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Point Atomism, Space and God, 1760–80

~ KARIS MULLER ~

ABSTRACT *This paper compares and contrasts the main metaphysical and religious ideas of the eighteenth-century political theorist and chemist Joseph Priestley (1733–1804) with those of his correspondent Ruder Bosovic (1711–1787), astronomer, poet, mathematician, diplomat and Jesuit priest. It points out the theological differences between the two thinkers resulting from the divergent ontological and metaphysical implications of the theory of point atomism that they shared. This theory they placed in a wider context, considering both its limits and its value as a contribution to ongoing speculations concerning the nature of space and time, theological conundrums such as free will and the mind-body problem. Where they differed, however, was that Priestley, a chemist rather than a mathematician, used point atomism mainly to support his campaign to further materialism and discredit Christianity. Bosovic, on the other hand, carefully distinguished the truths of faith and reason and was therefore indignant at Priestley's misuse of his speculations. Bosovic's protest was probably motivated in part by the materialism of atheists such as the Baron d'Holbach (1723–1789). Priestley was no atheist, however. Interestingly, François Arouet de Voltaire (1698–1778), unaware of the works of either Bosovic or Priestley, devised a theistic materialism in his last years that in many respects resembled Priestley's. I begin with brief biographies of the two thinkers, and outline their intermittent relationship.*

DIVERGENT BELIEFS END A FRIENDSHIP

Ruder Bosovic left his birthplace, the Republic of Dalmatia (Croatia today) at fifteen, later studying, teaching or working as a diplomat in Paris, Vienna, Rome and Milan. As a result he was able to study the rival scientific theories of Descartes and Newton in Rome, some two decades before these were introduced into Dalmatia. An enthusiastic, if generally cautious exponent of the new ideas, he gained a reputation as a leading Jesuit thinker. He therefore retained the support of the Vatican, despite attempts of conservative Jesuit colleagues in Rome to discredit him owing to his radical teachings concerning the nature of matter and heliocentrism, for example. These teachings were being gradually accepted into the curricula of Jesuit and other colleges in the Austrian Empire, years before the religious orders in Rome followed suit. Bosovic was apparently instrumental in persuading Pope Benedict XV to lift the ban on heliocentrism in 1757. He was to remain a priest after the Jesuit order was dissolved in 1773.¹

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Whereas Boscovic confined his innovative ideas to physics and was therefore able to overcome the hostility of his conservative co-religionists, Priestley left the country of his birth, England, in 1794 because of his dissident religious beliefs, which he considered alone faithful to the stance of the early Church. The details of his religious beliefs do not concern me here, however, but rather the manner in which he made use of a scientific theory that he found both plausible and fruitful in support of those beliefs.²

The two men became acquainted with one another's work indirectly sometime during 1760–61, when during a stay of several months in England, Boscovic met Priestley's friend, the astronomer, geologist, atomist and Anglican priest the Rev. John Michell (1724–1793) at Cambridge University. Michell was at the time devising his own version of point atomism independently of that of the learned Jesuit,³ and later informed Priestley of Boscovic's mathematically based *Theoria*. Priestley, already impressed as he was by Michell's atomism, was pleased to find this confirmed and elaborated by a respected continental thinker. Priestley's *History and Present State of Discoveries Relating to Vision, Light and Colours* (1772) includes a short and generally positive account of Boscovic's theory. Two years later, Priestley was able to discuss the *Theoria* with its author in person when they met in Paris, thanks to an introductory letter from Michell. Thereafter the two occasionally corresponded. Priestley's *Disquisitions Relating to Matter and Spirit* (1777) cited both Michell and Boscovic as an authority on the subject of matter's non-solidity: "We see in the case of Father Boscovich, and Mr Michell that the very idea of the proper impenetrability of matter may be disputed."⁴

When Priestley met Boscovic in Paris a few years before the publication of his "Disquisitions," he expressed admiration for the *Theoria*. Boscovic had already begun a stay of several years as a royal protégé. During Priestley's second visit to Paris their paths did not cross, although both met leading sceptics and materialists. In 1778, a year after the *Disquisitions* appeared, an unnamed member of the French Academy of Sciences informed Boscovic (by then a French citizen) of the use the English materialist had made of his matter theory. Boscovic wrote indignantly to Priestley's aristocratic patron, Lord Shelbourne, pointing out that as he was a convinced dualist, Priestley's misuse of his work was detestable and a personal insult. Priestley, informed of the complaint, protested to Boscovic that he was in no way accusing him of unorthodoxy:

I have not made you an accomplice with me in it: for that I have only adopted your theory of the nature of matter, without supposing that you had the most distant idea of the use that I have made of it.

Priestley declared that he had read the work carefully. If that is so, his claim that the point atomism of the Dalmatian Jesuit undermined Christian metaphysics was a deliberate distortion.⁵ Boscovic, reputedly a man quick to take offence, was not mollified. He was so concerned at the risk Priestley's allegations posed to his reputation that he ended their relationship.⁶

Although Priestley's approach was entirely foreign to the Jesuit's aims and methods, his contentious, materialist interpretation of point atomism did not destroy interest in the theory itself. On the contrary, by the late 1770s Boscovic's explanations were being enthusiastically expounded not only by Michell but also by leading Scottish academics and geologists such as Robinson and Hutton.⁷

What use did Priestley make of point atomism, a theory Boscovic regarded as uniquely his? To answer these questions I now compare how the two scientists-philosophers dealt with the consequences as they saw it of point atomism.

BOSCOVIC'S *THEORIA*: SPACE, MATTER AND GOD

The complex question of absolute versus relative space had been famously debated in an exchange of letters between Gottfried Wilhelm Leibniz (1646–1716) and Samuel Clarke (1675–1729).⁸ This occupied many leading thinkers of the time, among them Immanuel Kant (1724–1804), who had a keen interest in the competing ontologies of the time. Kant developed an ontology based on Leibnizian principles similar to that of Boscovic, though lacking the latter's extensive mathematical demonstrations. His *Monadologia Physica* (1756) came to a conclusion very similar to that of Boscovic, whose *Theoria* came out two years later, namely, that matter was made up of dynamic monads lacking extension.⁹ Kant later wrote an essay on space (*Gegenden im Raume*) in 1768.¹⁰ Among British philosophers, Locke, Hume and Hobbes were also interested in the problem of space or the vacuum.¹¹ This question of the nature of space (or space-time) is as problematical today as it was in the eighteenth century. "Absolute versus Relational Spacetime: For Better or Worse, the Debate Goes On."¹²

Where was God to be found? The Newtonian view of space as unbounded and infinite implied to its critics either that there was a second eternal and infinite being alongside God, or that space was God, which was a form of pantheism. Newton had suggested that the divine presence was 'in' space, 'of' it, or external to it, never deciding for one or the other hypothesis. Equally problematical was the question concerning the nature and operation of gravity. Those who adopted Newton's principles generally interpreted gravity as either a mysterious force acting at a distance, or as a quality inherent in matter. Leibniz instead argued that gravity was a force, which was itself matter.

Boscovic had received a thorough training in the philosophies of Descartes, Newton and Leibniz and was an accomplished mathematician and astronomer. His prime objective was to account mathematically for the behaviour of bodies. He took for granted that order proved the existence of an external, intelligent and non-material Cause, until obliged to state his orthodoxy publicly owing to subsequent ill-informed or malicious accusations.

His best known work, the *Theoria philosophiae naturalis, reducta ad unicam legem virium in natura existentium* (1758, 1763) distinguished his ontological dualism from its Cartesian, Leibnizian and Newtonian equivalents.¹³ He supported his original synthesis of these three competing ontologies with complex mathematical calculations and diagrams. The *Theoria* adopted Newton's concept of universal gravity, which purported to show that Nature operated according to mathematically demonstrable laws. On the other hand he rejected the Newtonian universe, a finite mass of hard corpuscles having measurable dimensions and subject to several types of force. He also disagreed with Newton's contention that the material universe operated in absolute space, a space that, Newton speculated, might possibly be a divine property, although God, the sole eternal, necessary and infinite being, could not Himself be said to be 'in' space (*Principia*, *Scholium*

generale, 1687). Instead, Boscovic explained that a unified force law operated as mass points (*puncta*), from which radiated alternating, orderly sequences of attraction and repulsion, which fully occupied space. At the same time Boscovic was disinclined to conclude from his postulated oscillatory waves that these actually were what the *puncta* were made of—their essence—as opposed to simply a useful explanatory principle. The *puncta*, then, admirably explained phenomena better than did any competing ontology, but whether matter actually behaved according to the laws he describes themselves might well be forever hidden to human curiosity. The ultimate nature of the properties of matter such as inertia was, therefore, best left as a mystery known only to God:

Whether this (inertia) is dependent upon an arbitrary law of the Supreme Architect, or the nature of points itself, or on some attribute of them, whatever it may be, I do not seek to know; even if I did wish to do so, I see no hope of finding the answer.... I truly think that this also applies to the law of forces (art. 8, p. 39).

Boscovic was confident that his *puncta* hypothesis best explained the behaviour of bodies and was therefore useful and predictive, rather than merely a theoretical speculation equal to any other:

To me, matter is nothing but indivisible points, that are non-extended, endowed with a force of inertia, and also mutual forces represented by a simple continuous curve having those definite properties which I stated in Art. 117; these can also be defined by an algebraical equation. Whether this law of forces is an intrinsic property of indivisible points; whether it is something substantial or accidental superadded to them, like the substantial or accidental shapes of the Peripatetics; whether it is an arbitrary law of the Author of Nature, who directs those motions by a law made according to His Will; this I do not seek to find, nor indeed can it be found from the phenomena, which are the same in all these theories. The third is that of occasional causes, suited to the taste of followers of Descartes; the second will serve the Peripatetics, who can thus admit the existence of matter at any point; and then a substantial form producing a circumstance (*accidens*) which becomes a formal law of forces; so that, if they wish, having destroyed the substance, that the same circumstances shall remain in the individual, they can preserve that individual circumstance. Hence the sensibility will remain the same exactly, and such as will be different for a different combination of such circumstances pertaining to different points. The first theory seems to be that of most of the modern philosophers, who seem to admit impenetrability and active forces, such as the followers of Leibniz and Newton all admit, as the primary properties of matter founded on its very essence. This Theory of mine can indeed be used in all these kinds of philosophising, and can be adapted to the mode of thought peculiar to any one of them (art. 516, p. 365).¹⁴

Boscovic avoided the pantheistic connotations implicit in Newton's absolute space, thereby avoiding any suspicion that space might be an absolute and eternal attribute of God. All that could be stated with certainty was that God was present everywhere yet had no dimensions, rather like the *puncta*:

Further we believe that God Himself is present everywhere throughout the whole of the undoubtedly divisible space that all bodies occupy; and yet He is onefold in the highest degree and admits not of any composite nature whatever.... Further, we

are absolutely ignorant of the nature of the presence of God, and in no wise way do we say that He is really extended throughout divisible space (Supplements, p. 85).

Space was neither an absolute, eternal and infinite substance, nor an agent or spirit acting upon divine instructions.¹⁵ If, as he suggested, objects extended in space were to be explained as clusters of dimensionless points subject to oscillatory curves, this in no way implied that matter had become nothing, or was some sort of spiritual miasma. Absolute space was an imaginary, geometrical concept as Leibniz and Descartes had demonstrated, whereas space in the physical universe was relational, being but the spatio-temporal relations between puncta or centres of force. Like space, time also was in his view merely an expression of distances and successions between unextended collections of points held in dynamic tension, alternately attracting and repelling one another according to precise mathematical formulae (Supplement I, p. 393 and supplement II, p. 405).¹⁶

Disputants assume that their non-extended points are placed in contact with one another, so as to form a mathematical continuum; and this cannot happen, since things that are contiguous as well as non-extended must co-penetrate; but I assume non-extended points that are separated from one another. Nor indeed have the arguments, which some others use, any validity in opposition to my Theory; when they say that there is no such extension, since it is founded on non-extended points and empty space, which is absolute nothing. According to my Theory, it is founded, not on points simply, but on points having distance relations with one another; these relations, in my Theory, are not founded upon an empty intermediate space; for this space has no actual existence. It is only something that is possible, indefinitely imagined by us; that is to say, it is the possibility of real local modes of existence, pictured by us after we have mentally excluded every gap (art. 372, p. 273).

Boscovic explained that lack of solidity was not the same as nothing:

Now what kind of extension can that be which is formed out of non-extended points and imaginary space, i.e. out of pure nothing? How can Geometry be upheld if no thing is considered to be actually continuously extended? Will not groups of points, floating in an empty space of this sort be like a cloud, dissolving at a single breath, and absolutely without a consistent figure, or solidity, or resistance? These matters pertain to that kind of extension and cohesion, which I will discuss in the third part, where I apply my Theory to physics and deal fully with these very difficulties. Meanwhile I will here merely remark in anticipation that I derive cohesion from those limit-points, in which the curve of forces cuts the axis, in such a way that a transition is made from repulsion at smaller distances to attraction at greater distances. For if two points are at the distance that corresponds to that of any of the limit-points of this kind, and the forces that arise when the distances are changed are great enough (the curve cutting the axis almost at right angles and passing to a considerable distance from it), then the points will maintain this distance apart with a very great force; so that when they are insensibly compressed they will resist further compression, and when pulled apart they resist further separation. In this way also, if a large number of points cohere together, they will in every case maintain their several positions, and thus form a mass that is most tenacious as regards its form; and this mass will exhibit exactly the same phenomena as little solid masses, as commonly understood, exhibit (art. 165, p. 131).

Boscovic briefly considered Newtonian speculation concerning a hypothetical invisible ether filling space, but dismissed it as redundant:

A somewhat greater difficulty arises from the huge distance to which this kind of force extends. But even this can take place through some intermediate kind of exhalation, which owing to its extreme tenuity has hitherto escaped the notice of observers, and such as by means of intermediate forces of its own connects also remote matter; if perchance this phenomenon cannot be derived from merely a different combination of points having forces represented by that same curve of mine (art. 515, p. 365).

Elsewhere he elaborated that:

Newton derived an explanation of the matter from an attraction of a different kind to gravitation; although he indeed seems to seek to obtain this attraction from some compressing fluid of very small density. In fact, he seeks to obtain it, at the end of his *Optics*, from a 'spirit' permeating the inmost substances of bodies; but I never was able to grasp clearly what he intended by the term 'spirit'; and even he confessed that the mode of action was unknown to him (art. 409, pp. 293, 295).

MIND, BODY AND PUNCTA

Boscovic, like most other natural philosophers of his time and since, applied his new physics also to the mind-body problem. This topic, like that of time, space and (for theists) their relation to God, is as central today to philosophical discussion as it was then.¹⁷ For his part Boscovic declared that spirit or mind belonged to another reality not open to scientific investigation:

We are quite unable to ascertain with any certainty from phenomena alone the position of the seat of the mind. That is to say, we cannot ascertain whether it is present in any definite number of points.... It cannot be ascertained whether it has compenetration with some one point of matter...so that either this point acts on certain other points.... It cannot be ascertained whether it exists in a single point of space, which is unoccupied by any point of matter (Appendix, art. 534, p. 377).

Although he regarded the nature and location of mind as mysteries not susceptible of scientific investigation, in both the *Theoria* itself and in its *Appendix Relating to Metaphysics, the Mind and God*, Boscovic tackled the problem of mind-body communication to forestall possible allegations that his new physics undermined Christian beliefs. Just as force bore no relation to spirit, so for Boscovic, the distance between Spirit-God and the physical world was absolute:

It is clear how great a distinction there is between the body and the mind, and between things that we term corporeal matter and those which we feel in our spiritual substance (Appendix, art. 526, p. 373).

Boscovic carefully explained also that God-spirit was distinct from mind-spirit as the former was ontologically prior; God had created the latter within time. Just as matter (redefined as force or non-solid intensity-points) was created, so too were human spirits, which though immortal were nonetheless created. Our minds belonged to a

superior order, were immeasurable and unpredictable, and thereby manifested their non-material nature and their affinity with the perfectly free Supreme Spirit that made them. Puncta were created by God too, of course, but these differed from mind because the behaviour of puncta was subject to scientific demonstration and prediction, whereas spirit was free. Furthermore, force did not imply consciousness:

These points of mine are material points, and masses of them compose bodies that are different from spirits. Now if it were possible that there should be some kind of substance, which has both active forces of this kind together with a force of inertia and also at the same time is able to think and will; then indeed it will neither be body nor spirit, but some third thing (art. 155, p. 125).

Having established his orthodoxy, Boscovic conceded that mind and body clearly did interact. Yet point atomism provided no insight into their manner of interaction. In the hypothesis that mind was associated with the brain, was it united with only one punctum? Although puncta do not themselves occupy space, Boscovic wonders whether a spirit-punctum might occupy one infinitesimal area of space, or might it be present in various relational spaces interspersed between material points? Again, since the brain is a physical organ, could it be the source of only sensations and emotions, whereas thought and will were altogether different so neither in the brain or in the body in general? Perhaps, then, the soul or mind might dwell within its own punctum located somewhere in our bodies, possibly in the brain:

I do not think that it can ever be proved that the rational soul does not exist in merely a single, simple and non-extended point of the body Further, we are absolutely ignorant of the nature of the presence of GOD; and in no wise do we say that He is really extended throughout divisible space (art. 85, p. 85).

For in the brain, somewhere, it seems that the seat of the mind must be situated. (Appendix, p. 373).

Unwilling as he was to accept the Cartesian solution of the soul's location within a part of the brain, he was, then, equally reluctant to advocate the alternative, that mind might be suffused throughout the body. Boscovic conceded that nothing certain could be known about such questions:

The simple elements of matter cannot exist except in single points of space at single instants of time, each to each, while the mind can also be one-fold, and yet exist at one and the same time in an infinite number of points of space, conjoining with a single instant of time a continuous series of points of space; and to the whole of this series it will at one and the same time be present owing to the virtual extension it possesses; just as God also, by means of His own infinite Immensity, is present in an infinite number of points of space (and He indeed in His entirety in every single one), whether they are occupied by matter, or whether they are empty (Appendix, p. 379).

Since God was Spirit, which was not subject to the laws of nature, Boscovic conformed in this respect to Newton's metaphysics rather than to that of Leibniz. He conceded that his physics did not a priori preclude a God compelled to create a rational universe, that is, according to Leibnizian "sufficient reason." However, since he upheld

the Christian and Jesuit doctrine of free will, he stressed the Creator's freedom to make the universe as He saw fit:

First of all, if force is an essential property of matter, there is no need for any other reason beside that of the very nature of matter, to determine that this, rather than another, force should correspond to this, rather than to another, distance.... It may be asked... why the Architect of Nature chose this matter in particular, such as it should have this essential law of forces, and no other. In that case, I, who believe in the supreme freedom of the Architect of Nature, think, as in all other things, that there is nothing else required for the sufficient reason of this choice beyond the free determination of the Divine will.... This reply applies just as well, even if the force is not an essential property of matter, but established by the free law of the Author; for in that case, He, of his own free will, could give this law to this matter, having chosen it in preference to all other laws (Supplements III, art. 72, p. 421).

Faced with difficulties similar to those Newton had encountered before him, Boscovic felt himself on safer ground rehearsing the familiar argument to design:

What the properties of the single substance called air, which at one and the same time is suitable for sound, for breathing, even for the nutrition of animals, for the preservation during the night of the heat received during the day, for holding rain-clouds, and innumerable other uses. What those of gravity, through which the motions of the planets and comets go on unchanged, through which each sea is contained within its own bounds, and rivers flow, the rain falls upon the earth and irrigates it, and fertilizes it, houses stand up owing to their own mass, and the oscillations of pendulums yield the measure of time. Consider, if gravity were taken away suddenly, what would become of our walking, of the arrangement of our own viscera, of the air itself, which would fly off in all directions through its own elasticity. A man could pick up another from the Earth, and impel him with ever so slight a force, or even but blow upon him with his breath, and drive him from intercourse with all humanity away to infinity, nevermore to return throughout all eternity (Appendix, art. 552, p. 387).

In sum, Boscovic regarded his theory as the most plausible yet to explain natural phenomena, without undermining religious orthodoxy. Joseph Priestley's aim was different.

PRIESTLEY'S MATERIALIST THEISM

Materialism is generally a philosophy held by agnostics or atheists. In the last quarter of the eighteenth century both Joseph Priestley and François Arouet de Voltaire independently developed a materialist monism which they considered better able to demonstrate God's existence than traditional dualism, in which God's existence posited the doctrine of the immortality and spirituality of the soul. Priestley (unlike Voltaire) found the *Theoria* useful in support of his claim that materialism alone demonstrated the total dependence of the physical universe on God, since it assumed the passivity and inevitability of both mental acts and physical movements. His "Disquisitions Relating to Matter and Spirit" (1777) contains no mathematical curves, no formulae. Instead it sets out to demolish arguments for spirit substance. Christian materialism was, he asserted,

simply a return to the teachings of the Bible, though supported also by the latest scientific experiments and theories. Among these he counted the point atomism of Boscovic as well as the findings of Newton, the physician David Hartley and the Rev. John Michell. Priestley ignored the *Theoria's* mathematical basis and modified its metaphysical conclusions. He considered it useless to postulate a spirit substance to account for activity in the universe:

As to the difficulty arising from the divine material essence penetrating other matter, it has no place at all in the hypothesis advanced from Father Boscovic and Mr Michell, and certainly this idea is much more consonant to the idea which the sacred writers give us of his filling all in all, than that of a being who bears no relation to space, and thereof cannot properly be said to exist any where, which is the doctrine of the rigid immaterialists (3.301).

The unusual phrase "divine material essence" implies that Priestley's God is matter-energy, or that it is simply a word for the organising principle within the universe, abstracted from the universe itself. As we shall see, Voltaire faced a similar conundrum in his last years; for if God is merely a name for the order manifest in the universe, why should we attribute any moral qualities to him, indeed any meaningful existence to him at all?

Priestley claimed that the "immaterial" new physics of Boscovic removed the theological difficulties associated with classical dualism, such as how to explain a Spirit-God's intervention in an alien material world. But what did the "Disquisitions" derive, however imperfectly, from Boscovic (and no doubt from Michell too)? First, instead of the hypothesis of a hard, passive matter, the assertion that point atomism best accounted for the behaviour of bodies: "This hypothesis will account for all the phenomena of nature" (3.237). While the Jesuit never claimed his theory to be as certain as were the tenets of faith, he surely would not have approved of the statement that "point particles" remained a "random speculation," useful rather than proven (4.105, 240).¹⁸ On the other hand, although Boscovic's curves were certainly not "random," but were instead serious attempts to account mathematically for the observed behaviour of processes and bodies, it is true that Priestley was not misinterpreting Boscovic when he warned that the epistemological status of the powers of matter was as uncertain as was their origin:

how far the powers which we ascribe to it may be said to inhere in, or belong to it, or how far they are the effect of a foreign power, viz. that of the Deity, concerns not my system in particular (3.238).

Priestley was professing a Lockean ignorance concerning the 'real' nature of matter. Yet despite this, his ontology tended to the empirical and dogmatic, even claiming, as Boscovic never did, that observation proved matter was no more than attraction and repulsion, "which essential, fundamental properties are as appearing to me not to be properly what is imparted to matter, but what really makes it to be what it is" (3.237). Matter existed 'in itself' as a substance having certain forces.

Priestley's ontology, then, owed less to Boscovic than he claimed. As he had apparently read the *Theoria*, he was, paradoxically, probably citing its author as a respectable authority to deflect possible criticism of his own heterodoxy, while at the

same time he was allowing his readers to conclude that point atomism had no place for spirit.

In addition to the ontological waverings apparent in the *Disquisitions*, and the neglect of the *Theoria*'s mathematical underpinnings, Priestley either overlooked Boscovic's Leibnizian concept of space and time, or chose to ignore it. Instead he assumed as had Newton that if matter were to disappear, absolute space would remain (3.299–300).¹⁹

The most radical departure from the Jesuit's system was, however, his solution to the mind-body problem. In the *Disquisitions* he argued that mind was not a substance distinct from body, and that whatever matter 'really' might be, the simplest and most likely hypothesis was that thought was matter organised in a particular way (3.221f, 244, 246). Why, wondered Priestley, should mind alone not be subject to scientific investigation?

Whatever matter be, . . . the human mind is nothing more than a modification of it A philosopher ought to have been apprised that we are to suppose no more causes than are necessary to produce the effects; and therefore, that we ought to conclude that the whole man is material, unless it should appear that he has some powers or properties that are absolutely incompatible with matter (3.220, 246f).

Boscovic had found in free will proof that humans were created spirits. Priestley concluded in contrast that if matter was in fact 'immaterial', that is, not made up of solid extended particles, then the metaphysical and theological conundrum of explaining how spirit and matter interacted disappeared. As he put it:

A substance possessed of the property of extension, and of powers of attraction or repulsion is no more incompatible with sensation and thought, than that substance which . . . we have been used to call immaterial.

Mental activity was then no more than the effect of attractive and repulsive forces within the brain. Bodily and mental faculties were aspects of the same substance, as recent medical experiments showed:

The power of thinking belongs to the brain of a man, as that of walking to his feet, or that of speaking to his tongue (277).

If spirit or soul was redundant, the Christian doctrine of immortality necessarily disappeared with it:

On the whole, the state of things is now such that it appears to me to be also necessary to abandon the notion of a soul, if we would retain Christianity at all (214).

Since Priestley eliminated spirit on both scriptural and scientific grounds, declaring that materialism alone accorded with the Scriptures and that furthermore the simplest explanation was always to be preferred, why then not conclude that the universe was its own first cause, was itself the eternally necessary and eternally active being? Why not accept that materialism must eliminate God altogether? Alternatively, why not elect a form of pantheism, citing perhaps Spinoza as an illustrious predecessor?

Priestley based his argument for the existence of God on His ontological necessity. Certainly God was not spirit; yet He was ontologically distinct from, and prior to matter.

Divine intervention throughout the universe was proven because matter had no inherent activity whatsoever:

As there is no active force in nature but that of God, this being is the infinite force which unites all the parts of matter (224–25).

The ability of matter to attract or repel was a purely blind and mechanical process, so that in no way could a reader conclude from his writings that his Christian materialism lacked reverence for the Almighty, on whom the universe depended for every event and every action, and without whom the purposeful arrangements of bodies were inexplicable. Furthermore dependency on God was total; thought and will were no freer than were sensations. Even the creation itself was not an arbitrary act of divine will (as Boscovic and Newton stated for example), but rather an eternal necessity:

As the matter of which the world consists can only be moved and acted upon, and is altogether incapable of moving itself, or of acting; so all the powers of nature, or the tendencies of things to their different motions and operations, can only be the effect of the Divine energy, perpetually acting upon them, and causing them to have certain tendencies and effects. A stone, for instance, can no more move . . . towards the earth, of itself, than it can move or tend upwards, that is, from the earth. That it does tend downwards . . . must, therefore, be owing to the Divine energy, an energy without which the power of gravitation would cease, and the whole frame of the earth be dissolved.²⁰

In short, for Priestley the universe would lack direction, pattern and predictability unless a God was constantly present in His universe creating order. God was everywhere.²¹ It is not clear whether he is re-introducing a surreptitious dualism here: eternally active divine energy directing eternally created, passive matter-energy, or is simply positing a Cause while emptying it of any ontological content. He declares both human will and purposive arrangements of matter to be passive and predetermined; then from this he deduces that God is ontologically prior, because order and finality in the universe could not possibly come about through the undirected agitation of force-particles:

All corporealists must not be condemned for atheists, but only those of them who assert that there is no conscious, intellectual nature presiding over the whole universe (327).

To this an atheist, or indeed an orthodox Christian, might object that if human deliberation were a process rather than a distinct substance directing matter, then evidence of purpose in the universe must be a process as well. God then becomes a mere name for physical activity, and is therefore redundant. Indeed Priestley's efforts to demonstrate the ontological ascendancy of divine Mind over non-solid matter while removing spirit as the necessary explanation of consciousness and order struck contemporary readers as incoherent. To them the postulate of a supernatural intelligence pointed equally to the existence of individual spirit-intelligences. Hence to deny spirit was to deny God himself.²²

Both Boscovic and Priestley were introduced to the sceptical or atheistic intellectuals or *philosophes* of Paris. Both would have noted that the puncta were not exploited by any of them.

BOSCOVIC, PRIESTLEY AND THE PARIS PHILOSOPHES

During his first stay in Paris in late 1759 and early 1760 Boscovic found that Newtonian physics was often associated there with materialism. His *Theoria*, recently published, had not yet reached France, although his mathematical writings did attract the attention of the eminent mathematician A. C. Clairaut (1713–1765).²³ The Jesuit order had been expelled from France in 1763–64, and was disbanded by Pope Clement V shortly before Boscovic arrived in Paris for the second time, from 1774 to 1783. Boscovic remained a priest and took French nationality, enabling him to obtain the post of Director of Marine Optics. He was also elected to the Academy of Science. His relations with scientists had been cordial at first, but ended in recrimination because he successfully bypassed normal election procedures. Instead he persuaded his aristocratic friends to put in a word with the King.²⁴ It seems that resentment and jealousy on the part of the Paris *philosophes* estranged them from him, rather than his status as a former Jesuit. Even had the two sides been on good terms, many of the Academy's members were indifferent to established religion, while their wider circle of friends preferred to turn to easily accessible anti-religious polemics and to scientific discoveries that showed, for example, that matter could develop its own order over time as a result of chance, could even evolve from inanimate to animate, given the right conditions. For all these reasons there was no French equivalent of Priestley among the philosophes to seize upon the puncta and damage the former Jesuit's reputation. It must have been some comfort to Boscovic that militant French sceptics and atheists had no use for his immaterial force-points.²⁵ Instead, these continued to assume that matter consisted of hard, impenetrable particles, whatever their disagreements about the nature of space and its relation to matter.

Priestley visited Paris in 1774, taking the opportunity to discuss the *Theoria* with Boscovic in person. He also dined once with the Baron d'Holbach's atheistic circle, as had Boscovic and many others. There is no record however of Priestley's having read Holbach's notorious apologia for atheism, *Système de la Nature* (1770), which raised some of the theological and logical difficulties that Priestley himself considered some years later.²⁶ Since both were materialists there were naturally metaphysical affinities. Soul, for example, was dismissed as an imagined mystery of faith that supposed mind to be indicative of immortal spirit instead of simply an aspect of brain function. On the other hand, unlike Priestley, Holbach described matter in terms derived both from Scholastic and Cartesian ontologies: it was endowed with an intrinsic energy or fire, yet was solid and divisible. As an atheist Holbach also rejected the vestiges of theism that Priestley was to retain, namely, the argument from Design (which Boscovic had likewise considered entirely untouched by his new Theory), and the argument from the essential passivity of matter. If physical and mental activity required a Cause external to its manifestations, then, wrote Holbach, the problem remained of a God lacking extension who interacted mysteriously with a substance extended in space. Why, he asked, must we postulate an imagined external agency that has no contact with matter, and that merely provides a complicated and useless explanation for observable phenomena?²⁷

As we have seen, Priestley developed a materialistic system that he considered both more logical and truer to historical Christianity than was the mind-spirit dualism of orthodoxy. Furthermore, he considered that the non-solid point atomism of Michell

and Boscovic provided further evidence for a metaphysics that, if not absolutely certain, at least saved the phenomena.

Voltaire, the most famous of the French *philosophes*, never met Boscovic or Priestley. While he had briefly corresponded with Boscovic on mundane matters some thirty years previously, there is no evidence that he learnt of the Jesuit's new physics.²⁸ Nonetheless, it is interesting that, though Priestley's pious materialism was unique in England, in France Voltaire developed in his final years a personal religion that was similar, though derived from different premises. He too contended that the elimination of spirit as an explanatory principle increased reverence for divine power in the universe. And, as in the case of Priestley, so too Voltaire's semi-mystical theistic materialism was as much a response to the intellectual challenge of atheism as a refusal of contemporary revealed religion. It was a position that reinforced a sense of human inadequacy in the face of the Almighty and, to that extent, both had much in common with the occasionalism of Malebranche, with which Voltaire at least was familiar. Just as for Priestley all the powers of nature derived from God, so for Voltaire too, once soul was eliminated, God became directly responsible for activities considered too "noble" for matter to produce of itself.²⁹

Both Priestley and Voltaire agreed with d'Holbach that thinking, growth and other particularities of living organisms were processes, not entities or substances. It would then logically follow that mind too was an activity of bodies, not a separate, superior category. No behavioural characteristics of living beings, in other words, could or should be hypostatized. Yet at the same time the two theists insisted that the human mind was God at work. There was, they argued, a pre-existent divine Mind ordering and eternally creating the world. Neither Priestley nor Voltaire considered their religious materialism incoherent. Immortal souls were an illusion, both agreed, yet matter's passivity pointed directly to an all powerful deity; furthermore, cosmic design irrefutably signalled divine existence. Both, then, clung in the late 1770s to a deity as an explanatory principle, even as they dismissed spirit substance. For both of them, the assumption of a spirit acting within bodies was demonstrably false, and so misled people into thinking that there was no God. Yet, clearly, once consciousness is demoted from an essence or entity, whatever its relation to matter, to a process that dies along with its host, is not theism much weakened?

CONCLUSION

This paper has briefly compared two natural philosophers who reinterpreted atomism as what later came to be called force fields. Boscovic's *Theoria* is not primarily an apologetic work, for the bulk of it consists of geometrical figures and mathematical formulae whose purpose was to explain phenomena such as cohesion, light, electricity or magnetism, but certainly not consciousness and order in nature. Boscovic did not question the reality of both an ontologically distinct, spirit-God and an immortal soul, so he was theologically beyond reproach. In the *Theoria* itself, especially in its *Annexe* and *Supplements* he protested that his system posed no danger to a Christian standpoint.

Nonetheless, because the solidity of matter was the mainstay of orthodox apologetics at the time, and the *Theoria* demonstrated that the constituent components of matter

were neither inert nor solid, indirectly he undermined the certainties of both Cartesian and Newtonian ontological dualism, which Christian apologists used to demonstrate the compatibility of faith and natural philosophy. Boscovic, as original in his physics as he was conservative in his faith, carefully distinguished force and spirit; he was too well versed in metaphysics to favour the hylozoism of a Cudworth for example, or Priestley's assumption that somehow force or activity of any kind must be divine, while at the same time denying it any substantial reality at all.

The absolute or relational nature of space and time was also central to metaphysics at the time. As a propagandiser for atheism d'Holbach was not concerned with the complex considerations that exercised some of his contemporaries. He tended to a view of the material universe as eternal and infinite, which conceptually eliminated empty space. For Boscovic space and time were relational, since these were expressions of non-extended force-points. Priestley had a Newtonian rather than a Cartesian or Leibnizian view of space; yet, since for him God was manifest through activity, the conclusion may be inferred that He was present in matter but not in space. Voltaire abandoned his earlier belief in empty space. His late works suggest that an eternal, infinite material universe, including consciousness, emanated from an ordering God, though neither God nor consciousness was spiritual. Consciousness was simply God at work. God's omnipresence in a material universe, whatever the differences with respect to the reality of empty space, may border on pantheism. It is interesting that Priestley, impressed by the work of Boscovic, came to conclusions close to those of Voltaire, who retained a classical Newtonian definition of matter's basic particles.

Priestley and Voltaire both developed a unique theistic materialism, but their repudiation of mind-spirit dualism, the philosophical basis of contemporary Christian belief, appeared weak to dissident contemporaries. For Boscovic, in contrast, religious beliefs belonged to another, superior reality not open to mathematical demonstration. Confident as he was in the scientific usefulness of his theory, this could never be as certain as were the truths of Revelation:

It is enough for me that I have pointed out the extreme fertility of my Theory, and its use in any of the most difficult and special problems of physics (art. 515, p. 365).

Certainly Priestley also professed a Lockean scepticism regarding the ultimate nature of physical reality, but the case of the later Voltaire may serve to show that point atomism neither supports nor repudiates theism. It seems fair, then, to conclude that Boscovic's *Theoria* has better withstood the passage of time than the "Disquisitions" of Priestley; some regard Boscovic as the father of modern atomism.³⁰

NOTES

1. See Zarko Dadic, *Boscovic*, trans. Janko Paravic (Zagreb: Skolska Knjiga, 1990), 24–41, 54; L. L. Whyte, "R. J. Boscovich, SJ, FRS (1711–1787), and the Mathematics of Atomism," *Notes and Records of the Royal Society of London*, 13.1 (June 1958): 38–48; L. L. Whyte, *Roger Boscovich, SJ, FRS: Studies of His Life and Work in the Anniversary of His Death* (London, 1961); Henry Gill, *Roger Boscovich SJ (1711–1787) Forerunner of Modern Physical Theories* (Dublin: Gill and Son, 1941); *The Philosophy of Science of Ruder Boskovic*, Proceedings of the Symposium

- of the Institute of Philosophy and Theology (Zagreb: Croatian Province of the Society of Jesus, 1987); J. Brooke Spencer, "Boscovich's Theory and Its Relation to Faraday's Researches: An Analytical Approach," *Archives of the History of the Exact Sciences* 14 (1967–68): 187–94; Branko Franolík, "Rudjer Boskovic (1711–1787), Physicist, Astronomer and Mathematician in England," *Croatian Times* (London), 16 (April 1997). I am grateful for comments made at a lecture on this topic given at the Boskovic Institute, Zagreb, in 2004, and for comments made by Thomas Mautner, Philosophy Department, ANU.
2. On Priestley, see J. G. McEvoy, "Joseph Priestley: Philosopher, Scientist and Divine" (Ph.D. diss., University of Pittsburgh, 1973); H. G. McEvoy and J. E. McGuire, "God and Nature: Priestley's Way of Rational Dissent," *Historical Studies in the Physical Sciences* 6 (1975): 325–404; Robert E. Schofield, *The Enlightenment of Joseph Priestley, A Study of his Life and Works from 1733 to 1773* (Pennsylvania: Pennsylvania State University Press, 1997), 247–48; A. J. Saunders, "Be Candid Where You Can: The Rational Dissent of Joseph Priestley" (Ph.D. diss., ANU, 1989); P. M. Harman, *After Newton: Essays on Natural Philosophy, Variorum* (Aldershot: Ashgate, 1993); Alan Tapper, "Reid and Priestley on Method and the Mind," *The Philosophical Quarterly* 52.209 (October 2002); Henri Laboucheix, "Chimie, matérialisme et théologie chez Joseph Priestley," *Studies on Voltaire and the Eighteenth Century* 183 (1976): 1219–44.
 3. On Michell, see Clyde L. Hardin, "The Scientific Work of the Reverend John Michell," *Annals of Science* 22.1 (March 1966): 27–47; and, Richard Crossley, "Mystery at the Rectory: Some Light on John Michell," *Yorkshire Physics News* 17 (January 2000), 18 (April 2000), 20 (January 2002); the revised, collated version was put on the Internet in 2001, at <http://www.yorksphilsoc.org.uk/files/michell.pdf>
 4. Joseph Priestley, "Disquisitions Relating to Matter and Spirit" (1777), in *Theological and Miscellaneous Works of Joseph Priestley*, ed. J. T. Rutt, 25 vols. (London: Smallfield, 1817–31, reprint by Kraus Reprint, New York, 1972), vol. 3; subsequent references to "Disquisitions" are cited parenthetically in the text.
 5. Robert E. Schofield, *A Short Autobiography of Joseph Priestley (1733–1804)* (Harvard, MA: MIT Press, 1966), from Priestley to Boskovic, 19 August 1778, no. 79; from Boskovic to Priestley, 17 October 1778, no. 80.
 6. Ivo Slaus, "Forces in Modern Physics and in Boskovic's Theoria," in *The Philosophy of Rudjer Boskovic* (Zagreb, 1987), 110; Mirko Grmek, "L'explication des phénomènes vitaux dans l'œuvre de Boskovich," in *R. J. Boskovich, Vita e Attività Scientifica* (Rome: Istituto della Enciclopedia Italiana, 1993), 321; Ante Kadic, "A Literary and Spiritual Profile of Boskovich," in *idem*, 16–17.
 7. Branko Franolík, "Rudjer Boskovic (1711–1787): Lasting Influence on British Scientists," *Croatian Times* (London) 19 (August/September 1997).
 8. H. G. Alexander, ed., *Leibniz-Clarke Correspondence* (Manchester: Manchester University Press, 1956); R. Arthur, "Space and Relativity in Newton and Leibniz," *British Journal for the Philosophy of Science* 45.1 (1994): 219–40.
 9. Immanuel Kant, "The Inaugural Dissertation, 1770," in *Selected Pre-Critical Writings* (Manchester: Manchester University Press, 1968); Ronald Calinger, "Kant and Newtonian Science: The Pre-Critical Period," *ISIS* 70. 3 (September 1979): 349–62.
 10. David Walford, "Kant's 1768 Gegenden im Raume Essay," *Kant Studien* 92.4 (November 2001): 387–407.
 11. Dale Jacquette, "Hume on Infinite Divisibility and the Negative Idea of a Vacuum," *British Journal of Philosophy* 10.3 (2002): 413–35; L. Falkenstein, "Hume on Manners of Disposition and the Ideas of Space and Time," *Archiv für Geschichte der Philosophie* 79.2 (1997): 179–201; T. M. Lennon, "Sources et signification de la théorie lockienne de l'espace," *Dialogue* (Kingston) 22.1 (1983): 3–14; G. B. Herbert, "Hobbes's Phenomenology of Space," *Journal of the History of Ideas* 48.4 (1987): 709–17.
 12. Title of an article by Carl Hoefer in the *British Journal for the Philosophy of Science* 49.3 (1998): 451–67. See, for example, Andrew Newman, "A Metaphysical Introduction to a Relational Theory of Space," *Philosophical Quarterly* 39.155 (April 1989): 200–20; John Earman,

- World Enough and Space-Time: Absolute versus Rational Theories of Space and Time* (Harvard, MA: MIT Press, 1992); Hans Reichenbach, *Philosophy of Space and Time* (New York: Dover, 1958).
13. S. d'Agostino, "Boscovic's Reception of Newton's Legacy," in *The Bicentennial Commemoration of R. G. Boscovic* (Milan: Edizioni Unicopoli, 1988), 27–45; Richard Olson, "The Reception of Boscovich's Ideas in Scotland," *Isis* 1(1) (Spring, 1969): 91–103.
 14. Childs translates *sententia* as sensibility. A phrase such as "what will be observed through our senses" or "sensory experiences" would better convey the author's meaning here.
 15. A. T. Winterbourne, "On the Metaphysics of Leibnizian Space and Time," *Studies in the History and Philosophy of Science* 13 (1982): 201–14.
 16. See Dadic, *Boskovic*, 71–72, 77–83.
 17. See, for example, Tim Crane and Sarah Patterson, *The History of the Mind Body Problem* (London: Routledge, 2000); Paul MacDonald, *History of the Concept of Mind* (Ashgate: Aldershot, 2003); Nicholas Humphrey, *Journal of Consciousness Studies* 7 (2000); Alex Byrne, "What Mind Body Problem?" *Boston Review* (May–June 2006): 5–20.
 18. See McEvoy, "Joseph Priestley, Philosopher, Scientist and Divine," 127–28.
 19. Wolfgang Malzkorn, "Leibniz's Theory of Space in the Correspondence with Clarke and the Existence of Vacuums, *Paideia*, no date, at <http://www.bu.edu/wcp/Papers/ModeMalz.htm>
 20. Priestley, *Institutes of Natural and Revealed Religion* (1772–24), ed. J. T. Rutt, 2nd ed. (1782), vol. 2, 15.
 21. For a discussion of the Design argument from the eighteenth century to the late twentieth century, see, for example, J. H. Hick, *Arguments for the Existence of God* (London: Macmillan, 1970), 1–17.
 22. Anon, "An Essay on the immateriality and immortality of the soul and its instinctive sense of good and evil, Appendix in answer to Dr Priestley's Disquisitions on matter and spirit" (1778), 420.
 23. Zarko Dadic, "Boskovic and the Question of the Earth's Motion," in *The Philosophy of Science of Ruder Boskovic* (New York: Fordham University Press, 1987), 136. R. Taton, "Les relations entre R. J. Boscovich et Alexis-Claude Clairaut (1759–1764)," *Revue de l'histoire des sciences* 49.4 (1996): 415–58.
 24. See John Pappas, "R.J. Boscovich et l'Académie des sciences de Paris", *Revue de l'Histoire des Sciences* 49.4 (1996): 401–14.
 25. Roger Hahn, "The Ideological and Institutional Difficulties of a Jesuit Scientist in Paris," in *R. G. Boscovich, His Life and Scientific Work* (Rome: Istituto della Enciclopedia Italiana, 1988), 1–13.
 26. Tapper, "Priestley's Metaphysics," 33.
 27. Paul-Henri Thiry Baron d'Holbach, *Système de la Nature, ou des Loix du monde physique and du monde moral* (Geneva: Slatkine Reprints, 1973), 1.2.26–32, 99–105; 1.3.29–31; 1.7.94–101; 2.5.191.
 28. See Besterman, D3201, 21 August 1745, vol. 93, 314; D3420, 15 June 1746, vol. 94, 47; D3452, vol. 94, 94.
 29. Voltaire, *Le philosophe ignorant*, ed. J. L. Carr, p. 60; *Il faut prendre un parti ou le principe d'action* (1772), ed. T. Moland, vol. 28, 518–25; *Lettres de Memmius à Cicéron* (1771), vol. 28, 453; *Dialogues d'Evhémère* (1777), vol. 30, 471–75. See also E. D. James, "Voltaire and Malebranche: From Sensationalism to Tout en Dieu," *MLR* 75 (1980): 282–90, and "The Concept of Emanation in the Later Philosophy of Voltaire," *Studies on Voltaire and the Eighteenth Century* 284 (1991): 199–209.
 30. See, for example, Dadic, *Boskovic*, 111–30; Robert Kargon, "William Rowan Hamilton, Michael Faraday and the Revival of Boscovichean Atomism," *American Journal of Physics* 32.10 (October 1964): 792–95.