

Newton's Metaphysics of Space as God's Emanative Effect

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In several of his writings, Isaac Newton proposed that physical space is God's "emanative effect" or "sensorium," revealing something interesting about the metaphysics underlying his mathematical physics. Newton's conjectures depart from Plato and Aristotle's metaphysics of space and from classical and Cambridge Neoplatonism. Present-day philosophical concepts of supervenience clarify Newton's ideas about space and offer a portrait of Newton not only as a mathematical physicist but an independent-minded rationalist philosopher.

Key words: emanation; God; metaphysics; Henry More; Neoplatonism; Isaac Newton; ontology; sensorium; space; Stoic theocosmology; time.

Newton's Natural Philosophy

Isaac Newton (1642–1727, figure 1) was not only a great innovator of applied mathematical physics but, in the language of the day, a natural philosopher who pursued speculative metaphysical and theological side-interests, among more colorful endeavors. The ambition to contribute to philosophical understanding is explicit in the title of his monumental *Philosophiae Naturalis Principia Mathematica* (*The Mathematical Principles of Natural Philosophy*, 1687). The explanatory and practical utility of Newton's "System of the World" carved out the exact domain of natural philosophy until philosophers and scientists generally stopped speaking of natural philosophy almost two hundred years later. The distinction still survives between hard applied mathematical natural science and philosophical or metaphysical speculation. In his writings, Newton excludes but does not silence the most persistent and interesting questions about the metaphysics, nature, and origin of physical space. Although he banishes these questions and speculations from natural philosophy, he does not deport them entirely from philosophy, but allows them their place in speculative metaphysics and contributes his own thoughts outside the tightly enforced perimeter of natural philosophy.

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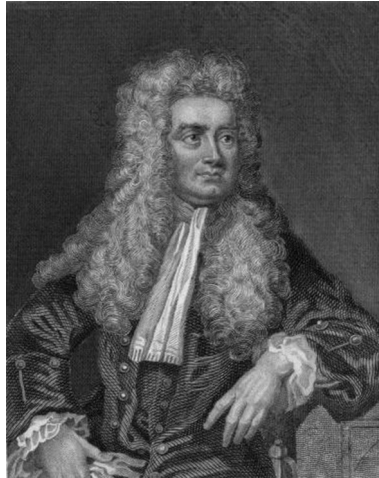


Fig. 1. Isaac Newton. Source: David Brewster, *The Life of Sir Isaac Newton* (London, 1840).

Besides Newton, natural philosophers such as Aristotle, Archimedes, Galileo, Descartes, and Leibniz inquired into mechanical principles, the most abstract and idealized of which, confirmed by repeated elementary experiments, are considered laws of nature. These basic statutes of physics for Newton involved kinematics plus dynamics in an applied mathematics of *fluxions*, the limiting ratios better known today through Leibniz's terminology as infinitesimals of differential and integral calculus.¹ Newton's metaphysical reasoning ascribed the infinite divisibility of physical reality to the infinity of God as a supernatural intelligent Agent and Creator of the universe. Newton did not consider God as a unitary, centralized spiritual entity transcending and overlooking all the movements of objects in physical space and time as though from a single vantage point, but as physically omnipresent and pantheistically coextensive with all of physical space. As I shall argue, through this decentralized distributed model of God's relation to physical space, Newton transformed earlier Neoplatonic ideas of physical space as God's emanation or emanative effect and as God's sensorium.

Newton's driving objective was to understand the mechanics of the empirical world by means of applied mathematical physics. When engaged in natural philosophy, Newton resolutely avoided metaphysical speculations concerning the origin of the physical universe, in particular the origin of physical space. He takes as given physical objects in motion to which he applies the laws of physics. He reserves his metaphysical speculations about the origin of space for his posthumously published *De Gravitatione et æquipondio fluridorum* (usually dated as c. 1660, although The Newton Project's Newton Manuscript Catalogue lists the document as c. 1680), and in his replies to certain *Queries* appended to the *Opticks*, acknowledging that he is taking metaphysical reasoning beyond the proper

bounds of natural philosophy. Although Newton is keen to mark and police the division between physics and metaphysics, this scruple does not prevent him from voicing considered and philosophically significant opinions about the metaphysics, nature, and origin of physical space.

Physics and Metaphysics of Space

Natural philosophers, Newton not excepted, are often tempted to stretch hypothesis beyond the limits of natural philosophy, speculating metaphysically and often theologically about the origins and greater purpose or meaning of the universe whose applied mathematical properties they study. Those who closely consider the world's mechanical principles with mathematical precision unsurprisingly ask intelligent questions about the existence and nature of the physical universe itself, of the existence of the physical space in which physical objects are moved. Newton would probably insist that there is a danger here of transgressing sound empirical methodology, to be avoided only if the inquirer does not confuse natural philosophy with speculative metaphysics. Newton considers natural philosophy to be limited in principle to identifying laws of nature that govern the forces impinging on physical objects in motion. Otherwise, as he defiantly declares, *Hypotheses non fingo*: "I do not make [or feign] hypotheses."²

Where explanation by appeal to the natural laws of physics gives out, philosophy may feel compelled to outpace natural philosophy, as it did in the thought of Newton and his contemporaries. The rule is that we risk confusion and compromise of scientific findings if we are not clear in reflecting that our broader philosophical, metaphysical speculations are not part of natural philosophy. Philosophy, incorporating commitments to the existence and properties of what are excluded from natural philosophy by default as supernatural entities, is not popularly known as supernatural philosophy, although one imagines a respectable division affirmed in exactly those terms. Newton speculates openly in his answers to *Queries* of his *Opticks* (fourth edition, 1730) that God or an intelligent Agent of Choice is responsible for the remarkable mathematical order that prevails throughout the universe and that physical space is God's *sensorium*. In his posthumously published manuscript, *De Gravitatione*, Newton further speculates that physical space is God's emanative effect. Newton seeks answers to fundamental metaphysical questions beyond those available to natural philosophy in an applied mathematical science of physics. His solution is to invoke religious pre-commitment to the existence of a supernatural realm that God inhabits, and from which physical space emanates into the unfolding in time of the phenomenal world as God's expanding sensorium, and like any perceptual field, consequently, in this case, as God's emanative effect.

Remarkably, Newton's reference to physical space being an emanation or emanative effect of God, and of physical space as God's sensorium, are clearly cast in Neoplatonic language. Plato himself had speculated that physical space was a



Fig. 2. Henry More (1614–1687), Cambridge philosopher. Source: Richard Ward, *The Life of the Learned and Pious Dr. Henry More* (London, 1710).

“receptacle” (*chora* in ancient Greek, literally “country”), in which physical objects can then be shaped by the *demiurgos* (the divine craftsman or Creator) according to the pattern given by pre-existent perfect Platonic Forms.³ Newton believed that Plato’s *demiurgos* does not have enough responsibility for the reign of causal regularities enshrined as laws of nature. Newton requires a more enterprising and intelligent Agent to serve as the divine applied mathematician, architect, designer, and builder of the physical universe. Aristotle posited “primary substances” (*prôtai ousiai*), but did not discuss space and time as physical entities in their own right, other than as the inherent where and when of all physical things.

In contrast, the Neoplatonic tradition that began in Hellenistic times with Plotinus (204–270 AD) considered physical reality (including space) to be created by the emanation or pouring forth from the primordial One, a single centralized Godhead or Principle of Being.⁴ Newton may have picked up not only the jargon but something of the concepts of Neoplatonism from his reading of classical authors or from his Cambridge contemporaries, among whom Neoplatonism was then enjoying a revival. Strangely, Newton in his published writings and unpublished manuscript does not mention the most noteworthy Cambridge Neoplatonist, Henry More (1614–1687, figure 2), whose works Newton probably encountered.⁵ More described all of physical reality of moving objects in space and time as an emanation of a personal monotheistic God, considered as the Neoplatonic Godhead or Principle of Being rather than the abstract Platonic Idea of the Good. More also described physical space as God’s sensorium, the precise words Newton himself would later use.⁶ These extraordinary coincidences, if they are no more than that, between Newton’s emanativism and More’s Cambridge Neoplatonism do not necessarily imply that Newton was a Cambridge Neoplatonist.⁷

From our perspective, Newton seems a paradoxical combination of uncompromising scientific discipline and tradition-based, though unconventional, religious faith, a thinker of curious inclinations and originality, practical and impractical accomplishments, and eccentric extramural diversions. To mention only a few, Newton's sideline activities include not only public service as a member of Parliament and Master of the Mint but astrological investigations and extensive experiments in alchemy. An autopsy after his death revealed Newton's contact with an element once thought to be useful in transforming base metals into gold that left his body thoroughly imbued with mercury, a deadly poison.⁸ Throughout his life, Newton maintained an explicit theism, as well as a belief in angels and the possibility of "miracles," brought about by God as "the intelligent Agent." This intelligent Agent acts, exercises a divine, all-powerful, rational will to create and set the world of moving physical objects in motion. This Agent might also occasionally intervene in space and time against the laws of nature by producing miracles, in order to bring about a desired and divinely intended result from which the clockwork physical universe would otherwise have strayed. Among Newton's specific religious commitments, many were not untypical for his time, while others he seems to have arrived at by reasoning processes uniquely his own. Newton was a devout if, according to the accepted religious standards of his time, somewhat eccentric believer in the existence of God. We can think of Newton in this regard as very much in league with his peers, including especially Descartes, Leibniz, and Robert Boyle, but also with such eighteenth-century figures as William Paley, Thomas Reid, Robert Hooke, and especially George Berkeley.⁹ If we want to understand Newton as a rationalist-era philosopher, then we must consider his speculative metaphysical reflections independently of the unprecedented achievement of his mathematicization of physical nature. However off-beat some of his pursuits, Newton displays great intellectual virtue in maintaining an open mind about questions previously undecided by the forward march of science, including alchemy, astrology, and the theocosmological metaphysics of space.

Space as God's Emanative Effect

In *De Gravitatione*, Newton describes space as an *effectus emanativus* or "emanative effect" of God. Newton's kinematics, the applied mathematics of his system, including the principle of universal gravitation, explains, predicts, and retrodicts the geometrical trajectories of objects moving in space and time, demonstrating applied mathematical laws of motion, mass, and force. Questions thus naturally arise as to the existence and origin, more generally, the metaphysics of space itself, of the *dimensions* in which the projectiles of Newton's System of the World are propelled, attracted, or repelled.¹⁰

We know that for Newton physical space is Euclidean, at least in an analogical sense, rectilinear, and infinite in extent and mathematical subdivisibility. Such knowledge, though invaluable, belongs entirely and contributes exclusively to the

mathematics rather than metaphysics of space. We do not learn what kind of thing a moment of time is from a mathematical description of its structural properties in relation to other moments of time. We must first know what other things are moments of time, which is to say, what it is for something to be a moment of time, in order to understand the proposal. We are thereby caught up in a vicious circle: we must previously know metaphysically what a moment of time is in order to understand any mathematical explanation of the concept of a moment of time in structural relation to all kindred entities.

By analogy, consider that someone otherwise unfamiliar with an apple cannot hope to understand it merely from a complete mathematical description of its physical properties alone, that it is so large and has such length and girth, weight, spatiotemporal persistence, and the like. Mathematical description gives us *form* but cannot supply an adequate concept of the *content* of such real dynamic spatiotemporal physical objects as apples. Nor does this downplay the usefulness of knowing the mathematical forms of physical objects and the movements of their centers of mass in space and over time. We must still admit that applied mathematics does not imply everything there is to know about the objects of its law-governed explanations, and in particular does not help us know what the thing in question *is*, what *kind* of thing it is, beyond its implied status as a spatiotemporal physical entity. $F = ma$ governs how physical objects move through space. But what is space?

Newton's *De Gravitatione* speculates that space *emanates* or *radiates forth* from God as an *emanative effect*, a *divine emanation*. Newton explains in three connected passages in the manuscript:

[Space] is not substance: on the one hand, because it is not absolute in itself, but is as it were an emanative affect of God and an affection of every kind of being...¹¹

Space is an affection of a being just as a being. No being exists or can exist which is not related to space in some way. God is everywhere, created minds are somewhere, and body is in the space that it occupies; and whatever is neither everywhere nor anywhere does not exist. And hence it follows that space is an emanative effect of the first existing being, for if any being whatsoever is posited, space is posited....¹²

Space is eternal in duration and immutable in nature because it is the emanative effect of an eternal and immutable being.¹³

The exact meaning of Newton's pronouncements on emanative effect has preoccupied scholars ever since the manuscript first came to light.¹⁴ Contemporary metaphysicians and philosophers of science have wanted to understand both the virtues and deficits of whatever Newton might reasonably have meant by an *emanation* from God. Newton certainly uses Neoplatonic terms when he refers to emanation and physical space as God's emanative effect, but there are more difficulties than insights whichever way one turns.

The historical connection between Newton and More is difficult to establish, primarily because Newton, perhaps guarding his sources, perhaps protecting his originality, but also perhaps because he knew and rejected too many of More's ideas, does not cite More as an authority nor discuss his works.¹⁵ Newton may have thought that More's Neoplatonism was excessively speculative or aimed in the wrong direction. The scanty extant historical evidence unfortunately has not yet yielded a definitive answer whether and to what extent Newton borrowed from or was influenced by More, though an interpretation is ventured below. The concept of physical space as God's sensorium, meaning the field of visual and other sensations wherein all that happens is directly known to an omnipresent divine and willful consciousness, was a central part of More's religious Neoplatonism and was also discussed by Newton in his *Opticks*. Whether this is coincidence or something approaching unacknowledged intellectual debt, Newton's concept of physical space as God's sensorium, like More's, also understands physical space as God's emanative effect, to which topic we later return.

It seems appropriate, accordingly, only to mention the similarities between Newton's vocabulary of divine emanation or emanative effect and More's Neoplatonism, rather than to speak of historically unproven influences. The emanation metaphor raises notable problems. Although a liquid can be poured into a pre-existent, partly unoccupied space, how is space itself to be poured out? What is space supposed to be poured into or onto? There seems to be no way to visualize this process that does not presuppose a pre-existent space-time "receptacle," an opening or entry into a pre-existent space-time recipient space in which all other physical existence is supposed to be decanted.

Classical Neoplatonists inclined to understand the Principle of Being as the impersonal abstract Platonic Idea of the Good, likened in Plato's *Republic* to the Sun, to which we living creatures on Earth owe all our being and sustenance. Especially in monotheistic religious Neoplatonism like More's, references to the abstract Platonic Good are easily converted into discourse about a personal God. The principle from which all being flows and on which all causal explanations are ultimately grounded is nothing abstract for religious Neoplatonism. What is abstract provides and is subject to no motivation and cannot be stirred to act, to do anything. If the Neoplatonic Principle of Being is no agent, but only a lifeless, abstract Platonic Idea to which agents may aspire, then to Newton it seemed incapable of accomplishing anything or of being more than in a vaguely metaphorical sense the unified source of being and font of goodness in the world. Classical Neoplatonists can strategically reply that the existence of good things in the world of experience implies that there is an abstract Platonic Idea of the Good, without which there could be no instantiated good things and in that sense nothing good. This reply leaves unanswered questions about the origin of all the many things that are not as easily said to be good.

Whatever the attractions of substituting God for the Good in a Neoplatonic metaphysics undergirding the emanation of space, divine or otherwise, we should

duly observe that a physical-world-transcendent God or Newtonian intelligent Agent is in precisely the same explanatory difficulty as the classical Neoplatonic impersonal abstract Platonic Idea of the Good as the ultimate source of all Becoming. The underlying dilemma in these problems, surfacing in different places and in different ways, for different reasons, has two main horns. Either God acts in a pre-existent space-time receptacle to create the universe, or God does not act in a pre-existent space-time receptacle to create the universe, but creates physical space and time in creating the physical universe. The dilemma for any theocosmological metaphysics of physical space, including Newton's, has this structure:

Dilemma Horn 1. If God created the physical universe in a pre-existent space-time receptacle, then God did not create all of space and time. In particular, God did not create the space-time receptacle, which Newton and others in the Platonic and Neoplatonic traditions takes conceptually and metaphysically for granted, and on which Newton builds without hesitation. If the concept of a totally empty Platonic space-time receptacle is unthinkable, then space and time must be created along with the rest of the physical universe in its entirety. If so, then God is not really the Creator, because physical space and time already existed before God or Newton's Agent acts. This contradicts Newton's belief that the physical universe is created in its entirety by the intelligent Agent.

Dilemma Horn 2. If God did not create the universe in a pre-existent space-time receptacle, then God must have created the space-time receptacle logically prior to the creation of any physical universe. Yet that alternative implies that there was not any space where or any time when such a space-time receptacle could possibly be made to exist.

Here, the space-time receptacle is understood as some kind of physical entity to be created and then stocked with physical objects, like the wooden toys kept in a wooden toy-box. If the physical universe were created in or along with the creation of a plan of physical objects generally distributed and moving in space over moments of time, then the receptacle has to exist somewhere and at some span of time, just like any other natural law-abiding physical object. The space-time receptacle cannot itself be a created physical entity, if space and time cannot themselves be created in space and time, as seems manifestly absurd.

Thus, we are promptly driven back to Dilemma Horn 1, denying that space and time or the Platonic space-time receptacle are created by God in creating the physical universe. As Plato and the abstract and personal-religious Neoplatonists would have it, the space-time receptacle is *presupposed* by Newton's intelligent Agent, or Plato's *demiurgos*, who, somewhat less brawny than the conventional monotheistic God, is capable of acting only *within* the pre-given spatiotemporal dimensions of a field of action and making use of pre-existent abstract ideal Forms.

The space of physical movement is peppered with possibly divinely created or crafted physical objects and otherwise reassembled available material substances set in motion by divine command to interact throughout the universe under the causal necessity of the same handful of natural laws idealizing the movements of all physical objects in all physical space and time. If so, Newton's intelligent Agent acts *within* a pre-given space and time, the space-time receptacle, and does not create all of physical reality. No Agent could possibly *create* physical space, if to create or craft something can only happen *in* physical space and time. These admissions seem rational on both sides but have the far-reaching implication that God or Newton's intelligent Agent did not create the field of action within which the physical universe is created.

If God created the universe but not the space-time receptacle, then Newton must acknowledge the implication that God, for all God's omnipotence, did not create all of the physical universe. If so, the existence and state of the universe might as well be attributed to the Neoplatonic abstract Platonic Idea of the Good or even to blind chance, rather than to the calculated choice of an intelligent, powerful Agent. If God furnishes, places, and motivates physical objects to have their ordered regularities within space and time, but did not create the space-time receptacle itself, then the existence of space and time is altogether independent of the existence of physical objects in space and time and altogether independent of God's creation of the contents of physical space. The toy-maker made the toys, but not the toy-box to contain the toys. The space-time receptacle would continue to exist even if all physical objects in space and time were annihilated and even were no creative act of God's divine will exercised to bring the physical universe into existence and set its objects in motion.

If a direct connection between More and Newton on the divinization of space could be documented, then despite their fundamentally opposed methodologies (empiricist versus rationalist), it would lend strength to the interpretation of Newton as having considered a metaphysics of physical space as God's emanation in a Neoplatonic sense, or some variant thereof. He might then have thought of space as an expansion of existence-dependencies flowing from God, in movement and natural law-governed causal interactions across infinitely extended phenomenal fields of action. More and Neoplatonism, classical and Cambridge, thought of all being, including physical objects in physical space and time, as flowing, pictorially speaking, like stew spilling from an upturned amphora into existence. Newton rejected this metaphysics of the relation between God and physical space and proposed a different explanation. If liquid flowing from a single Principle of Being does not appeal as perhaps too quaintly picturesque, then Neoplatonism invites us to think of the physical universe as in some sense issuing from a single source, perhaps the Big Bang, a wish of Brahma, or the creative act of the one God of many different monotheisms.

More and Newton fundamentally disagree about this vital proposition, although Newton's choice of language makes it appear as though he were agreeing with the Cambridge Neoplatonists that physical space emanates from God and is God's

sensorium. Alexandre Koyré argued that “not only philosophers shared, more or less, Henry More’s conception of space: it was shared by Newton, and this, because of the unrivaled influence of Newton on the whole subsequent development, is, indeed, of overwhelming importance.”¹⁶ Koyré adds that, “Newton, as far as I know, never quoted More; nor did he make an explicit reference to his teachings. Yet the relations between the theories of the two Cambridge men could not, of course, escape their contemporaries. It is therefore not surprising that, fifteen years after the publication of the *Mathematical Principles of Natural Philosophy* [Newton’s *Principia*], their connection was openly proclaimed by Joseph Raphson.”¹⁷ Koyré concludes that:

Newton...could have added that in the *Principia* he had already shown—without insisting upon it—that the inverse square law of attraction, the actual law of this world, was by no means the only possible—although the most convenient one—and that God, had He wanted to, could have adopted another. As he could have quoted his friend Robert Boyle who believed that God had actually tried out, in different worlds, different laws of motion; or Joseph Raphson who has just expressed the same opinion. Yet he did not. As he did not quote Henry More when he made infinite space the *sensorium* of the nevertheless transcendent God.¹⁸

The metaphysics of Newton’s physics is monotheistic, however untraditional in other regards. Insofar as Newton in *De Gravitatione* is understood as literally proposing that physical space is an emanation of God or God’s emanative effect, the concept of physical space is dependent on God or Newton’s intelligent Agent and therefore metaphysically related to the divine supernatural.

This concept needs to be understood against the prevailing historical philosophical framework of Platonic, Aristotelian, and Neoplatonic consideration of space as a receptacle in which spatiotemporal events take place, which, for the Neoplatonist, is poured forth from a single Principle of Being or Godhead. We can understand Newton’s hypothesis for the metaphysics of space as God’s emanative effect as concerning *none* of the events in space explained by the four categories of “causes” or explanatory factors (*aitiai*) (literally, “because” or distinct forms of explanation), which Aristotle named *formal*, *material*, *efficient*, and *final*.¹⁹ For instance, Aristotle explained the coming-to-be of a statue in terms of its *form* (the shape of the statue imposed on its material substance by the agency of the artist’s movements), *matter* (such as marble, wood, etc.), *efficient agent* (the artist), and *final cause* (the purpose for which the statue is made). Newton’s hypothesis of space as God’s emanative effect cannot be thinking of emanative effect as any of the four Aristotelian explanatory causes, all of which appear to relate spatiotemporal events or occurrences. If the four Aristotelian causes offer explanation types only within the spatiotemporal receptacle, then logically they cannot be expected to explain the existence of the spatiotemporal receptacle itself. How could space be an event *in* space? For Newton, space can neither be a cause nor effect in any of the four

Aristotelian senses but a metaphysical presupposition for any specific type of “causal” explanatory relation.

The nagging problem is to understand in what exact sense Newton means to speak of space as an *effect*, as God’s so-called *emanative effect*. What does this phrase mean? We are as yet no closer to a respectable answer to this difficult question. Earlier, we noted the passage from Newton’s *Opticks* that speaks of the universe as the *effect of choice* of an intelligent Agent, though without giving further insight into how that Agent could create an effect without a prior cause. We will examine the possibilities for understanding the concept of emanative effect on their own terms and in historical context in terms of the natural philosophy available to Newton, the background to whatever explanatory advances he may have sought.

Newton on God as Divine Intelligent Agent

Even apart from any philosophical assumptions, Newton was committed to the intelligence, will, and sufficiently powerful efficacy of an Agent responsible for the rational order in the universe. As he understands it, natural philosophy discovers the applied mathematical principles in laws of nature by which God has ordered the events of the physical universe into necessary-appearing causal regularities. The laws of physics determine how material particles move from place to place and causally interact with other moving material particles, in regular, empirically discoverable, mathematically expressible causal interrelations. That such elegant applied mathematical principles should be manifest in the physical world is proof enough for Newton that the universe is the rationally planned work of a divine intelligent Agent, whom he sometimes calls God.

Newton’s theistic metaphysics is the subterranean conceptual foundation of his applied mathematical physics or natural philosophy, as he makes clear in a later page of his wide-ranging discussion in *Opticks*, Book Three, Part I, Question 31. Newton summarily grounds the physical natural philosophical explanations in his System of the World on the assumption that all experienceable phenomena are the *effect of an agent’s choice*. On the courage of this conviction, upheld by belief in its certain truth, Newton politely invites philosophy not to distract itself further in the matter by entertaining alternative explanations. Newton steps lightly over this argument’s assumptions and conclusion as he unguardedly reveals the more esoteric theological elements of the metaphysics underlying his physics:

Now by the help of these [applied mathematical] Principles [of motion], all material Things seem to have been composed of the hard and solid Particles above-mention’d, variously associated in the first Creation by the Counsel of an intelligent Agent. For it became him who created them to set them in order. And if he did so, it’s unphilosophical to seek for any other Origin of the World, or to pretend that it might arise out of a Chaos by the mere Laws of Nature; though

being once form'd, it may continue by those Laws for many Ages... Such a wonderful Uniformity in the Planetary System must be allowed the Effect of Choice.²⁰

The severely limited human impression of uniformity (order) in the miniscule part of the one solar system we happen to inhabit Newton understands as evidence of the world's having been created by divine intelligent Agency. Newton discovers applied mathematical regularities in the world of physical phenomena. He infers from the laws of nature that such highly ordered relations can only reflect the rational plan of an infinitely wise and powerful intelligent Agent. Newton also deems the intelligent Agent morally good, for the interesting reason that there is at least some good in the world, which could not consistently be attributed to an evil or morally indifferent creative spirit. Like the deists, with their Masonic commitment to the existence of God as an intelligent Agent, great applied mathematician, architect, and builder of the physical universe, Newton stops short of attributing to God the property of being perfectly good, presumably in order to lubricate consistency with the manifest prevalence of suffering and natural evil in the world.

The philosophical worldview of Newton's time, in which he partly participates and from which he sometimes radically departs in exercising his independent, occasionally revolutionary, often unconventionally contrarian judgment, was deeply entrenched in a peculiar, interesting, reason-driven brand of Christian religious faith. Newton cannot imagine the existence, motion, and control of passive material entities constituting the physical universe, at any and every moment of its existence, without the active will of God. The carry-over from religion to his philosophical outlook interprets basic facts concerning the regularity of motion in space and time and the adaptation of organisms to environment as perceivable signs amounting to proof of the existence of an intelligent, morally good Agent, who has created the world with unsurpassable mathematical mastery and infinitely great and fine-grained rational planning. How else to explain these fortuitous improbabilities by which the universe is constituted? How else to understand the beauty of its applied mathematical principles that by so few laws of nature determine all physical occurrences in space and time?

So prevalent was the theistic perspective in early physics, still presenting itself as natural philosophy until the mid-nineteenth century, that most thinkers at the time, Newton included, did not hesitate to deduce the probable if not the logically or metaphysically necessary existence of an intelligent designer of the universe. The proof was meant to follow from the physical facts on which their natural philosophy is founded and which it is intended to explain. Newton's passion is in the discovery of mathematical laws of nature, which he claims as the limited reserve of natural philosophy. He is willing to speculate metaphysically about the existence, properties, and even origin of space, but not as a chapter of natural philosophy. Metaphysics, rather than physics, inquires into the existence and

origin of space and time as the given dimensions of physics, so that it seems only reasonable that there should be a sharp division between the two and that theorists should mind this distinction.

We are encouraged to think of Newton's understanding of the physical world as governed by what appear to be or are by definition causally necessary laws of nature and of God or the intelligent Agent with Effect of Choice as the divine, sufficiently powerful Natural Law-Maker. It is God who decides on Newton's laws of nature, on the principles governing all matter in motion that Newton cobbles together from his predecessors in physics or natural philosophy, to which he adds his signature law of universal gravitation. The force of gravitational attraction along with other physical forces knits all objects together from the macrophysical packages of material substance we find, make, use, and discard, extending to the universe we project as existing beyond the reach and resolution of our farthest orbiting telescopes.

Back on Earth, Newton continues immediately thereafter to extend the same general reasoning in support of divine Agency in the universe at large to the biological realm, which he catalogs:

And so must the Uniformity in the Bodies of Animals, they having generally a right and a left side shaped alike, and on either side of their Bodies two Legs behind, and either two Arms, or two Legs, or two Wings before upon their Shoulders, a Neck running down into a Back-bone, and a Head upon it; and in the Head two Ears, two Eyes, a Nose, a Mouth, and a Tongue, alike situated. Also the first Contrivance of those very artificial Parts of Animals, the Eyes, Ears, Brain, Muscles, Heart, Lungs, Midriff, Glands, Larynx, Hands, Wings, swimming Bladders, natural Spectacles, and other Organs of Sense and Motion; and the Instinct of Brutes and Insects, can be the effect of nothing else than the Wisdom and Skill of a powerful ever-living Agent, who being in all Places, is more able by his Will to move the Bodies within his boundless uniform Sensorium, and thereby to form and reform the Parts of the Universe, than we are by our Will to move the Parts of our own Bodies.²¹

Newton presciently discerns what Johann Wolfgang von Goethe (1749–1832) will later call the vertebrate *Urbauplan*, the original architectonic plan distinctive of that widely diversified type of animals to which we human beings also belong.²² Seen from a later nineteenth-century perspective in his native land, all the same evidence of physics and biology that Newton marshals in support of divine creationism later were understood without making God or divine Agency part of the account. In this later version, explanation should be satisfied with purely natural evolutionary histories, rather than by invoking supernatural factors.

Ironically, physics, as it was to unfold after the seventeenth century following Newton's death, even though still called natural philosophy, trended away from theological doctrine, unsupported by observation or experiment, while nevertheless assuming distinctive shape largely within a Newtonian framework of physical

laws. Anyone is free to speculate about the metaphysics of physics, after all, but we pay more attention to Newton's presumably authoritative opinion. His natural philosophy is thereby reinforced as distinct from his scientifically insupportable metaphysical speculations, separable from the applied mathematics of his natural philosophy.²³ Newton's science consistently provides physical principles governing at least the local causal workings of the macrophysical universe, divested of his theistic intelligent Agent metaphysics of the world's origins, motion, and maintenance. Compared to the Irish Enlightenment philosopher George Berkeley's (1685–1753) idealism, Newton's natural philosophy is fully detachable from his commitment to divine Agency as the final explanation of the existence and movement of physical objects in an intelligently created world.

Metaphysics of Divine Causation and Physical Dimensions

The fact that Newton in *Opticks*, Question 31, speaks of the Agent's "Effect of Choice" has general significance for efforts to understand Newton's creationist, theistic metaphysics of the physical universe. Referring to the existence and order in the universe as an *effect* of an Agent's choice makes it perfectly natural to suppose that God exercises a causal act of will, a decision as to what shall exist and how the resulting physical spatiotemporal world shall be ordered. The first instants of the world's existence must then be caused by the divine Agent's decision. Thereafter, the physical objects already in motion interact and play out their cause and effect roles as events within the universe progressing through time.

The Newtonian Agent's intelligent choice is modeled somewhat misleadingly as an event, which makes it further tempting to refer to God as *causing* the world to exist. If we think of *causation* as a transfer of energy *within* space and time, then this assumption will hardly serve. Causation thus understood is a process that takes place in time, which strongly suggests that time and space cannot themselves be caused to exist. We generally say that a cause must temporally precede its effect, cause and effect occupying distinct but connected moments of time, like the links in a sequence of *events*.

By an event, as Newton and his contemporaries would also have understood the concept under any terminology, is meant an intended object's having a property at a particular (span of) time. Importantly, Newton is not interested in his natural philosophy (as distinct from its metaphysics) in how energy is transferred from one object to another. He assumes instead the task of explaining how motion and causal interaction among projectiles are mathematically related, taking physical phenomena at face value and explaining their regularities by the laws of nature.

Newton's intelligent Agent chooses that there exist a universe, a particular distribution of matter in motion in pre-established pathways, governed by a particular set of laws of nature. If we refer to *event causation* as any exchange of energy over distinct moments of time, then there is a conceptual difficulty in imagining that God could have event-caused the existence or condition of the

universe. We may not suppose that God or Newton's intelligent Agent exists in time or that God's acts of will are events in the sense of occurring at moments of time. It is more plausible to argue that if God decides to create a universe of physical entities, then God effectively decides in so doing also to create space and time as the physical dimensions of physical entities.

It would further follow that the moment of God's decision is instantaneous with its realization. Logically, God cannot efficiently bring space and time into being with all physical objects in motion as an *event* preceding the origins of particles moving in space and time. For God, on the proposed explanation, to create the physical world is to create all at once all moving physical objects throughout space and time. There can be no lag-time between the intelligent Agent world-builder's moment of decision and the moment of action or realization of the object of choice, as would be needed even for ordinary human agency to produce anything as an effect of an act of will. If causation generally presupposes a temporal ordering of cause preceding effect, then we cannot literally, but at most only metaphorically, ascribe to God the property of having *event-caused* the universe to exist through a *prior* divine act of will. If God or Newton's intelligent Agent in any sense causes the universe to exist, then there must be another sense of cause and causation by which God exists outside of the physical world of space and time that he is presumed to create.

There are several important points to take away from this brief discussion of Newton's *Opticks*, Question 31. First, Newton has no hesitation, despite his disclaimer of "hypotheses," to advance a theistic explanation of the origins of the universe as some kind of *effect*. Second, as a natural philosopher, Newton perceives no conflict in combining an applied mathematical structure of causally necessary natural laws with beliefs about a divine supernatural Agent who creates the world with its natural law-governed order. Third, we learn something interesting about Newton's sense of the limits of meaningful or worthwhile philosophical inquiry, in relation to what he believes his own reason has adequately and incontrovertibly disclosed, in agreement with a popular understanding of what was in Newton's day a Neoplatonistic Christian metaphysics. Newton does not hesitate thereafter to declare the topic closed to further philosophical scrutiny, at least insofar as it is directed toward any other explanation of the origin and order of the universe than divine Agency. As a generally open-minded inquirer into the secrets of nature, this for Newton is an extraordinarily dogmatic stance. His remark suggests the extent to which he believes the question to be settled once and for all.

A more contemporary philosophical outlook, with which it may be instructive to compare Newton's, would be that even established truths can yield useful philosophical insights when subjected to criticism, so that proposing alternative explanations of the phenomena a theory addresses can only strengthen commitment to its validity. Attempting to close off further discussion of the origin of the universe makes it appear that Newton does not want the theistic foundations of his

physics exposed to any philosophical doubt or risk of discreditation. We are now prepared to begin the search for a methodologically more interesting interpretation, one that is more plausible and charitable about Newton's personal and philosophical motives.

Emanation as Effect Without Causation

Although Newton speaks of space as God's emanative *effect*, there are good reasons to doubt that his speculations amount to making God the *cause* of the existence of space, in what seems to be the generally accepted meaning of the word in Newton's era. We should be reluctant to consider Newton's references to emanative effect as belonging either to any of the four canonical Aristotelian causes or as implying a fifth cause to take its place alongside Aristotle's quartet. Newton inherited from Aristotle the common-sense view that physical objects in space and time are the primary existents, just as for Aristotle they are the primary substances (*prôtai ousiai*). Indeed, Aristotle's four causes assume a predetermined spatiotemporal receptacle. We think (and Newton himself is partly responsible for our conceiving of things this way) that causation is a relation holding conditionally between certain kinds of events. We can scarcely make sense of the existence of space as an event occurring *in* space and time. If Newton makes free with Aristotelian terminology to express his own unique concepts, why should he not also have reconceived the Neoplatonic vocabulary of divine emanation?

In *De Gravitatione*, Newton goes beyond the four traditional Aristotelian causes in explaining space as God's emanative effect in a *non-causal* or *extra-causal* sense, beyond event-causation. If so, then we should consider the following questions:

- (1) Are there any other kinds of *effects* with which Newton's concept of emanative effect might be compared, such as those postulated by Neoplatonism, that are also not the effect of a cause in a recognizable category of causal relation?
- (2) How can Newton's concept of space as God's emanative effect be more *positively* understood, beyond saying merely that it is *not* a matter of efficient causation?

Of these, question (2) is more pressing than (1), which asks whether Newton's concept uniquely belongs to this special kind of explanation. There is admittedly something strange in supposing that there could be an effect without a cause, like trying to speak of a child without a parent or a shadow without a light source. How, then, could Newton's proposal that space is the emanative *effect* of God not involve some type of causal relation?

We could simply write off Newton's unpublished reflections on the origins of space as internally inconsistent explorations. This may not be the most charitable option, but one in these circumstances we might logically feel compelled to make.

If Newton has set up a category of extra-causal explanation that has only one instance, then it could turn out that he has inadvertently involved his account in conceptual or terminological confusion. He cannot have it both ways, we might say: Either emanative effect is a *causal* relation or emanative effect is not appropriately designated an *effect*.²⁴

Other Types of Extra-Causal “Effects”

That said, it would obviously lend strength to the interpretation of Newton’s concept of emanative effect as extra-causal if we could point to other cases of extra-causal genuine effects. A good answer to question (2) is strengthened by supportive comparisons with other recognized kinds of effects, which it would be comforting to have available as answers to question (1).

We might consider as an uncaused effect such things as aspects of existent entities that are not themselves events. To begin with an extreme but relatively clear-cut and uncontroversial example, we can and in practice we sometimes do speak of the effects of abstract entities that cannot possibly be spatiotemporal events. For instance, we say that “one *effect* of π ’s being an irrational number is that there is no possibility of squaring a circle.” Admittedly, this sense of “effect” is akin to if not indistinguishable in meaning with that of “implication,” which is certainly extra-causal.

From this, we cannot conclude that effects in this more general sense are without explanation, only that as non-events they are specifically without Aristotelian *causal* explanation. We may suggest that God’s emanative effect holds out the possibility of an extra-causal explanation of the existence and nature of space.²⁵ Newton may be groping for a terminology by which to express a *supervenience relation*. To apply present-day philosophical terminology, God provides not the cause but constitutes the *supervenience base* for the existence of supervenient physical space, now understood as a *supervenient* effect of the existence of the supervenience base. Where events are related by supervenience, the supervenient event would not exist were it not for the existence of its supervenience base. A common illustration would be to describe the events of consciousness as supervenient on the events constituting a psychological subject’s neurophysiological states, considered as the relevant supervenience base. If the existence of physical space supervenes on the existence of an omnipresent God as supervenience base, then the two need not involve events separated in time, as in the relations prescribed by all four Aristotelian causes.²⁶ We support this suggestion by observing that it seems unobjectionable to speak of what supervenes on something else, as an *effect* of, although *not* even counterfactually *caused* by, the supervenience base. There are effects of causes and there are noncausal effects of supervenience base conditions and states. The supervenient state is always the effect, but not the causal effect, of the supervenience base on which it supervenes. In referring to physical space as God’s emanative effect, Newton might be

interpreted in contemporary philosophical terminology as proposing that God, known to exist on the evidence of the beautiful mathematical regularity in the physical universe, is the supervenience base from which supervenient physical space emanates distributively forth from God's physical omnipresence as Creator, and, we might add, implicitly the constant, omniscient Surveyor of the physical world.

One need not imagine that Newton would have recognized the contemporary concept of supervenience or its relevance to emanative effect, especially not using that exact terminology. To offer an analogy, using supervenience to explicate Newton's remarks about space as God's emanative (but non- or extra-causal) effect, implies that the existence of physical space is dependent on the existence of God. Without supposing any act of efficient causation, space accompanies the existence of an omnipresent God as the creator of the physical universe, on whom the existence of the physical universe ontically depends. Physical space is God's emanation, conditional upon his creating a physical universe freely and without logical necessity or compulsion. The emanation of physical space is then a manifestation of God, emanating from his omnipresent existence throughout the created physical universe, much as God's intelligence, power, and good will are entailed by his nature, character, essence, concept, or definition.

God's making physical space as an emanative effect is conditional on his decision to create a physical universe, whereas his other properties are not even divinely volitional. The metaphysical sense of supervenience, understood as one-way ontic dependence, has been adapted for philosophical purposes in roughly the last fifty years, the word having a more varied history in logic and epistemology. It is supervenience in the metaphysical sense of one-way ontic dependence exclusively that we hazard here as an explanation in contemporary terminology of the kind of metaphysical relation Newton may have had in mind between the existence of physical space depending on the existence of God, but not conversely.

This interpretation is supported by the consideration that Newton would likely accept the proposition that if God did not exist, then physical space would not exist, since he apparently believed that physical space is the emanative effect of God. If physical space is God's emanative effect, then there can hardly be physical space were there no God from whom physical space could emanate. Not, however, conversely. That is, we know also from Newton's works that he would be likely to reject the converse conditional that if physical space did not exist, then God would not exist. God's existence is unconditional, especially in Christian thought at the time, within the general orbit of which Newton was an intellectually eccentric participant. If the existence of the physical world and hence of physical space is the product of God's free choice, then the existence of physical space is conditional on the existence of God, whereas the existence of God is not conditional on the existence of physical space.

This must be so, moreover, for two connected reasons. First, as already observed, God by definition exists unconditionally. The more cautious of apologists for theistic metaphysics might hedge the ontic implications of such free conceptualization by qualifying theism as implying instead that our idea of God is such that if God exists, then God exists unconditionally. This of course does not imply that God's existence is conditional on our idea of God, but rather (what should be impossible to deny) that God's unconditional existence is conditional on God's existence. To maintain that if God exists, then God exists unconditionally does not conditionalize God's existence on anything other than itself, to which it then (assuming God exists) truly predicates the property of existing unconditionally. What is conditional is the truth of whether or not God exists, though God's existence, unlike the existence of absolutely everything else that exists, is not conditional on the existence of anything other than itself. It could scarcely have been otherwise for the seventeenth-century rationalist mind: If God's existence is conditional on anything other than God, then God's existence is conditional on the existence of something that God did not make. The concept of God that Newton appears to accept collides frontally with there being something that God did not create yet on which God's existence depends. Newton's God is an intelligent Agent, a divine applied mathematician, designer, architect, and builder of the entire physical universe. To argue on Newton's behalf, we can conclude that, beyond God's creation in space and time, there exists nothing other than God on which the existence of God could be conditional. Second, the one-way ontic dependence of the existence of physical space on the existence of God expresses Newton's likely acceptance also of the proposition that God, logically speaking, can freely choose not to make a physical universe. An unconditionally existent God would then exist, as a logical possibility, but physical space would not exist.

This is precisely the definition of a one-way supervenience relation, in which the existence of event *a* supervenes on the existence of supervenience base event *b* if and only if, if *b* exists, then *a* exists, but not conversely. There are directionally weaker converses and stronger equivalences, quantificationally weaker and stronger variants, and a spectrum of modally weaker to stronger concepts of supervenience, from possible to necessary in every distinct system of modal logic. The one-way directionality of the standard supervenience relation in the metaphysics of consciousness has exactly the same one-way conditional structure. There we also expect that conscious experiences one-way supervene on the supervenience base of neurophysiological events. To oversimplify, if my brain did not exist, then my consciousness would not exist, but not conversely. It does not follow that conscious awareness exists whenever an active brain exists, as we know even from personal experience and reports of intermittent lapses of consciousness in moments of deep sleep, coma, fainting, under general anesthetic, hypnosis, and so on. One-way supervenience is the default relation in the metaphysics of

consciousness, as it seems to be in Newton's implicit speculative metaphysics of physical space as God's emanative effect.

Infinitely Extended and Divisible Physical Space as God's Sensorium

Let us now turn to question (2), to explain in positive terms what Newton might plausibly mean in asserting that space is the emanative effect of God. It may be useful in this connection to highlight Newton's provocative claim in *Opticks* that infinite space is or is like God's perceptual field or sensorium.²⁷

There is a conceptual historical puzzle, investigated by Newton scholars, concerning Newton's remarks on this topic in different editions of the text. The first edition was published in English in 1704, after which Newton's associate Samuel Clarke began work on a Latin translation to reach a larger international scientific readership. In this 1706 edition, there are included the notorious *Questions 17–20*, concluding Book Three, Part I, and renumbered after the addition of further material in later editions beginning in 1718. Informed opinion seems to be that Newton himself wrote the questions in Latin, which Clarke dutifully added to the manuscript. Relying on George MacDonald Ross's translation of this original Latin version of 1706, we find Newton rhetorically asking: "Is not universal space the sensory of an incorporeal, living, and intelligent being, who discerns and comprehends innermost things themselves, and perceives them all from within and present in himself; whereas that in us which senses and thinks only looks at images of them in the brain?"²⁸

To this, Ross remarks: "The thesis is that real things are situated in God's sensory, in the same way as *images* of things are situated in our individual sensories. The heretical implication is that the whole universe is nothing other than a set of images in God's mind. I personally have no doubt that Newton meant what he said, but it is hardly surprising that he was worried about its appearing in print."²⁹ If Ross is right, then Newton in part anticipates Berkeley's idealist thesis that *Esse est percipi, aut posse percipere* (To be is to be perceived, or to be able to be perceived).³⁰ The gaffe was noted and corrected by Newton and Clarke, but not before several of the original printings of the edition were released. The corrected text in the later edition qualifies the description of infinite space as God's "sensory," his sensorium or visual and perceptual field. This choice makes it appear that Newton only wishes to characterize space in this way analogically or metaphorically, by adding the Latin word *tanquam*, meaning "as if" or "as it were." Thereafter, anyone consulting Newton's text in subsequent authorized editions will find him saying only that space is, as if, if you will, so to speak, or as it were, God's *sensorium* or visual field. In the fourth English edition of 1730, we read instead, in a more expansive treatment of the subject:

Is not the Sensory of Animals that place to which the sensitive Substance is present, and into which the sensible Species of Things are carried through the

Nerves and Brain, that there they may be perceived by their immediate presence to that Substance? And these things being rightly dispatch'd, does it not appear from Phænomena that there is a Being incorporeal, living, intelligent, omnipresent, who in infinite Space, as it were in his Sensory, sees the things themselves intimately, and thoroughly perceives them, and comprehends them wholly by their immediate presence to himself: Of which things the Images only carried through the Organs of Senses into our little Sensoriums, are there seen and beheld by that which in us perceives and thinks. And though every true Step made in this Philosophy brings us not immediately to the Knowledge of the first Cause, yet it brings us nearer to it, and on that account is to be highly valued.³¹

Whether Newton's pronouncement about space and God's perceptual field is intended literally or only analogically, perhaps even heuristically, it is clear that in none of Aristotle's classical four causes does a sighted subject *cause* a visual field to occur, either to exist or to have the particular nature it has. When I open my eyes on the world, I do not *cause* the field of vision in which certain visible things are revealed. Vision and perception more generally, as most seventeenth- and eighteenth-century philosophers understandably believed, is passive rather than active, applying another of Aristotle's important distinctions. The field of vision in particular, aside from its specific content at any given moment, is not something that a perceiver causes to exist. Where finite beings such as ourselves are concerned, in contrast with God's reputedly infinite mind, having a perceptual field is an event that occurs in space and time. Significantly, if physical space is God's perceptual field, then its existence or coming into existence cannot itself be a spatiotemporal event. A vicious circle, and perhaps an infinite regress in response, is launched, if physical space is needed in which God or the Neoplatonic Principle of Being is to create and install physical space.

There is a vital difference between our mortal perceptual fields and God's. For both, the field of vision is not caused or created by the viewing subject as perceiver. In the case of a finite human perceiver, we know phenomenologically from personal experience that the occurrence of our visual field is a spatiotemporal event for which there is a cause, even if it is not a cause within the subject's voluntary control. We can choose to experience our visual field by electing to open our eyes rather than keeping them tightly closed. That, however, is a different matter altogether from having a perceptual field to experience, a field independent of personal volition because the individual perceiving subject neither creates nor manages its content, over which the subject exercises only limited control. God's situation metaphysically and epistemically is importantly different. No prior event can cause God to have a visual field, because there are no spatiotemporal events existing independently of God, at least not on Newton's conception in the *Opticks*, if physical space is supposed to be identical with or even if at most only analogically or metaphorically like God's sensory field.

When More says that physical space along with the physical universe emanates from God as the Neoplatonic Principle of Being, he means something very different from Newton's proposition that physical space is God's emanative effect. Newton believes that God does not survey the physical universe from a special vantage point. Rather, God perceives the physical universe he has created because he is omnipresent, spread out pantheistically everywhere throughout the created physical universe, as in the Stoic theocosmology.³² God's eyes, even metaphorically speaking, being too specific and centralized, Newton might prefer a physiological analogy in which the universe in its entirety is more like God's body of sensitive nerve endings spread out over an infinite Euclidean extent, in every infinitely divisible Euclidean part communicating perceptions of the state of the world. As God, so to speak, opens divine eyes on the physical universe to gaze upon the world in space and time, space and time emanate forth from God as a condition, but not as a single gushing or gurgling Neoplatonic font of existence. Newton's conception is metaphysically more sophisticated than the Neoplatonists, making every part of the physical universe God's sensorium by virtue of God's infinite omnipresence, rather than from a centralized perceiving situation. This consideration makes it less surprising that Newton does not credit the Cambridge Neoplatonist More, whose ideas Newton fundamentally rejects, with also having thought of physical space as a divine emanation in a different sense, from a unified Principle of Being, and of physical space as God's sensorium, again in a centralized sense that analogizes the Godhead to the organs of sensation in a human head.

We must ask once again, what is *meant* in Newton's *De Gravitatione* by "emanation" and by space as God's emanative effect. We have already remarked that Newton might be interpreted as searching for the concept of supervenience in understanding the relation between God's existence and the existence of physical space. One possibility is that for Newton God's existence is essentially inseparable from the existence of infinite space, just as a finite human visual subject is essentially inseparable from having a perceptual field. Only the sighted have a visual field, but it is conceptually indispensable for a sighted finite visual subject to have a visual field, without which the subject would not be sighted. If so, God's nature is similarly logically inseparable from the existence of infinite rectilinear three-dimensional Euclidean space. God's visual field is the domain of all occurrences to which our most powerful mathematical natural science applies, the receptacle in which physical events occur with law-governed regularity in Newton's System of the World.

Now recall Newton's second quotation from *De Gravitatione* cited above: "[H]ence it follows that space is an emanative effect of the first existing being, *for if any being whatsoever is posited, space is posited*" [emphasis added].³³ More tellingly, perhaps, reflect also on what Newton says in the material following the

third passage previously quoted from *De Gravitatione*: “If ever space had not existed, God at that time would have been nowhere; and hence he either created space later (where he was not present himself), or else, which is no less repugnant to reason, he created his own ubiquity.”³⁴ The existence of space literally emanates from God’s nature, Newton concludes, in the sense that the existence of infinite space is already included in and hence conceptually implied by the fact of God’s existence, just as the contingent existence of a visual field is already conceptually implied by the existence of a finite sighted visual subject. Because God thinks as God does, there is space, fulfilling a vital requirement for the realization of God’s will in creating a physical universe.

On critical reflection, we cannot consider God’s emanative effect as something God *does* in order to create infinite space. True enough, if we choose, we can extend the technical use of the words “cause” and “causation” to comprehend also Newton’s concept of space as God’s emanative effect, and we cannot exclude this possibility as part of Newton’s original intent. It is then to be thought of analogously as an effect of God’s existence, something that follows from God’s creation and knowledge of the physical world just as the existence of a sensorium follows as an effect of the existence of a perceiving subject.

Newton’s thesis of space as God’s emanative effect need not be understood as implying that there exists in any sense a *causal* relation between God and space, or between God and the existence or nature of space. We are presented with the basis for a plausible extra-causal extra-Aristotelian explanation of space on Newton’s conception, provided we are open to acknowledging the existence of infinitely extended and divisible Euclidean space as a part or aspect of God’s existence. Physical space as God’s sensorium is logically inalienable from God’s existence and nature. If space, in that limited extra-causal extra-Aristotelian sense, is explained as emanating from God and from the fact of God’s existence, by analogy with the sensorium or visual field of the sighted, then a physical world-transcending supernatural God is essential to and ineliminable from Newton’s metaphysics of the natural phenomenal world and hence also essential to and ineliminable from the metaphysics of Newton’s mathematical physics.

Divine Emanation of Space as Universal Distributed Supervenience on a Physically Omnipresent God

The assumption that for Newton space is not something that could be efficiently caused and is not quite a Neoplatonic emanation from a Principle of Being, the Good, or the Godhead, leaves unanswered questions about the sense in which space is nevertheless supposed to be an (emanative) *effect* of God. This essay makes glacial progress toward understanding Newton’s hypothesis of physical space as God’s emanative effect, which departs eccentrically from both classical Neoplatonism and the Cambridge Neoplatonism of Newton’s day, flagshipged by More. We may need finally to invoke the contemporary concept of the existence of

a supervenient, but not causal, effect of the existence of a supervenience base. Newton himself has no better alternative at his fingertips than to twist Cambridge Neoplatonic terminology to his very different ends in venturing metaphysical speculations about the nature and origin of physical space.

The applied mathematical principles Newton discovers in nature are supposed to be chosen by God. In Newton's mind, they testify to God's wisdom and benevolence, to the existence, as the Stoics also maintained, of an end or *telos* of the physical order. The destination may be impenetrable to human knowledge, but belongs to the same general type exemplified also in rational human decision-making and action. Newton does not want to be a metaphysician, but is naturally drawn to the same kinds of questions that will later inspire Immanuel Kant to take Newton's natural philosophy as the philosophical starting place for metaphysics under a cautious epistemology in support of a purely secular transcendental metaphysics of space and time. More skeptical today about the existence of God, and less inclined, perhaps, following Kant, to make the faith-based belief in the existence or properties of God any part of philosophical explanation, we may return to Newton's gestures toward what I have called the supervenience of the existence of physical space on the existence of God. To say that space emanates from God or is God's emanative effect, in Newton's preferred form of expression, is then to say in more contemporary terms that the existence of physical space supervenes and is ontically dependent on, but still is not caused by, the existence of God.

Newton's main interests and talents, the questions he asks, and his express intellectual inclinations are those of a natural philosopher, a physicist and applied mathematician, with a side interest in philosophy outside the bounds of natural philosophy. In contrast, Aristotle and Plotinus are primarily philosophers with very different metaphilosophical perspectives on natural philosophy. Newton turns to God as soon as things get sticky for his metaphysics. Such a point is reached almost immediately in trying to explain the nature and origin of space and time. For Newton, assuming the space-time receptacle as given is good enough as a starting-place for physics, but not sufficient for metaphysics, in explaining why there is infinitely extensive and infinitely divisible Euclidean space and why the universe obeys the laws of nature. Newton reasons that there must be a highly mathematically proficient intelligence and sufficiently powerful Agent of will, who has determined the applied mathematical laws of physics by which physical events throughout the universe are ruled. What remains to be explained is only how the Agent's existence is related to that of physical space.

Rather than Neoplatonism's centralized Principle of Being, Newton held that the physical universe is permeated by a physically omnipresent God. God's omnipresence constitutes a distributed rather than centralized supervenience base for the existence of physical space, which Newton expressed in quasi-Neoplatonic language as God's emanative effect. Perhaps Newton could not think of a better word. Perhaps he did not want Neoplatonists to own this concept, but deliberately

infused it with a different meaning and non-Neoplatonic application. Perhaps Newton's point was to refurbish the concept in Stoic rather than Neoplatonic terms as the only defensible interpretation of the origins of physical space.³⁵ Though transcending space and time, God can only have created the world by efficaciously perceiving it. If so, physical space is God's sensorium in the sense of a distributed nerve network suffusing the body of the universe.

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References

- ¹ Isaac Newton, *The Method of Fluxions and Infinite Series*, ed. trans. John Colson (London: J. Nourse, 1736); Charles Hayes, *A Treatise of Fluxions* (London: Midwinter, 1704); Colin Maclaurin, *A Treatise of Fluxions, in Two Books, Philosophical Transactions of the Royal Society*, **42** (1744), 325–363 (Book I); 403–415 (Book II). Useful overviews include Florian Cajori, *A History of the Conceptions of Limits and Fluxions in Great Britain from Newton to Woodhouse* (Chicago: Open Court, 1919); Carl B. Boyer, *The History of the Calculus and its Conceptual Development* (New York: Dover, 1954).
- ² Newton, General Scholium, *Principia Mathematica Philosophiæ Naturalis*, trans. I. Bernard Cohen and Anne Whitman (Berkeley: University of California Press, 1999), 943.
- ³ Plato, *Timaeus* 28–29a.
- ⁴ My trusted sources include R. T. Wallis, *Neoplatonism*, 2nd ed. (Indianapolis: Hackett Publishing Co., Inc., 1995); Paulina Remes, *Neoplatonism* (Berkeley: University of California Press, 2008); Svetla Slaveva Griffin and Paulina Remes, eds., *The Routledge Handbook of Neoplatonism* (London: Routledge, 2014); Arthur O. Lovejoy, *The Great Chain of Being: A Study in the History of an Idea* (New York: Harper & Row, Publishers, 1960).
- ⁵ Alexandre Koyré, *From the Closed World to the Infinite Universe* (Baltimore: The Johns Hopkins Press, 1957), 126–160.
- ⁶ See Jasper William Reid, "The Evolution of Henry More's Theory of Divine Absolute Space," *Journal of the History of Philosophy* **45** (2007), 79–102.
- ⁷ Likewise, Spinoza talking about substance does not make him an Aristotelian. J. E. Power, "Henry More and Isaac Newton on Absolute Space," *Journal of the History of Ideas* **31** (1970), 289–296.
- ⁸ Newton may have been weakened but did not die from his alchemical experiments, but from a kidney stone. L. W. Johnson and M. L. Wolbarsht, "Mercury Poisoning: A Probable Cause of Isaac Newton's Physical and Mental Ills," *Notes and Records of the Royal Society of London* **34** (1979), 1–9. The aftermath following Newton's death is examined in detail by Richard S. Westfall, *Never at Rest: A Biography of Isaac Newton* (Cambridge: Cambridge University Press, 1980), 815–874.

⁹ Among many other valuable sources on this topic, and in addition to the period philosophers mentioned, see Kasper von Geyertz, *Religion and Culture in Early Modern Europe, 1500–1800* (Oxford: Oxford University Press, 2007).

¹⁰ Also, why is everything in motion? Why, for that matter, is *anything* in motion, moving from one place to another? Neoplatonism has the interesting option of answering that it is the nature of the Good or the choice of God as Godhead or unified Principle of Being to create the physical universe by having all Being emanate forth from its single centralized ontic font, in which everything is in motion by virtue of being an emanative effect. Newton rejects this explanatory model, while retaining some of the unique Neoplatonic framework of concepts and terminology, as he also does in redefining the metaphysics of physical space as God's sensorium.

¹¹ Isaac Newton, *De Gravitatione et æquipondio fluridorum*, in Newton, *Philosophical Writings*, ed. Andrew Janiak, trans. A. R. Hall and Marie Boas Hall (Cambridge: Cambridge University Press, 2004), 21.

¹² *Ibid.*, 25.

¹³ *Ibid.*, 26. On Newton's metaphysics and reluctance to use the word "metaphysics," see Howard Stein, "Newton's Metaphysics," in I. B. Cohen and G. E. Smith, eds., *The Cambridge Companion to Newton*, (Cambridge: Cambridge University Press, 2002), 256–307; Dale Jacquette, "Aesthetics and Natural Law in Newton's Methodology," *Journal of the History of Ideas* **51** (1990), 659–666.

¹⁴ See John Tull Baker, "Space, Time, and God," *The Philosophical Review* **41** (1932), 577–593; Koyré, *From the Closed World to the Infinite Universe* (ref. 6), 125–272; especially his discussion of Henry More, Nicolas Malebranche, Joseph Raphson, George Berkeley and Newton. Robert Rynasiewicz, "By Their Properties, Causes and Effects: Newton's Scholium on Time, Space, Place, and Motion — i. The Text," *Studies in History and Philosophy of Science A* **26** (1995), 133–153; Rynasiewicz, "By Their Properties, Causes and Effects: Newton's Scholium on Time, Space, Place, and Motion — ii. The Context," *Studies in History and Philosophy of Science B* **26** (1995), 295–322; Robert DiSalle, "Newton's Philosophical Analysis of Space and Time," in *Cambridge Companion to Newton* (ref. 15), 33–56; Andreas Blank, "Existential Dependence and the Question of Emanative Causation in Protestant Metaphysics," *Intellectual History Review* **19** (2009), 1–13; Eric Schliesser, "Newtonian Emanation, Spinozism, Measurement and the Baconian Origins of the Laws of Nature," *Foundations of Science* **18** (2013), 449–466.

¹⁵ Henry More, *An Antidote Against Atheism*, 2nd ed. (London: J. Flesher, 1655); More, *The Immortality of the Soul* (London: J. Flesher, 1659); More, *Enchiridion Metaphysicum* (London: E. Flesher, 1671). Only More's *Enchiridion* would have appeared after Newton wrote *De Gravitatione* and certainly all of these books in More's large repertoire would have been circulating before Newton wrote answers to the *Queries* in later editions of the *Opticks*.

¹⁶ Koyré, *From the Closed World to the Infinite Universe* (ref. 5) 159.

¹⁷ *Ibid.*, 190.

¹⁸ *Ibid.*, 220. See also J. E. McGuire, "Newton on Place, Time, and God: An Unpublished Source," *British Journal for the History of Science* **11** (1978), 114–129.

¹⁹ Aristotle, *Physics* 194b16–195a27; *Metaphysics* 1013a24–1014a16, and *De Partibus Animalium* 639b12–15.

²⁰ Newton, *Opticks* (New York: Dover, 1952), 402.

²¹ *Ibid.*, 402–403.

²² Johann Wolfgang von Goethe, *The Metamorphosis of Plants* (Cambridge, MA: MIT Press, 2009).

²³ Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).

²⁴ See Geoffrey Gorham, "God and the Natural World in the Seventeenth Century: Space, Time, and Causality," *Philosophy Compass* 4 (2009), 859–872; Gorham, "Newton on God's Relation to Space and Time: The Cartesian Framework," *Archiv für Geschichte der Philosophie* 93 (2011), 281–320; J. E. McGuire, "Predicates of Pure Existence: Newton on God's Space and Time," in *Philosophical Perspectives on Newtonian Science*, ed. Phillip Bricker and R. I. G. Hughes (Cambridge: Cambridge University Press, 1990), 91–108; Edward Slowik, "Newton's Metaphysics of Space: A 'Tertium Quid' betwixt Substantivalism and Relationism, or Merely a 'God of the (Rational Mechanical) Gaps'?" *Perspectives on Science* 17 (2009), 429–456.

²⁵ *Ibid.*, 404–405.

²⁶ On the concept of supervenience, with applications especially in the philosophy of mind, see Jaegwon Kim, *Supervenience and Mind: Selected Philosophical Essays* (Cambridge: Cambridge University Press, 1993), who distinguishes between *weak* and *strong* supervenience (53–78); see also Elias E. Savellos and Umit D. Yalcin, eds., *Supervenience: New Essays* (Cambridge: Cambridge University Press, 1995).

²⁷ *Ibid.*, 403. See Ayyal Lesham, *Newton on Mathematics and Spiritual Purity* (Berlin: Springer Verlag, 2003), 78–80.

²⁸ Samuel Clarke's Latin translation of the original English edition of Newton's (1704) *Opticks* was published as *Optice: Sive de reflexionibus, refractionibus, inflexionibus & coloribus lucis* (London: William and John Innys, 1706). I was originally drawn to this source by an on-line translation and commentary of the Clark edition by George MacDonald Ross, on a website that seems to have been deactivated. I hope to avoid both offending Ross and violating copyright or other intellectual property right in quoting from this part of his once public domain translation.

²⁹ *Ibid.*

³⁰ I. C. Tipton, *Berkeley: The Philosophy of Immaterialism* (London: Taylor & Francis, 1974), 117, discusses some of the difficulties of attribution of the famous formula to any of Berkeley's writings. Nicholas Malebranche should also be mentioned in this connection, despite essential differences from Berkeley.

³¹ Newton, *Opticks* (ref. 20), 370.

³² See Jacquette, "Zeno of Citium on the Divinity of the Cosmos," *Studies in Religion/Sciences Religieuses* 24 (1995), 415–431.

³³ Newton, *De Gravitatione* (ref. 11), 26.

³⁴ *Ibid.*

³⁵ This pantheistic view goes back to the Stoics, beginning with Zeno of Citium, later maintained by Spinoza and in an idealist variant Nicolas Malebranche; see Jacquette, "Zeno" (ref. 32).

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