unless at the same time we say that mind has no extension at all, and so is not substantially present in any extension, or exists nowhere [adeoque nulli extensioni substantialiter praesentem esse, sive nullibi esse]; which seems the same as if we were to say that it does not exist, or at least renders its union with body thoroughly unintelligible and impossible. (Newton 1962, 109; Newton 2004, 31—I have slightly altered the translation)

Newton ultimately contends that canonical Cartesian dualism is saddled with the claim that the mind is nowhere, and therefore does not exist according to Newton’s criterion or analysis of existence, which involves spatial location at some time. But he also adds that dualism is unintelligible because if the mind is not extended in any sense, it cannot be substantially present to the body, or to any other extended thing. And if it is not present to the body, we cannot understand its union with the body, or (presumably) any of its interactions with the body. Newton seeks a unified account of substances and their actions, ensuring that the mind and God are each substantially present to the bodies on which they act.

1. **Empiricism’s limits: Newton’s rejection of distant action**

There is no doubt that Newton often deploys a concept of substance with empiricist credentials in the course of criticizing figures like Descartes, as Stein has emphasized (Stein 2002). And there is no doubt that many of Newton’s remarks about our knowledge of substances could be pages taken right out of Locke’s *Essay*.[[17]](#endnote-17) However, we have also found that at a fundamental level, Newton is committed to a traditional metaphysical conception of substances and their actions—one to be found, at least in its essential elements, in Thomas, Descartes and More—that conflicts with the empirically-based picture of substantial interaction presented in his own physical theory. Despite that conflict, Newton never altered his remarks about substances in the General Scholium (found in the 1713 and 1726 editions of the *Principia*), so that would appear to represent his considered view of these matters. Thus Newton’s concept of substance indicates a key limit to the philosophical empiricism attributed to him by Stein: if he was unwilling to alter his traditional conception of substantial action in the face of his own physical theory, then it seems unreasonable to regard him as holding that conception on empirical grounds. He evidently took it to be an unrevisable aspect of his basic view of God’s creation.[[18]](#endnote-18)

We might view this episode in the history of philosophy of science as bearing both interpretive and methodological import. First, it helps to solve one of the most vexing interpretive puzzles to have faced Newton’s readers, both in the eighteenth century and today. That puzzle takes various forms, but it can be stated simply as follows.[[19]](#endnote-19) Newton’s theory of universal gravity, which appears in Book III of the *Principia* (1687), *seems* to postulate distant action between material bodies, for as we have seen above, it asserts that (e.g.) the earth impresses a force of gravity on the moon independently of whether there is any medium between them.[[20]](#endnote-20) And yet in his famous correspondence with Bentley, which accompanied Bentley’s preparations for delivering the first Boyle Lectures in London in 1692/2, Newton makes a strong pronouncement *against* distant action.[[21]](#endnote-21) In his fourth letter to Bentley, written on 25 February 1692/3, he writes:

It is inconceivable that inanimate brute matter should, without the meditation of something else, which is not material, operate upon and affect other matter without mutual contact, as it must be, if gravitation in the sense of Epicurus, be essential and inherent in it. And this is one reason why I desired you would not ascribe innate gravity to me. That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum without the meditation of anything else, by and through which their action and force may be conveyed from one to another, 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. Gravity must be caused by an agent acting constantly, according to certain laws; but whether this agent me material or immaterial, I have left to the consideration of my readers.[[22]](#endnote-22)

It certainly appears from this letter that Newton fully rejected the very idea of action at a distance between material bodies.[[23]](#endnote-23) He does not address the action of *immaterial* substances here, as this was not relevant for his discussion with Bentley, which focused on the proper interpretation, and the various implications, of his theory of universal gravity. But he also leaves no opening for exceptions involving immaterial substances. Finally, he insists that gravity must be caused by an agent, by which he may mean a substance.[[24]](#endnote-24)

We can solve this interpretive puzzle precisely by connecting it with the neo-Aristotelian concept of substance that Newton shares with More and even to some extent with Descartes. Like Descartes and More, Newton did not approach the question of substantial action within narrow physical or empirical parameters; he was not concerned solely with the question of how bodies in nature interact causally with one another. Instead, he had a much broader, *metaphysical*, concern with the concept of substantial action, and it was this concern, in turn, that led him throughout his career to deny that he had invoked action at a distance within his theory of universal gravity. If misinterpreted, his own theory violated what he took to be a central feature of the concept of substance found in the tradition; but he always insisted that it could be interpreted in a way that avoids that violation.[[25]](#endnote-25) His conception of substantial action, as we have seen, was not empirical, and therefore operated at a distinct (more general) level than his physical theory. We might even speculate that many eighteenth century figures were in a position to embrace action at a distance precisely because of their thoroughgoing rejection of the traditional concept of substance.

This aspect of Newton’s thought also has a second, methodological, upshot. It nicely illustrates the idea that there are issues in the history of science that can be fully understood only if we appeal to a canonical “scientist’s” relationship with the philosophical tradition from which he or she emerged. Hence the vexing question of how to characterize, and to understand, Newton’s attitude toward action at a distance—a major topic of Newton interpretation among historians of science for the past century—can be answered in part if we place Newton’s thought within the metaphysical tradition of the seventeenth century. Although I have raised doubts about the view that Newton was fully committed to *philosophical empiricism*, it seems to me that Stein is absolutely right about the more general methodological issue: we can gain insight into Newton’s work by looking not only at the history of science as traditionally conceived, but also by embedding Newton’s principles into the long history of philosophy from which they emerge. That is a good beginning for thinking about the philosophical history of science.

1. Peter Anstey has reminded me that ‘empiricism’, and the related concept, were inventions of the late eighteenth century in general, and perhaps of Kant and his followers in particular. Certainly it is true that in Newton’s milieu, this term was not used; instead, it was sometimes said that natural philosophy had an “experimental” and a “speculative” aspect or could take on approaches picked out by those names. And certainly Newton himself often contended that his “philosophy” was *experimental*, as did his expositor and defender, Roger Cotes, who edited the second edition of the *Principia*, which appeared in 1713 (Newton 1999, 386). However, since my focus here is Stein’s interpretation of Newton—especially the culmination of his thinking in his influential 2002 paper, “Newton’s metaphysics”—and since Stein speaks of Newton as holding (e.g.) that our knowledge of nature is *a posteriori*, which clearly has a post-Kantian sense in Stein’s hands, I think it is sensible to consider Newton’s relation to *empiricism* in this paper. As with Stein’s usage of *a posteriori*, I think this anachronism, if it is that, is harmless.It may even be that if we are to take Niccolo Guicciardini’s notion of a *philosophical* history of science seriously, it is appropriate in particular cases to use terms and concepts that are crucial to our understanding of the philosophical canon when thinking about the views of various historical figures even if they are not actors’ terms and concepts. For that is often what philosophers do, even when considering the history of their own discipline. [↑](#endnote-ref-1)
2. One might add two other components to Stein’s perspective that I cannot describe in any depth in this paper. First, a scientist—such as Newton or Maxwell, who each figure prominently in Stein’s work—may be the best commentator on his or her own work. I take this to mean that interpreters ought to treat the *scientist* as a *philosopher*, one whose reflection on her own work is an essential component of any interpretation of it. That is a standard practice in the history of philosophy, of course, but it may not be standard practice in the history of science, where the focus often lies on scientific practice, experimental results, and so on, where little attention is paid to a scientist’s own comments on that practice or those results. Second, we cannot simply inherit a preconceived notion of the philosophical canon, as if it were hermetically sealed: we must always be open to the idea that there are figures who are central to science’s history and who have been unjustly neglected within the history of philosophy. Christiaan Huygens is an excellent example—for years, Stein has been discussing Huygens’s views, both because he reacted in deep and interesting ways to Newton, and because he developed powerful conceptions of space, time and motion. Newton, too, is a good example: it was surely due to Stein as much as anyone that Anglo-American scholars now focus on Newton’s role in the development of modern philosophy. [↑](#endnote-ref-2)
3. Newton 1972,Volume 2: 762. The crucial fifth sentence might also be translated as follows: “He is omnipresent not only actively, but substantially: for action cannot subsist without substance.” The only problem with the latter phrasing is that the obvious contrast to *actively* is *passively*, which is misleading in this context. For comparison, the always reliable Emilie du Châtelet has: “Il est présent partout, non seulement *virtuellement*, mais *substantiellement*, car on ne peut agir ou l’on n’est pas.” [Newton 1749, tom 2: 177]. [↑](#endnote-ref-3)
4. Given the theory of gravity presented in Book III of the *Principia*, I take it to be incontrovertible that: (1) Newton takes spatially distant material bodies to impress forces on one other; and, (2) the claim that one body impresses a force on another spatially distant body does not depend on there being any medium between them. Similarly, in the Scholium following the Corollaries to the Laws of Motion, Newton highlights the fact that he applies the third law to the interactions of spatially separated bodies—Newton 1999, 427-28. [↑](#endnote-ref-4)
5. For a helpful discussion of several relevant issues in Newton interpretation, see Dempsey (2006). [↑](#endnote-ref-5)
6. Of course, this was not the only view articulated in the medieval period that is relevant here: famously, Scotus represents a distinct tradition, one that does not endorse the sorts of views outlined by Aquinas in the quotation given in the body of the text. As we will see, however, Aquinas’s views are probably the relevant background to Descartes’s views, and to Newton’s as well. [↑](#endnote-ref-6)
7. For an outstanding discussion of the spatial presence of spirits within the tradition, as understood from the Cartesian perspective, see Reid (2008). [↑](#endnote-ref-7)
8. For an illuminating discussion of action at a distance within Cartesian natural philosophy, but not necessarily within the broader domain of Cartesian metaphysics, see Suppes (1954). [↑](#endnote-ref-8)
9. It is not clear whether Newton read Descartes’s correspondence with More, although he was certainly familiar with More’s main works—he had eleven of More’s books in his personal library (Harrison 1978), including (1655, 1659, 1662) —and he knew More personally. It is probable that Newton understood More’s changing opinion of Cartesianism over the course of his career, and it is certain that he knew More’s principal objections to Cartesian ideas toward the end of More’s life. More’s views shed a great deal of light on Newton’s conception of substance, and those views, in turn, must be understood in the context of his reactions to Descartes in the late 1640s; More even coined the term ‘Cartesianism’. Finally, Descartes’s own struggle to articulate a coherent position concerning God’s action vis-à-vis the creation indicates the strength of a neo-Aristotelian conception of substance even for him. [↑](#endnote-ref-9)
10. More to Descartes, December 1648, AT 5: 238-9. For discussion, see Garber (1992, 144*ff*) and cf. Reid (2008). I largely follow Garber’s translation of More’s letter. On More’s philosophical views more generally, including their relation to Cartesianism, see Gabbey (1982). [↑](#endnote-ref-10)
11. Many thanks to Alan Gabbey for assisting me in thinking about how to translate the Descartes-More correspondence into contemporary English. The translations presented here are my own, although I have tried to follow the commonly available CSMK translation (Descartes 1985) when possible. [↑](#endnote-ref-11)
12. This discussion enables me to confront an implicit ambiguity in the notion of action at a distance. It seems that distant action in the late seventeenth-century can mean *at least* three distinct things: (1) some substance, A, is located at position Q but acts on something located at position P (where the distance between P and Q is too large to involve contact); (2) some substance, A, acts on something located at P without itself being *located* at P; and, (3) some substance, A, acts on something located at P without itself being *present* at P. It seems *prima facie* that (1) can be applied only to substances with spatial locations, but (2) and (3) might be applied to substances that lack spatial location. In affirming God’s substantial omnipresence, Descartes affirms that God never acts where God is not present, hence God does not engage in distant action in sense #3; but Descartes might deny that God’s presence at P entails God’s being *located* at P, which means that God may act at a distance in sense #2 (in virtue of being located nowhere). The reason may be that for Descartes, for an entity to be *located* is for it to be *extended*. [↑](#endnote-ref-12)
13. Indeed, at the end of the paragraph quoted above (from Descartes’s February 1649 letter to More), we find that Descartes provides a kind of definition of *extended*: “thus that alone which is imaginable, as having parts outside [other] parts, which may be of determined magnitude and shape, I say to be extended, even though other [things] may be said, by analogy, to be also extended.” So perhaps Descartes means that God is not extended in the usual sense, but can be considered extended by analogy, for God’s substance is present throughout extension. [↑](#endnote-ref-13)
14. More already accommodates these points by saying in his first letter that God is extended “in his own way,” which reflects More’s view—adopted later by Newton (2004, 25-6)—that an immaterial substance can be extended without being impenetrable, and also his distinction between space, which he takes to be penetrable, and body, which he takes to be impenetrable. [↑](#endnote-ref-14)
15. Descartes explicitly mentions this distinction between extension and God in his letter to More of 5 February 1649. Descartes is reluctant to say that extension is infinite, rather than indefinite (i.e., potentially infinite rather than actually infinite) in *Principles of Philosophy*, part two, section 21 (AT 8-1: 52); Newton later criticizes that reluctance (2004, 24-5). [↑](#endnote-ref-15)
16. This view is presumably analogous to *res cogitans*: if God were to separate my mind from my body, it would not—or at least, not *necessarily*—follow that my mind would *ipso facto* lack powers. It might retain the power to think, even if it would lack the power to move my body, which is the essential reason for thinking that my mind’s power must bear a *location* (the pineal gland?). Hence thinking of God’s power vis-à-vis the creation is analogous to thinking of the mind’s power within the context of the union. In his first letter to Princess Elisabeth of Bohemia, in May of 1643, Descartes notes that the *Meditations* focuses on the mind’s capacity for thought, leaving aside its interactions with the body. Yet he makes it perfectly clear that he *does* take the mind to act on, and to be acted on by, the body in the context of their “union”—see AT 3: 665-7 and Shapiro (2007, 65-6). Elisabeth is wisely skeptical of his suggestion that we can use the (false) Scholastic notion that heaviness is a real quality—thinking of how a heavy body is impelled toward the center of the earth—to help clarify how the soul moves the body; see AT 3: 685 and Shapiro (2007, 68). Descartes may be suggesting here that just as we experience a body’s heaviness, even when we do not understand it (and certainly, he thinks the Scholastic explanation will not help us to understand it), we *experience* the union of the mind and body, even if we do not understand it. Elisabeth rightly insists that this helps little if we are attempting to grasp the mind’s *interaction* with the body. Intriguingly, Descartes tells her roughly what he tells More in their correspondence a few years later: if you like, you are free to conceive of the mind as extended—this is just to conceive of the union, he suggests—just as you are free to conceive of God as extended, so long as you are clear on what this does and does not entail. [↑](#endnote-ref-16)
17. For instance, see Newton’s comments in *De Gravitatione* (2004, 29) and in the General Scholium, presumably written many years later (1999, 942-43). [↑](#endnote-ref-17)
18. This story has an ironic twist. More than any scholar in the past forty years, Stein has prompted the next generation into finding deep philosophical insight (in every sense of that phrase) within Newton’s myriad published and unpublished writings. But it seems that Newton’s own pronouncements about substances call out for further clarification, for he leaves us wondering: how is it possible for us to know that all substances (even the divine) act only where they are present? This type of claim transcends any empirical evidence we might muster, and yet Newton seems assured of its truth. Our frustration arises from the fact that Newton seems to ignore the epistemological implications of his metaphysical commitment. But the false view—one that Stein has decisively put to rest—is to think that Newton simply avoided metaphysical positions that cry out for various kinds of epistemological underpinnings. [↑](#endnote-ref-18)
19. This puzzle has, in one way or another, always dominated interpretations of Newton, both among canonical philosophers and among canonical scientists. Remarkably, in the late eighteenth century, no less a figure than Kant bemoaned Newton’s reluctance to embrace his theory’s apparent postulation of action at a distance, and no less a figure than Maxwell wrote extensively about Newton’s attitude toward such matters in the late *nineteenth* century. See Kant (1910, 4: 515) and Maxwell (1890, 2: 315-16). [↑](#endnote-ref-19)
20. For excellent histories of the problem of action at a distance within physics, see Hesse (1961) and McMullin (1989). [↑](#endnote-ref-20)
21. On the Boyle lectures, which were endowed by Robert Boyle’s will (he died at the end of 1691), and on Bentley’s lectures, see the classic accounts in Koyré (1968, 201-2), and Metzger (1938, part 2: 80-91). [↑](#endnote-ref-21)
22. See Newton to Bentley, 25 February 1692/3, in (Newton 2004, 102-3). In recent work, Schliesser (forthcoming) has argued that the interpretation of Newton’s remarks to Bentley that I give here ignores several nuances in what Newton means by an “Epicurean” view of gravitation. He argues instead that Newton’s letters to Bentley are compatible with a fundamental acceptance of action at a distance, at least under certain circumstances, or when certain issues are under discussion. In this connection, see also Henry (1994). [↑](#endnote-ref-22)
23. There is certainly no consensus on the question of whether Newton allowed for action at a distance in any sense, either between material bodies or between substances more generally, in his thinking. In *Newton as Philosopher*, I argue that Newton rejected action at a distance *per se*, despite the fact that his theory of universal gravity can reasonably be interpreted as postulating such action between the planetary bodies (see Janiak 2008, 163-178); cf. also the next endnote. For the view that Newton did allow action at a distance of some kind, or perhaps in some circumstances, see McMullin (1978, 144 note 13 and 151 note 210) and Henry (1994). I address Henry’s view, and the apparent postulation of action at a distance in various Newtonian texts, including the Queries to the *Opticks*, in Janiak (forthcoming). Thank you to an anonymous referee for raising this issue. [↑](#endnote-ref-23)
24. Many thanks to Michael Friedman for discussion of this point. [↑](#endnote-ref-24)
25. But why did Newton think that he could posit universal gravity—which includes the claim, e.g., that the sun impresses a force on the earth from a great distance—while still rejecting action at a distance on fundamental metaphysical grounds? I can only sketch my reply here: Newton can hold these two beliefs because he can claim that it is a misunderstanding to view the contention that the sun impresses a force on the earth—or transfers momentum to the earth, if you like—as identical to the contention that the sun *acts* on the earth *at a distance*, for the action may *not* be at a distance. It may not be at a distance, in turn, for this reason: although Newton’s theory does not depend on, or posit, any medium between the sun and the earth, it is *compatible* with such a medium (as long as it does not involve any non-negligible transfers of momentum). Hence there is an *interpretation* of Newton’s theory that takes it to postulate action at a distance, but Newton claims that this is not a favored or required interpretation. I deal with this issue in some depth in Janiak (2007), more comprehensively in Janiak (2008), and with links to the materials discussed in this paper in Janiak (forthcoming).

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