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Title. How the Mind-World Problem Shaped the History of Science: A Historiographical Analysis of Edwin Arthur Burtt's *The Metaphysical Foundations of Modern Physical Science* Part I

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Abstract

This manuscript, divided into two parts, provides a contextual and historiographical analysis of Edwin Arthur Burtt's classic *The Metaphysical Foundations of Modern Physical Science*. My discussion corroborates the sparse technical literature on Burtt (Moriarty 1994; Villemaire 2002), positioning his work in the aftermath of American idealism and the rise of realist, pragmatist and naturalist alternatives. However, I depart from the existing interpretations both in content and focus. Disagreeing with Moriarty, I maintain that Burtt's *Metaphysical Foundations* is not an idealist work. Moreover, I provide an alternative to Villemaire's mainly Deweyite/pragmatist reading, emphasizing the import of new realism and naturalism. Burtt's historical thesis should not be viewed as outlining a systematic philosophical position, but rather as a (coherent) culmination of numerous philosophical problematics. To support my conclusion, I provide a substantial summary of Burtt's text alongside a contextual analysis of the philosophical issues that preoccupied his teachers and peers in Columbia's philosophy department. I conclude with a historiographical section, rendering explicit the connections between Burtt's understanding of the scientific revolution, and his distinctive early 20th century American intellectual context.

Keywords

Edwin Burtt, Scientific Revolution, John Dewey, Frederick Woodbridge, History of Science

1. Introduction

Ever since its original publication almost a century ago, Edwin Arthur Burtt's *The Metaphysical Foundations of Modern Physical Science* (hereafter *MF*) has remained an underground classic in the history of science and a foundational text in 20th century science studies. Alexandre Koyré once described it as providing "the best account of the metaphysical substructure (Platonic mathematicism) of modern science" (1943: 425).[1] More recently, in his extensive historiographical study of the scientific revolution, Floris Cohen maintained that "together with Dijksterhuis' *Val en Worp*…Burtt's book constitutes the first truly contextual historical treatment of vital aspects of the origins of early modern science" (1994: 88). Lastly, Lorraine Daston, although penning a highly critical piece on Burtt's intellectual legacy, recognized that his "book made a lasting impression on most historians of my generation", drawing many to the discipline (1990: 530). These remarks are not mere exaggerations. Burtt provided an original and fascinating reading of the scientific revolution, suggesting that the birth and present character of modern physical science is explained by the early modern privileging of mathematical modes of reasoning, ultimately based on a Neoplatonic metaphysics. More crucially, he exhibited remarkable historical erudition by translating and synthesizing a considerable amount of previously untranslated material by Copernicus, Kepler, Galileo, Descartes, More and Barrow.

Despite the pervasive influence that *MF* exerted in the historiography of early modern science and philosophy, the book's relevance for contemporary scholarship has steadily declined. There are numerous reasons for this. Firstly, Burtt's pioneering analysis was

[1] Also see Villemaire (2002: 3-4).

chronologically succeeded by Koyré's similar, albeit significantly more technical, output. For all its innovations, Burtt's early interest in the history of ideas was intimately connected to wider intellectual projects. Although Koyré certainly held philosophical views, – his anti-positivism, his intellectual debts to Meyerson and Brunschvicg, his appreciation of Husserl – it would not be unfair to note that his historical treatises reflected the ongoing institutionalization of the history of science. Koyré's works, penetrating as they may be, are characterized by their significantly more restricted subject matter. The Platonic/Pythagorean 'mathematization of nature' thesis, a thesis rigorously formulated by Burtt, became almost synonymous with Koyré, at least with respect to that thesis' technical details.[2] Consequently, it was Koyré who emerged as the more obvious point of reference for the professional historian of science and philosophy.

Another reason for the decline of interest in *MF* is, expectedly, influential criticisms raised against it. In his important M*etaphysics and the New Science* (1990), Gary Hatfield notes how the application of mathematics to physical problems need not presuppose a metaphysics in the Neoplatonic vein as Burtt upheld. Hatfield argues that for *MF*'s central argument to obtain, Burtt was required to show that the practitioners of mathematical-physical science in the 16th and 17th centuries explicitly evoked Neoplatonic conceptions and sources. Some examples provided are "the relationship between God…and nature, or…the fundamentally mathematical character of nature's parts and their order" (1990: 102). From such a standpoint, only Kepler unambiguously provides a Neoplatonic support for his astronomical/cosmological work.[3] While Hatfield clarifies that he is not critical of attempts to employ history for philosophical purposes, as Burtt presumably did, he concludes by observing how Burtt and his like-minded peers, Whitehead and Koyré, ultimately failed to "use the wheel of history to their best advantage" (1990: 147).

Lorraine Daston largely follows some of Hatfield's remarks, further highlighting an anachronism underlying Burtt's understanding of metaphysics. The claim is that Burtt understood metaphysics in a "postpositivist sense, as the presuppositions…that inform a scientist's work, which may be of either epistemological or ontological import…On this view, metaphysics is what is left over once the mathematical and empirical content have been subtracted" (1991: 523). Hence, Burtt erroneously imposed a recent conception of metaphysics to the early moderns. While Daston is also not wholly critical, noting that "Burtt…cannot be blamed for not attending to a historiography of science that did not yet exist when he wrote his book" (1991: 525), her central point is that Burtt's deep-seated philosophical convictions deterred a properly contextual analysis.

It will become obvious from my subsequent discussion of Burtt's text that I agree with

[2] Villemaire protests that Kuhn unjustly acknowledged only Butterfield and Koyré as genuine influences (2002: 3). I think she is right – even if we should not solely attribute the decline of *MF*'s import to Kuhn's specific acknowledgments. For example, Peter Dear's important *Discipline and Experience (1995)* nowhere mentions Burtt, attributing the thesis of a priority of metaphysics in early modern science to Kuhn and Koyré. Capecchi's (2017) deeply impressive work also omits any references to Burtt, despite highlighting knowledge of both Kuhn and Koyré. More surprisingly, Vesel's (2014) recent monograph, defending a Platonist Copernicus, acknowledges only Kuhn and Koyré yet again.

[3] For further discussion on Strong and Hatfield's arguments see footnotes 6 and 21. It is worth mentioning that Hatfield's arguments are still evoked when 'Burtt-ian' theses are proposed – notably, see Westman (2016: 602-603).

certain aspects of Hatfield and Daston's criticisms. Yet, I must also admit that 'short-sighted philosophical history' and 'immature historiography' do not appear to me to be particularly illuminating explanations. It is instructive to note that these were precisely the same criticisms that Burtt raised towards some of his predecessors and contemporaries.[4]

Thus, I wish to propose and explore a third reason that could partly explain the diminished relevance of *MF*: the truism that historiographical foci are subject to change. As John Herman Randall Jr. once remarked – following his mentor and Burtt's supervisor Frederick Woodbridge – "[w]ith the occurrence of fresh events, the meaning and significance of the past is constantly changing" (1958: 39). The historian experiences a world that appears to be characterized by certain intellectual and social problems. These problems are, in turn, reflected in her professional activities. In other words, the historian engages with the problems of her present via her professional activities, no matter how distant her present and the past she explores appear. Whether the problems of the historian's present are resolved or not, one thing is certain: new problems inevitably arise. When that occurs, novel histories are written.

One reason why *MF* does not draw the same attention as it once did is because its author does not share all our current problems, although he may well share many of them. Some of the past's problems appear obviously distinct when we are compelled to let our present experience clash with the documented experience of past authors. Similarly, some of the past's problems are deemed familiar because they have either genuinely shaped our present experience or appear to characterize it in some way. Finally, and more importantly, it is our present experience that supplies us with the historiographical foci/perspectives with which we track and uncover the past's – distinct or familiar – problems.

The import of the present for historical writing may seem, persistently and puzzlingly, paradoxical to the practicing historian, but it is certainly not alien to the historiographer. Burtt's present will form the basis of my historiographical analysis. My discussion corroborates the sparse technical literature on Burtt (Moriarty 1994; Villemaire 2002), positioning his historical work in the aftermath of American idealism and the rise of realist, pragmatist and naturalist alternatives. However, I depart from the existing interpretations both in content and focus. Disagreeing with Moriarty, I maintain that Burtt's *Metaphysical Foundations* is not an idealist work. Moreover, I provide an alternative to Villemaire's mainly Deweyite/pragmatist reading, emphasizing the import of new realism and naturalism. Burtt's historical thesis should not be viewed as outlining a systematic philosophical position, but rather as a (coherent) culmination of numerous philosophical problematics. To support my conclusion, I provide a substantial summary of Burtt's text alongside a contextual analysis of the philosophical issues that preoccupied his teachers and peers in Columbia's philosophy department. I conclude by rendering explicit the connections

[4] Commenting on the then recent philosophical works of Alfred North Whitehead and Charlie Dunbar Broad, Burtt notes that "[t]o follow the English critics is…to take much out of the past for granted which needs just as vigorous prying-into as the contemporary problems to which our inquiring attention has been drawn" (1925: 15). Similarly, in his analysis of the theological underpinnings of Newton's natural philosophy, Burtt sarcastically writes in a footnote: "Compare the present discussion of Newton's doctrine of space and time with those of Mach, *Science of Mechanics*; Broad, *Scientific Thought*; and Cassirer, *Substanz und Funktionsbegriff*" (1925: 255). Burtt also subtly criticizes Eucken's and Apelt's treatments of Kepler, noting a myopia regarding the deeper motivations behind Kepler's amassing of "numerical curiosities" (1925: 59).

between Burtt's understanding of the scientific revolution and his distinctive early 20th century American intellectual context.

2. Summary of *Metaphysical Foundations*

2.1. *Pre-Galilean Developments*

I commence by providing a summary of Burtt's historical treatise.[5] My summary follows Burtt's order of presentation and mode of reasoning with my own input being restricted in footnotes. Burtt's initial provocation is to ask why Copernicus, prior to any empirical considerations, advocated the hypothesis that the earth revolves around its axis and circles around the sun. We are reminded that this is an era before Galileo's telescopic discoveries. Indeed, Copernicus must have gone against brute sense perception in numerous ways. Sense-perception confirms that the earth is solid and immovable, while the celestial bodies are "the tenuous, the unresisting, the mobile thing" (1925: 24). Prior to Copernicus, some bodies were assumed to be at (absolute) rest and some others in motion, with the brute evidence of the senses being the final arbiter on the matter. Furthermore, the dominant Aristotelian conception of the universe and its array of physical arguments appeared decisive against earth's supposed orbit and rotation. For example, if Copernicus is correct, then a body thrown upwards vertically should land to the west of its starting point. Also, the annual parallax of the 'fixed' stars could not be confirmed. In other words, Copernicus neither possessed a fully developed relativistic physics/analysis of motion, nor could he attain crucial empirical evidence for his position in the astronomical context.

For Burtt, Copernicus' motivations demand a brief digression in the history of mathematics. The relevant context is geometry, pervading disciplines like astronomy, mechanics and optics. Geometrical representation warrants the "reduction of complex to simple features, a resultant simple triangle or circle being regarded as the equivalent of the more involved combination of figures which it replaced" (1925: 32). The astronomical import of geometrical reduction boiled down to a simpler representation of planetary orbits. Positioning the earth at the center of the universe (or close to the center), dictated the introduction of an excessive amount of epicycles. However, if astronomy is strictly reduced to a branch of mathematics then sense perception may be presently ignored: "mathematically, there is no question as to which [representation] is true. As far as astronomy is mathematics, both are true, because both represent the facts, but one is simpler and more harmonious than the other" (1925: 37).

It might appear then that Copernicus is depicted as an abstract geometer, uninterested in the physical implications of his claims. Surprisingly, however, Burtt treats him as a thorough-going realist. Burtt observes that the Copernican displacement of the earth concurred with a revival of a Neoplatonism of Pythagorean emphasis based on the geometrical atomism of Plato's *Timaeus*. The 'mathematicism' of this Neoplatonism contrasted with the dominant scholastic Aristotelianism that treated nature in qualitative and quantitative terms (1925:

[5] I will exclusively focus on the 1924-25 publication – see p. 16 for a chronology of *MF*'s editions. Burtt eventually revised his text in 1932. The differences between the two versions are inconsequential. In the 1932 revision, Burtt omits some of his concluding cosmological speculations, restating his 'mathematicist' thesis in a tentative fashion. Furthermore, he briefly expands on how More's extended spirit could provide the (behaviourist) psychologist with an operational concept for the modern study of mind.

44). Relatedly, Aristotle divided nature into two distinct realms, a harmonious celestial and a corruptible corporeal one. Copernicus, himself a disciple of the Pythagorean Domenico Maria Novara, clearly sides with the Platonic conception: Platonism/Pythagoreanism enables a realist interpretation of geometrical reduction, resulting in the abandonment of the Aristotelian dualistic and qualitative cosmos, and its homogenization and geometrization.[6] Our heliocentric cosmos shares the abstract features of a geometrical model/account. Accordingly, we may safely ignore those, now misleading, aspects of experience which elude a strictly geometrical treatment.

Although the Copernican system was adopted by a few luminaries like Rheticus and Bruno, its first major proponent is Kepler. Kepler has his own cosmological take on heliocentrism, motivated by a deification of the sun (1925: 45-49). His key importance in Burtt's narrative, however, stems from his proposed notion of formal causality, transforming the nature of scientific hypothesis: "causality becomes reinterpreted in terms of mathematical simplicity and harmony" (1925: 54). In effect, explanation is no more given in the guise of the underlying form, but rather by a demonstration of the facts' "*orderly and rational mathematical connexion*" (1925: 54) (italics original). These novelties are ultimately driven by a shift in our metaphysical conception of the universe: "*the real world is a world of quantitative characteristics only; its differences are differences of number alone*" (1925: 56) (italics original). However, Kepler is not solely a Pythagorean, but also a thinker who deeply ponders on methodological issues. His crucial departure from Copernican apriorism and mathematicism is an attitude "genuinely empirical in the modern sense of the term" (1925: 50). Despite its theological and aesthetic/metaphysical allure, the Copernican system must be subject to empirical confirmation.

2.2. *Galileo*

In Burtt's Galileo, a Keplerian merging of empirical confirmation and Pythagorean metaphysics is also uncovered. Galileo's work on projectiles, for example, begins with the empirical fact of the parabolic trajectory of projectiles, but then deduces further facts (like a maximum range of 45^{o}) "without need of recourse to experiment" (1925: 65). Generally,

[6] This position would soon gain credence through Koyré's influential works – see especially Koyré (1939; 1943a; 1943b; 1957; 1961). Surprisingly, Burtt has almost nothing to say about the development of this alleged revival of Neoplatonism. A scholarly response arrived only a few years later through Edward Strong's 1936 *Procedures and Metaphysics*. Strong provided an analysis of both ancient and renaissance Neoplatonists, distinguishing between the 'mathematical' tradition of – among others – Cardan, Benedetti, Valla, Tartaglia and the 'metamathematical' tradition of Renaissance Neoplatonists like Ficino and Pico. The former, followed the legacy of Euclid's *Elements*, namely the use/application of geometry for a series of restricted mathematical and mechanical problems. In contrast, the Renaissance Neoplatonists, with intellectual antecedents in Nicomachus, Theon, Plotinus and Proclus, maintained that mathematics forms "an initiation into realities which lie beyond the limited procedures of the mathematician" (1936: 28). In agreement with Burtt, Strong viewed Kepler as a Pythagorean whose metaphysics was ultimately moderated by an insistence on observation. However, the central claim of *Procedures and Metaphysics* was that Galileo's work should be safely positioned in the Euclidean context, not the Platonist/metaphysical one. Strong's work never attracted widespread attention, but it has consistently met the general approval of specialised circles for almost a century (Johnson 1938; Barnes 1974: 118; Hatfield 1990:110). Koyré indicates – dismissively – awareness of *Procedures and Metaphysics* (1943a: 425). For Burtt's belated response to Strong see Burtt (1943). What is quite surprising is that Strong's book was another doctoral dissertation supervised by Woodbridge in Columbia. I am currently completing a similar manuscript, situating Strong's historical treatise in its appropriate philosophical context.

nevertheless, Galileo's method is characterized by a three-step procedure of intuition, demonstration and experiment (1925: 70-71). Intuition is a two-fold process: first, there is abstraction from sense perception whereby the phenomenon to be investigated is isolated. Secondly, an attempt to trace the aspects of the phenomenon translatable in mathematical terms occurs. Intuition is the main appeal to sense perception – and, certainly, a substantially distortive one – as the next step requires deductive demonstrations from the previously mathematically-apt aspects of the phenomenon in question. Experimental confirmation comes only last, concluding a predominantly a prioristic process. Yet, Galileo's empirical leanings allow his dynamics[7] to assume physical (non-mathematical) concepts like force and motion.

Furthermore, Galileo draws more rigorously the implications of the recently revived primary/secondary quality distinction.[8] The primary/essential qualities of bodies are geometrical (or geometrically representable) qualities like size, shape and – controversially – motion; secondary qualities are qualitative, consisting of sounds, colors, odors, etc. Galileo's contribution is the clear construal of secondary qualities as subjective. Indeed, Burtt maintains that in *Il Saggiatore,* Galileo

> fell definitely in line with the Platonic identification of the realm of changing opinion with the realm of sense experience, and became the heir to all the influences emanating from the ancient atomists which had been recently revived in the epistemology of such thinkers as Vives and Campanella. The confused or the untrustworthy elements in the sense picture of nature are somehow the effect of the senses themselves…The secondary qualities are declared to be effects on the senses of the primary qualities which are alone real in nature (1925: 74).

Galileo also abandons final causes, focusing on efficient causation – an account of the 'how', contrary to the 'why' of motion.[9] An emphasis on efficient causation "inevitably thrusts into

[7] Burtt never distinguishes between statics, kinematics and dynamics. He simply discusses Galileo's mechanics as dynamics.

[8] Burtt traces the origins of modern epistemology in the renaissance philosophies of Vives, Sanchez, Montaigne, Campanella and the natural philosophy of Kepler (1925: 56).

[9] This is a rather peculiar way to frame the shift in our conception of causality, a shift further emphasised in Burtt's conclusions (1925: 300). Final causes indicate a purpose, an ultimate end. On the other hand, efficient causes are those deemed responsible for the motion (or rest) of bodies. Certainly, Galileo was not preoccupied with the former, at least not in his physics. One could understand Burtt's use of efficient cause as denoting a force – notably gravity. This seems appropriate given his understanding of Galileo's mechanics as dynamical. Yet, his subsequent analysis on the geometrical account of space and time alludes to the kinematical description of the *Two New Sciences*; this analysis is more in line with Burtt's admitted shift from the 'why' to the cause-independent 'how' of motion. Moreover, efficient causation is primarily attributed to the motions of atoms, a matter-theory that Galileo does not wholeheartedly adopt. To complicate things further, I have noted that Burtt's Kepler replaces the Aristotelian formal cause with a Platonic one: instead of an underlying form of substances, Kepler introduces a Platonic alternative where differences in number account for perceived change and variation. My own assessment of this confusing situation is that Burtt is eager to explain key aspects of the new science as a selective appropriation, and, occasionally, a distortion, of the richer Aristotelian notion of causation. This may well be explained by the surprising revival of interest in Aristotle in Burtt's Columbia context (Anton 2005). One problem, however, is that Burtt assumes the exhaustiveness and correctness of the Aristotelian scheme. The more serious defect of his analysis though, especially since his narrative is built around the idea of a genuine conceptual revolution, is the attempt to describe what is purportedly new in the allegedly superseded Aristotelian terminology. Regardless, Galileo's understanding of causation remains an

prominence the concepts of space and time" (1925: 81). If the real world is a mathematical world of bodies in motion, then the "[r]eal world is a world of bodies moving in space and time" (1925: 83). The efficient construal of motion renders space and time our background quantitative categories. In Aristotle, space was simply a boundary between things, drawn from the qualitative observation that an object is separated from those enclosing it. So-called temporal relations were understood in terms of potentiality and actuality. With Galileo, time becomes "a spatial dimension, [that] can be represented by a straight line and co-ordinated with spatial facts similarly represented" (1925: 86).

More broadly, Galileo, especially via the primary/secondary distinction, is perceived as the source of modern metaphysical and epistemological problematics:

> Obviously man was not a subject suited to mathematical study. His performances could not be treated by the quantitative method, except in the most meagre fashion. His was a life of colours and sounds, of pleasures of griefs, of passionate loves, of ambitions, and strivings; Hence the real world must be the world outside of man; the world of astronomy and the world of resting and moving terrestrial objects. Observe that the stage is fully set for the Cartesian dualism…Man begins to appear for the first time in the history of thought as an irrelevant spectator and insignificant effect of the great mathematical system which is the substance of reality (1925: 79-80).

Thus, Galileo's understanding of primary and secondary qualities entails the separation of humans from the real world; nature now exhibits her own autonomous operations. More crucially, such separation leads to an explanatory gap that would be operative in the Cartesian system. If nature is geometrical, then clearly our perceptual apparatus is somehow radically distinct.

2.3. *Descartes*

Burtt's Descartes further systematizes the prevailing Pythagorean metaphysic. Firstly, Descartes' early innovations in analytic geometry allowed for numerical truths to be represented spatially and spatial relations to be expressed in numerical terms (1925: 97). It is only a small step from these assumptions to the claim that "the whole realm of physics might be reducible to geometrical qualities alone" (1925: 98). Both Galileo and Descartes agree that "there is absolutely nothing in the motion of a physical body which cannot be expressed in mathematical terms" (1925: 105). However, Galileo maintained that bodies exhibit more ultimate qualities – motion and force – that enable a strict mathematical treatment. In contrast, Descartes unsuccessfully conceals these issues in his all-encompassing vortex cosmology that only superficially saves the "geometrical character of the visible bodies" (1925: 105).

Methodologically, Descartes highlights the privileged status of mathematical and logical propositions. The role of empirical confirmation is, at best, complementary to some form of pure cogitation. This methodological thesis has obvious ontological implications. Since the realm of sense perception is distinct and less trustworthy, the subjective secondary qualities

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open question – see Wallace (1983), Ducheyne (2006), Capecchi (2017: 295-308).

must find “a haven…in an equally real though less important entity, the thinking substance” (1925: 108). This admission conflictingly localizes the mind in the brain. Burtt agrees that Descartes treats the brain as the place of interaction of two substances. Nevertheless, when compared to the infinite nature of an extended geometrical universe, “the universe of mind, including all experienced qualities that are not mathematically reducible, comes to be pictured as locked up behind the confused and deceitful media of the senses, away from this independent extended realm, in a petty and insignificant series of locations inside the human bodies” (1925: 115).

2.4. *Hobbes, More, Barrow*

Even with his generally scholastic orientation, Hobbes serves as a mediator of continental (Galilean/Cartesian) ideas in the English context. His metaphysical thesis is materialist, noting that all change is due to extended matter and motion. Thus, the mind is understood as a series of motions in an organism; so-called ideas/images are corporeal, consisting of names given to extended moving things. Beyond the nominalistic overtones of Hobbes’ theorising, Burtt observes an absolutist take on Galileanism (1925: 121). Consistent with his metaphysics, Hobbes argues that primary and secondary/sensible qualities alike are phantasms in the brain of perceivers. Moreover, spatiality and temporality are also phantasms; real extension and motion are somehow spatialized and temporalized (‘phantasmically’) in perception (1925: 124). In Burtt’s narrative, Galileo renders time a key (quantitative) category. In the Cartesian context, however, temporal relations are ‘modes of thought’. Hence Descartes does not entertain a hypostatized conception of time (1925: 154). On the other hand, Descartes identifies space with matter. What Burtt seems to be mainly concerned with here is motion, purportedly denoting a power of bodies. Galileo accepts the existence of this power, thus watering down his Platonism; Descartes conceals this issue in his cosmology of vortices. Hobbes, in contrast, appears to undermine a qualitative understanding of motion. Yet, despite a largely critical discussion, Burtt concludes rather favorably by noting that “[Hobbes] is trying to reunite the sundered halves of the Cartesian dualism and bring man back into the world of nature as a part of her domain“ (1925: 125).

An interesting alternative to Hobbes and Descartes is provided by Henry More. Although initially appreciative of Cartesian mechanism, More admits the existence of ‘non-mechanically’ accountable phenomena; cohesion, magnetism, heaviness/gravitas (1925: 135), and, above all, human volition (1925: 131) cannot be convincingly explained on strictly mechanical grounds – in terms of ‘geometrical’ atoms and their collisions. More’s proposal is a vitalistic/animistic conception of nature, maintaining that extension should not be restricted to matter alone. Nothing whatsoever can be conceived without first possessing extension. Therefore, we must admit the existence of an extended spirit differing from matter in other qualities: spirit is penetrable and can penetrate and move matter; it can contract and dilate; it can also occupy greater or less space. This spirit resides in the bodily brain, but “it is able to spread throughout the whole body on occasion, and even slightly beyond the limits of the body” (1925: 128-129).

More’s metaphysics of extension serves the ideal of an integrated picture of mind, world and God that also accounts for the deficiencies of mechanism. As an active entity, i.e. as the causal agent for changes in motion, the spirit or soul has a genuine efficient role and is thus

subject to the dictates of the new science (1925: 134-135). However, the notion's significance lies in its theological implications. Our soul's active nature is indicative of more widespread activity, ultimately revealing a spirit of nature, a "universal soul of the world" (1925: 133). This spirit of nature attests to the presence of an "incorporeal substance of a higher order…a spiritual substance rational, purposive, extremely worthy of obedience and worship" (1925: 136). Moreover, the pervasive activity/motion in the world presumes an absolute and homogeneous space. Such absolute all-pervading space simply denotes the omnipresence of the divine.[10] More's metaphysics demands that God must also be viewed as an extended Being (1925: 137).

What Burtt highlights in More is an animistic world, alongside a (theological) hypostatization of space. Isaac Barrow, the Cambridge theologian and mathematician, attempts a similar theological treatment of both space and time. Burtt's analysis mainly focuses on *Lectiones Mathematicae* where Barrow admits that mathematics can be understood in pure and mixed form. A line can be considered abstractly – in geometry – or as a distance between the centers of two real bodies – in astronomy, optics and mechanics.[11] The geometer and the scientist both abstract from the sensible realm. Physics, so long as it is a science, is mathematical, and mathematics (geometry) is applicable to physics; these inquiries are "co-extensive and equal" (1925: 145).

Geometrical figures, therefore, "really exist in the sensible world, though not visibly or tangibly" (1925: 147). These figures also occupy space. However, space should not be identified with matter; the infinite nature of matter/space defies scripture. Moreover, space should not be viewed as an independent existent. Rather, it simply denotes the power of God to create matter and extend beyond it. Burtt further quotes a considerable portion of Barrow's writings where a similar interpretation of time is attempted: time should not be viewed as an independent existent, but as the "capacity or possibility of permanent existence" (1925: 150). In effect, Barrow "admits the validity of More's religious approach; considered as real and absolute existences [space and time] are nothing but the omnipresence and the eternal duration of God" (1925: 152). From the perspective of mathematical science "[space and time] express potentialities of magnitude and duration" (1925: 152). The disagreement between absolutistic and relational/relativistic treatment of these concepts disappears when one realizes the primacy of an independent and all-pervasive entity, God.

2.5. *Boyle*

Alongside the prevailing mathematicism, Burtt considers the presence of another, more empirically-oriented, current.[12] Variants of atomism were already revived in the natural philosophies of the time, including those of Galileo, Descartes and Gassendi. In such context, debates regarding the infinite divisibility of the constituents of matter were commonplace. A

[10] Burtt does not examine the theological parallels with Descartes' conservation of motion. More broadly, he does not entertain an absolutist account of Cartesian motion; Descartes' treatment is viewed as geometrical, hence relational/relativistic.

[11] 'Physics' is not mentioned in this passage.

[12] Burtt also briefly touches upon Gilbert's work on magnetism and Harvey's physiology. In what follows, I will mainly focus on his discussion of Boyle.

natural philosophy that did not delve into such controversy is traced in Boyle. Boyle adopted an atomism of strictly hypothetical standing: the guiding claim is that phenomena may be explained by reducing them to the motions and configurations of minute corpuscles.

On the issue of secondary qualities, and having already witnessed the danger of Hobbes' materialism, Boyle "is eager positively to reassert the factual place of man in the cosmos and his unique dignity as the child of God" (1925: 173). Boyle insists that all qualities, primary and secondary, are real. Nevertheless, the specifics of their reality remain ambiguous. Surely Galileo and Descartes did not deny the reality of the secondary qualities; instead, Galileo suggested their subordinate place in a correct cosmology, while Descartes admitted their ontologically distinct status. Nevertheless, both agreed that the perceived qualitative features are not parts of the objects themselves. Boyle's novel contribution appears to be that qualitative features are in the objects and can be explained by the primary qualities. Elsewhere, Boyle appears more clearly Aristotelian, noting that secondary qualities "have an absolute being" (1925: 174). For Burtt, these difficulties indicate Boyle's reactions towards the novel cosmological picture. His theological/ontological interventions are suggestive of "touches of the medieval teleological hierarchy…against the prevailing current" (1925: 176).

Contrary to his metaphysics, Boyle's epistemological proclamations appear modest. The Cartesian localization of mind in the brain denotes epistemological difficulties:

> How any certain knowledge at all is possible of the real corporeal world outside, with which the soul is never in contact? How is it possible for it to build an orderly system of ideas that shall truly represent a world forever inaccessible to it?...Boyle now raises the doubt, still rather naively and innocently, on the basis of the new psychology[:] I see no necessity that intelligibility to a human understanding should be necessary to the truth of existence of a thing, any more than the visibility to a human eye should be necessary to the existence of an atom, or of a corpuscle of air (1925: 178-179).

For Boyle true knowledge is strictly confined to the phenomenal. The phenomena, however, need not necessarily capture the real world. This epistemological problematisation highlights a "positivistic spirit" (1925: 180).[13]

2.6. *Newton*

Newton is viewed as an ingenious experimental scientist, but a derivative metaphysician. His methodological procedure, according to Burtt, and given Newton's own remarks, appears two-fold: firstly, we observe motions and deduce the forces responsible; then, we demonstrate further motions from the previously isolated forces. Of course, all demonstrations are mathematical. Thus, the natural philosophical mathematicism of his predecessors remains with slight deviations (1925: 205).[14] On the other hand, Burtt observes

[13] Yet, Burtt observes that Boyle shares More's more grandiose beliefs in the (metaphysical) inadequacy of mechanism. Thus, "God was somehow needed constantly to keep the universe from going to pieces" (1925: 191). God is not simply viewed as the first (efficient) cause of things, but as an entity that maintains the harmony of the world.

[14] Specifically, Burtt notes that Newton takes arithmetic and algebra as the basic mathematical sciences, not geometry. This directly relates to the development of the fluxional calculus whose "operations could not be

an equally strong empiricist component: "[t]he world is what it is; so far as exact mathematical laws can be discovered in it, well and good; so far as not, we must seek to expand our mathematics or resign ourselves to some other less certain method" (1925: 208). Newton's empiricism is most clear in his famous attack on hypotheses at the end of the *Principia*: anything not deduced from the phenomena is hypothetical and should be discarded. Discovered properties and experimental laws must have a phenomenal basis; the demonstration from our phenomenal basis secures their certainty. The impenetrability and mobility of bodies, the laws of motion and the law of gravitation are purportedly established on these grounds. At first approximation, Newton is the conflicting culmination of both his mathematical and empirical/Boylean precedents.

Yet, Burtt appears especially suspicious of the Regulae Philosophandi. These rules form the methodological edifice of the *Principia*. The empirical/phenomenal status of these principles is unclear. Specifically, the third rule maintains that "the qualities of bodies, which admit neither intension nor remission of degrees, and which are found to belong to all bodies within the reach of our experiences, are to be esteemed the universal qualities of all bodies whatsoever" (1925: 214-215). To Burtt, this rule appears Cartesian because it departs from experience and attributes properties to all existence. Newton admits that the Third Rule is motivated by the previous two, where the uniformity of nature and the ideal of minimizing the number of causes responsible for observed effects are denoted. Burtt, nevertheless, observes that this simply relocates the problem.

Regardless, the Regulae clarify that the abovementioned two-step procedure (observation of motion/detection of forces, demonstration of further motions from forces) is schematic. Instead, Newton's method is significantly more laborious. According to Burtt, Newton's procedure begins with an artificial experimental situation that simplifies the observed phenomena. This step allows the introduction of physical concepts, the isolation of quantitative features and the articulation of basic propositions. Secondly, our basic propositions are further elaborated mathematically. Thirdly, a round of experimentation occurs that either confirms our propositions, or helps us detect additional causes hitherto escaping notice. Fourthly, if further causes are detected/suspected, we repeat the process by subordinating their effects to mathematical treatment and experimentation. In the case of Galileo, experiment comes last; in the case of Newton, "experimentation must occur at the beginning and end of every important scientific step" (1925: 218).

Thus far, the presence of a genuine metaphysical component might look questionable. And, indeed, the conventional interpretation is that Newton is the consistent follower of Galileo and Boyle and, therefore, "the first great positivist" (1925: 223).[15] Nonetheless, Burtt disagrees. Metaphysics typically takes three forms: firstly, our historical context forces upon us specific cosmological views. Secondly, serious inquirers possess a method and typically attempt to draw that method's metaphysical implications. Thirdly, human nature itself demands metaphysics; the greatest of minds inevitably entertain ultimate notions (1925: 227). On these grounds, and despite his self-professed empiricism, Newton outlines a world

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fully represented geometrically" (1925: 206).

[15] Burtt makes extensive critical use of David Brewster's 19th century biographies of Newton. The 'positivist' view is purportedly drawn from Brewster's *Memoirs of the Life, Writings and Discoveries of Sir Isaac Newton* (1865). For a contextual discussion of Brewster's related work see Higgitt (2007).

of particles with primary geometrical qualities alone.[16] In line with previous thought, perceived change is explained via the motions of these particles. Moreover, the Cartesian physiology and theory of perception are gullibly adopted:

> …in the Opticks, [Newton gives] full assent…to the orthodox view. Man's soul…is locked up within his body and has no immediate contact whatsoever with the outside world; it is present in a particular part of the brain, called for that reason the sensorium, to which motions are conveyed from external objects by the nerves, and from which motions are transmitted to the muscles by the animal spirits (1925: 230-231).

Unsurprisingly, Newton affirms how his experiments on refraction and reflection have overthrown the view that color, a secondary quality, is a real property of bodies. Philosophically speaking, colors have no real existence, but "are phantasms produced in our minds by the modes or actions of light" (1925: 233). Finally, a similar gullibility is observed in the notions of space, time and motion, although these concepts attain interesting novel connotations. Sense perception dictates that space, time and motion (and rest) should be attributed relative status. For Newton, beyond the relativist treatment of these quantities one must also accept their absolute existence. Newton admits that his absolutist conception can be experimentally proved.[17] However, this admission should not conceal the fact that Newton's insistence has a deep theological basis:

> To him, as to More and Barrow, space and time were not merely entities imposed by the mathematico-experimental method and the phenomena it handles; they had an ultimately religious significance which was…fully as important; they meant the omnipresence and continued existence from everlasting to everlasting of Almighty God (1925: 256).[18]

Thus, despite his 'empiricist' insistence, Newton succumbs to the mathematical treatment of nature, uncritically adopts the Cartesian physiology and dualist theory of perception, and is motivated to hypostatize space and time on theological grounds. In effect, Newton possesses a rather detailed and extravagant cosmology, one that would exert pervasive influence in subsequent thought.

2.7. Burtt's Conclusions

Burtt's strictly present-centered conclusions appear incongruous with his historical undertaking. He commences by observing three divergences in modern cosmological thinking: i) of reality, ii) of causality and iii) of the human mind. Firstly, the Aristotelian

[16] The sole exception is the notion of vis inertiae, a quality/power that is also treated mathematically (1925: 230). I have also omitted Burtt's extensive discussion on the aether, a concept with theological connotations that also serves the potential 'physical' purpose of the mediator of gravitational and magnetic forces.

[17] Surprisingly, Burtt is not wholly unsympathetic to Newton's famous example of the rotating bucket of water (1925: 252-253).

[18] As Burtt argues, "Newton's longer theological treatises, such as the *Observations on the Prophecies*, but confirm these indications that he was a pious, believing Christian, in all that the term then implied, as well as a master scientist. His Arianism was radical for the age, but it did not prevent his approaching the world of science under the necessity of seeing it cloaked by a divine glory…" (1925: 283).

qualitative and hierarchically ordered cosmos is replaced by a world of atoms that possess mathematical properties. Secondly, formal and final causes are obsolete and efficient causality reigns. Thirdly, the human mind is localized in the brain and conceived as the realm of inner sensations. The relationship between mind and world is understood in Cartesian terms, motivated by the doctrine of primary and secondary qualities.

Despite the pessimistic presuppositions of post-Newtonian cosmology, Burtt maintains that it should not be wholly discarded:

> Well it ought to be fairly obvious after the feats of modern science that the world around us is, *among other things at least*, a world of masses moving according to mathematical laws in time and space…To bring complaint against so much would be to deny the actual usable results of modern scientific inquiry into the nature of our physical environment (1925: 301-302) (italics not original).

However, the unreflective insistence on the exhaustiveness and finality of the above picture is precisely what generates the metaphysical conundrums of our time:

> [W]hen in the interest of clearing the field for exact mathematical analysis men sweep out of the temporal and spatial realm all non-mathematical characteristics, concentrate them in a lobe of the brain, and pronounce them the semi-real effects of atomic motions outside, they have performed a rather radical piece of cosmic surgery which deserves to be carefully examined (1925: 302).

Burtt then surprisingly attacks Berkeley and Kant. The former is perceived as failing to appreciate the value of mechanical science. Furthermore, his empiricism was short-sighted. Berkeley raised a polemic against abstract ideas; his real enemy should have been "a doctrine of mind and its world" (1925: 304). On the other hand, Kant erred on different grounds. By granting that the new metaphysical picture of the universe applies to phenomena alone, he proposed a dualistic self[19] that leaves room for "human ideals and cravings" (1925: 303). Yet, Kant reverted to another absolutism, namely the idea that our ideals and practices are specific and uniform. Kant's moral framework, therefore, demands even more elaborate justification than the emerging scientific worldview.

Nevertheless, Burtt admits that such philosophical reactions are understandable. Every post-Lockean philosopher simply reacts to the following question: "taking for granted the assumptions, methods, and results of science, how and how far is man's knowledge of his world possible?" (1925: 304). Nonetheless, this problematic denotes a degrading role for modern philosophy. The discipline has failed to fulfil its historical purpose in providing an exalted view of humanity:

> Others are attacking the problem in terms suggested by present scientific and pragmatic interests; the present study has furnished in outline the historical background of such analysis; it waits only for enough thinkers to see clearly that modern philosophy must for ever remain in its pitiful rut until such an analysis is once

[19] Presumably, Burtt refers to Kant's distinction of the empirical and transcendental self.

> for all done. For those who believe that metaphysics is and always must be the heart of philosophy, this is the only path to a genuine and vital reconstruction of philosophy (1925: 305).

Burtt illustrates how a metaphysical 'reconstruction' can occur by attacking the brain/mind localization thesis. A notable proponent of this analysis is the Darwinian Thomas Huxley, adopting a dualistic view of perception and even flirting with the Berkeleyan position. The claim here is that a sensation occurs in specific parts of the brain, without being strictly reducible to it; this representational account suggests that, in a deep sense, things are not seen, touched, or heard. However, no science of sense perception is ever possible without first admitting "the trustworthiness of our immediate perception of spatial directions and relations" (1925: 312-313). Huxley takes for granted that a sensation of pain, for example, is not located in our limbs, but in the brain. This position "[f]latly contradicts the immediate testimony of sense [and] can only lead, if carried out consistently, to the complete extinction of science as we know it and must inevitably appear to abolish the extended universe itself" (1925: 314).

Having affirmed the 'trustworthiness of immediate sense perception', Burtt finally envisions an alternative cosmology:

> The material world in its spatial expanse seems to be an object of mind, but not its cause nor its complete stimulus…it is the object of cognition as a marvellous system of orderly mathematical relations; it is the object of aesthetic joy as a gloriously beautiful harmony; it is the object of purpose as a vast yet absolutely regular and dependable means for the ever enrichment of life and the achievement of ideal ends. Mind appears to be an irreducible something that can know the world of extended matter, love ardently its order and beauty, and transform it continually in the light of a still more attractive and commanding good (1925: 318).

Burtt maintains that the material world is cognized by the mind though it does not exhaust the stimulus of mind. After all, an extended material world is a recent historical phenomenon as his treatise details. What one should concede is that the world is not a static but a dynamical and pluralistic concept. Moreover, the import of the human mind is elevated. Nevertheless, the time is ripe for more precise transformation. The main problem of the new cosmology is that it outlines an erroneous account of nature, reduced as an elaborate geometrical/mathematical structure. However,

> mind [is] not subject to mathematical handling. It consists of too many irreducible, unpredictable, unformulable things; is it a wild and violently changing jumble of feelings, beliefs, longings, visions, secondary qualities. In the face of such volatile phenomena the mathematical mind stands confounded and abashed (1925: 324).

Modern physical science is not devalued as it retains its instrumental use and, perhaps, parts of its cosmology. The problem consists in the lack of recognition of its limited domain and dynamic nature. Subordinating the mind to a mathematical conception is an impossibility. The alternative of strictly demarcating the mind and imposing on it everything that cannot be explained by mathematical science also generates a dead-end; mind and world should be

treated as intertwined. However, modern inquiry is mired by a strange dualism between theory and practice; on the one hand, mathematical particles are presumed to be the only real things; yet, practical applications of science conceal how these 'real' things are exploited for 'unreal' ideal ends. This dualism has a metaphysical basis that must be overcome: we must get rid of our cosmological mathematicist pretentions (1925: 330).

3. Interpreting Burtt

Having summarized Burtt's treatise, I shall now briefly designate the few and disparate interpretations in the relevant literature, as well as highlight my own approach. The most surprising fact is that despite the influence of the historical aspects of Burtt's work, its concluding – and central – claims appear mysterious[20] with the major critical commentators expressing numerous views. Daston maintains that "Burtt's metaphysical yearnings sprang from…the radical empiricisms of Henri Bergson, William James, and…Ernst Mach" (1990: 529). Robert Westman briefly brands Burtt's work as "neo-Kantian" (1994: 87). Hatfield (and Daston) discusses Burtt as a proto-Collingwoodian,[21] imposing on past figures, and for his own metaphysical purposes, the anachronistic view of metaphysics as "the absolute nonempirical presuppositions of a thinker or an age" (1990: 94).[22] Even Bertrand Russell, an astute philosophical contemporary with connections to Burtt's Columbia philosophy department,[23] maintained in his *History of Western Philosophy* that *MF*'s enterprise is ultimately destructive, as "[t]he general purpose of [the] book is to discredit modern science by suggesting that its discoveries were lucky accidents springing by chance from superstitions as gross as those of the Middle Ages" (1946: 549). Common to these critical pronouncements is a neglect of Burtt's intellectual milieu. One also witnesses a polemic move to unearth a highly specific motivation behind his historical undertaking.

Contextual accounts of Burtt's early intellectual outlook do exist. Firstly, there is Francis

[20] The obscure origins of Burtt's work have led notable historians like Cohen to imply the work's 'ahistoricity': "[i]n its location beyond philosophical or historical currents or fashions [*MF*] just represents that priceless thing: the individual thought of an individual thinker" (1994: 88-89).

[21] On Burtt's eventual discovery of Collingwood, also touching upon his late thought, see Villemaire (2002: 215-232).

[22] Burtt's understanding of metaphysics occasionally resembles Collingwood's, denoting the absolute presuppositions of inquiry. As noted, Daston and both claim is that Burtt neglects how metaphysics was understood in the 17th century, i.e. as an inquiry with its distinctive method and subject-matter. They are partly correct. Kepler aside, it is indeed questionable whether Burtt's examined subjects possessed a metaphysics in this historicised sense. Specifically, Burtt's allusion of an unreflective 'mathematicist' Descartes, seemingly ignores the metaphysical (and physical) intricacies of the *Meditations* and *Principia.* Nonetheless, I will maintain that Burtt's presentist leanings are not unreflective. Moreover, as my summary of *MF* hopefully clarifies, Burtt remains flexible in his understanding of metaphysics, appropriately discussing More's spirit of nature as a reaction to the Cartesian metaphysical concept of extension. Hobbes' metaphysics of extension and motion also appear contextual. Even Copernicus' Pythagoreanism, the starting point of Burtt's inquiry, is attributed to Novara. For a recent and similarly critical discussion see Ariew (2014: 131-137). Ariew abstains from characterising Burtt's work in narrow philosophical terms, but labels Koyré's related historical thesis as "Husserlian- and Bachelardian-inspired" (2014: 131).

[23] In a 1911 letter to Lucy Donnelly, Russell noted: "I am interested to hear I have admirers in Columbia – the American Realists take very largely the same view of the nature of things as I do, and seem to be the dominant school among the younger men" (Griffin 2002: 378-388). Russell would spend a few months teaching in Harvard in 1914, while giving a series of lectures in other American universities, including Columbia. For a candid account of Russell's experiences during these months see Willis (1989).

Moriarty's doctoral dissertation titled *The Philosophy of E. A. Burtt: The Metaphysical Foundations for a World Community* (1994) and completed in Adelaide's politics department. The second is Diane Davis Villemaire's *E. A. Burtt, Historian and Philosopher* (2002), an elaboration of her doctoral thesis (1998) completed in McGill's history department. Both works contain numerous biographical, chronological and institutional details that go beyond Burtt's early treatise, but are often thin in philosophical[24] and scientific detail, presumably due to the purposes and educational background of the authors. Moreover, both works are occasionally hyperbolic on the originality of Burtt's early thought.[25]

Nevertheless, Moriarty and Villemaire correctly point out that *MF* was Burtt's doctoral thesis in Columbia's philosophy department. Therefore, Burtt is best understood when situated within the early 20th century American philosophical context in the aftermath of idealism and the rise of pragmatist, naturalist and realist alternatives. The interpretative problem remains, however, as Moriarty and Villemaire also offer contradictory accounts. Moriarty views *MF* as "itself a metaphysical treatise" (1994: 42) with Burtt being "one of the 'diminishing' number of American idealists who were on the defensive against pragmatism, realism, and naturalism" (1994: 36). Burtt became a pragmatist only in 1928, a few years after publishing his dissertation. In contrast, Villemaire describes the young Burtt as being influenced by Frederick Woodbridge and Morris Cohen's naturalisms and realisms (his supervisors), though mainly espousing John Dewey's pragmatism.

These more accurate interpretations appear to be motivated by a brief passage in Burtt's 1972 autobiographical essay:

> With what philosophical point of view did I begin my career as a teacher? Looking back to that period, I see that it was a rather incoherent form of idealism, reflecting the liberal Protestant orientation I had then adopted. The idealism was gradually revised to make room for major aspects of Deweyan instrumentalism. In my years at Columbia, Dewey had impressed me as a person, and during my decade in Chicago, in close contact with colleagues whom he had deeply influenced, I came to accept what appeared to be the core of his contribution to philosophy. But continued sensitivity to insights from various quarters prevented me from becoming a disciple of any one philosopher or philosophical school (Burtt 1972: 430).

There are certain chronological complexities to unpack here. Burtt clarifies that his idealist days reflect his first days as a teacher, not a researcher – hence, the apparent scholarly disagreement. We know that Burtt started to work as an instructor in Columbia in 1921, one year before he was awarded a graduate degree in theology. He commenced his research in 1922, completing it very quickly sometime during 1923. His thesis, originally titled *The Metaphysics of Sir Isaac Newton, A Critical and Historical Essay*, was published as *The Metaphysical Foundations of Modern Physical Science* by Harcourt, Brace and Company in

[24] Crucially, none of these works contain a proper discussion of Woodbridge's naturalism and realism.

[25] Villemaire is especially guilty of this, noting Burtt's obvious anticipation of Kuhn's *Structure*, even postmodernism (2002: 3-6; 9-10; 107; 118-120). These supposed anticipations, although not wholly unjustified, should be partly attributed to Dewey, if not earlier historicist traditions. For a recent work examining how Deweyite pragmatism foresees and overcomes postmodern problematics see Hickman (2007).

1924, and by Kegan, Paul, Trench Trubner & Co in 1925. By the time of the latter publication (1925), Burtt was already teaching in Chicago's philosophy department for two years. He would remain there until 1931, working alongside major Chicago pragmatists like James Hayden Tufts and George Herbert Mead. The second revised edition of *MF* was published in 1932 by Harcourt, Brace and Company; in that year, Burtt would also join Cornell's Sage School of Philosophy where he spent the rest of his career.

Moriarty claims that Burtt wrote *MF* in an idealist mood and then came to appreciate Dewey's form of pragmatism due to his surrounding Columbia and Chicago influence. However, the idealist interpretation is erroneous. Setting the content of *MF* aside, Burtt's autobiographical remarks clarify that his 'incoherent' idealism was already in flux. Moreover, Burtt clarifies that he always remained sensitive to his surrounding philosophical schools. Yet, the most obvious clue comes from Woodbridge, an avowed realist (anti-idealist) who remained selective with his graduate students.[26] It is implausible that he would supervise a thesis with a clear idealist orientation.[27] Indeed, I plan to show that Woodbridge's intellectual outlook is a contributing factor in *MF.*[28]

In contrast, Villemaire seemingly stands on firmer ground, examining Burtt's work in the light of his Columbia contemporaries. Generally, I agree with her orientation and believe that it deserves further elaboration. The main problem is that her more specific descriptions engender confusion. For example, Villemaire claims that Burtt was a member of the Pragmatic Naturalist movement, mainly constituted by Dewey's disciples. Yet she describes Dewey (and Burtt) as idealistic in outlook (2002: 11), adding that "Burtt and the other Naturalists were essentially realists" (2002: 16) though, when compared to Woodbridge, "Burtt…was a reluctant naturalist and half-hearted realist" (2002: 35). Finally, Villemaire maintains that Burtt's conclusions in *MF* "must have stepped heavily on Woodbridge's aversion to idealist epistemology" (2002: 37). These conflicting characterizations are philosophically unclear, if not contradictory.

I hold that only an in-depth historiographical analysis, explicitly relating crucial details of *MF* with the philosophical problems of his setting, helps us properly identify Burtt's numerous aims and presuppositions as a historian. Blanket descriptions are unhelpful, contributing to the confusion. The additional benefit of my historiographical argument is its strictly historical orientation. Burtt's text does not solely describe the development of early modern science, but also wonderfully captures diverse intellectual anxieties of early 20th century American

[26] As Edward Strong notes,

> [Woodbridge] would pose a question or a problem, he would develop it, and then he would require his students to continue with it. I was determined…that I would do my Ph.D. under Woodbridge, if he would accept me. I knew that he would not accept me unless I fitted in with research in which he was interested in and judged me capable of carrying it out (1990: 40-42).

[27] This is further corroborated by Burtt's admittedly few, albeit critical, quips towards idealism (Burtt 1925: 10; 308). Moreover, his concluding condemnations of Berkeley and Kant are equally revealing of a non-idealist intellectual orientation.

[28] Moriarty's interpretation faces additional problems. Burtt had already taught courses in reflective thinking from 1921 onwards, using Dewey's related works as textbooks (Villemaire 2002: 20). Moreover, in the year of the alleged conversion to pragmatism, he published a lengthy textbook on reflective thinking/logic (Burtt 1928), a textbook clearly influenced by Dewey and recognized as such (Robinson 1929; Mitchell 1929: 590). On a relevant note, the scope of Burtt's textbook is impressive, incorporating a technical chapter on reasoning in the development of early modern astronomy and mechanics.

philosophy. Therefore, a historiographical examination of *MF* invites a contextual analysis of generally neglected philosophical perspectives from Burtt's distinctive Columbia setting.

4. Isolating Burtt's Philosophical Context

4.1. *Epistemologically-Driven Idealism and Montague's Early Reaction*

Having delineated my own approach, I shall now examine Burtt's philosophical context. This will enable me to draw the appropriate historiographical conclusions in section 5. Before I outline the Deweyite and naturalist positions, I will first expand on the realist background of Burtt's work. The early 20th century saw the revival of realist philosophies and a retreat of the varieties of idealism that dominated the Anglo-American philosophical scene from the mid-19th century onwards. In the United Kingdom, the idealist philosophies of Caird, Bosanquet, Bradley, Green, McTaggart were abruptly challenged by the realist alternatives of Russell and Moore. A similar shift occurred in the United States. Post-Kantian idealisms were populating the country from the mid-19th century onwards. Douglas Anderson observes that the American Midwest, especially St Louis and Ohio, was home to numerous idealistic philosophers like August Willich, John Stallo, Monscure Conway, Thomas Davidson, Henry Clay Brockmeyer and William Torrey Harris. The first philosophical journal in the United States was created by Harris in 1867, translating the works of Hegel, Fichte, Schelling, but also publishing early manuscripts by Josiah Royce, Charles Peirce and William James (Anderson 2004: 27). The American idealist movement had a similar fate with its British counterpart as it lost its momentum with the growth of realist, including pragmatist, philosophies. Burtt's Columbia philosophy department contributed to this turn of events.

Royce's mature idealism, outlined in *The World and the Individual* (1900), sets the agenda for our discussion. One of the first 'Columbia' attacks on Royce was William Pepperell Montague's *Professor Royce's Refutation of Realism* (1902). Montague wrote the article when he was in Berkeley. He would move to Columbia a year later, where he taught for more than forty years. Burtt was exposed to Montague's writings and teaching, writing a generally favorable review of Montague's *Ways of Knowing* (1925) shortly after the publication of *MF* (Burtt 1926).

According to Montague, Royce argues that by accepting "the independence of object and idea, [realism] asserts the existence of a world of independent beings" (1902: 43). A presumption of this proposed independence is the doctrine of external relations. This doctrine maintains that obtained relations between an object x and an idea y are assumed to be external, in the sense that the object x and the idea y are independent existents and the former is not altered when it interacts with the latter. Royce maintains that such presumption renders experience impossible, because experience presumes a similarity between object and idea.

Montague's first target is Royce's emphasis on the doctrine of external relations, maintaining that the real is defined as that which makes us aware of its reality. For example, a realist who visually perceives a chair "wishes to find out whether the chair and its idea are merely two aspects of one fact, as the idealist believes, or whether they are two numerically separate facts, as he himself believes" (1902: 45). The idea of a chair may fade, but the chair itself

does not. Thus, variations in our idea have not altered the object of perception. The doctrine of external relations is simply a consequence of our procedure in examining whether an object is numerically distinct from our idea of it.

Another implication of the externality of relations for Royce is a form of mutual independence; object and idea have their own separate essences, as it were: the realist insists on numerical difference. However, numerical difference is a (reciprocal) relation; relations should be denied when the supposed relata (of the knowing relation) are absolutely distinct. More crucially, the mind appears to be wholly responsible for overcoming the alleged independence of object and idea. Royce's point here is that these realist admissions sound suspiciously idealistic. In his response, Montague maintains that Royce has not properly considered the status of the knowing relation. Firstly, an idea can exist in the mind of a perceiver who avoids to empirically test it. The independence of idea and object may be due to the artificial protection of the agent. The alleged 'reciprocality', alongside the presumed import of mind, are not genuine obstacles when one realizes that fresh experience of objects can alter an idea, but the reverse is not possible.

Montague's article concludes by affirming the realist alternative. It is admitted that idealism has indeed rendered explicit the difficulty to imagine how we can conceive things which are not inside a mind. The realist admits this difficulty, yet she remains agnostic on the nature of the relation between idea and object; it is assumed that these independent things can indeed interact/relate to one another. The sole motivation for abandoning idealism at this stage is experience itself, especially the observed contrast between the perceived variation of idea and the lack of similar variation in the object.

Summarizing Montague's early reaction, we may observe the primacy of epistemology in settling metaphysical debates. The correct metaphysics is grounded in reflections regarding the knowledge relation. The common assumption among realists and idealists appears to be that knowledge involves a knower, – a 'subject' – a knowledge relation – involving 'ideas', 'phenomena', 'appearances' – and the object known – the real.[29] What is effectively disputed in metaphysics is the ontological status of some, or all of these. However, both Montague and Royce fail to render explicit at this stage that their disagreement is rooted on perceptual issues. On the one hand, there is a subjective domain of experience (the knower); on the other, there is reality (the known). All participants in this debate assume that a subjective idea need not capture the real object. The idealist simply maintains that the very possibility of a relation between idea and object presumes the ideal nature of the known. The realist, on the other hand, believes in the ideal nature of the knower and the knowledge relation. One way to settle this dispute in favor of realism is to eliminate the subjective part of the knowledge relation; in effect, what must occur is a retreat to a form of naïve realism where the real object is immediately perceived. This realization culminates in the new realist debates that would play a crucial role in the American philosophical scene of the following decades.

4.2. *Towards New Realism*

[29] These distinctions are presumably solely practical for the absolute idealist.

There are two main Columbia-related events that contributed to the diminishing popularity of American idealism. In 1904, Woodbridge established the Journal of Philosophy, Psychology and Scientific Methods. The original goal of the journal was to provide a realist substitute for the Cornell-based and idealist-oriented Philosophical Review. The second event was the publication of *The Program and First Platform of Six Realists* (Holt et al. 1910), culminating in *The New Realism: Cooperative Studies in Philosophy* (Holt et al. 1912). These works were written by six realists, two of whom were Columbia's Montague and Walter Pitkin.[30] Woodbridge's realistic outlook will be examined last. Here, I will briefly recap some of the main claims of the New Realist platform by focusing on the 1912 publication.

The book contains a lengthy introductory statement by the six authors, alongside an article by each that elaborates on selected realist themes. The common statement begins by outlining three competitors for a theory of knowledge. The first theory is naïve realism, where no distinction between 'seeming' and 'being' is made. The main problem with naïve realism, however, is the existence of error. If seeming and being are identical, how can we ever make mistakes? The second view is a dualistic ontology,[31] dividing the world into two distinct realms: "the one visible, tangible, and regular, the other more or less invisible, mysterious, and capricious" (1912: 3). Dualism has the additional advantage of dictating a representational account of perception, whereby "the mind never perceives anything external to itself. It can perceive only its own ideas or states" (1912: 4). Thus, dualism can account for error because a perceived idea need not correspond to an object. This is where the dubious subjectivist project begins, however. According to this third position, one can never properly discuss a world of "extra-mental objects" (1912: 5). Subjectivism is more closely linked with idealism, lending credence to the belief that "there can be no object without a subject, no existence without a consciousness. To be, is to be perceived" (1912: 5).

The origins of subjectivism are traced in the early modern period, culminating in Berkeley's treatment of the doctrine of primary and secondary qualities:

> [Subjectivism] occurs in its first and most conservative form in the philosophy of Berkeley. Descartes and Locke, and other upholders of the dualistic epistemology, had already gone beyond the requirements of the picture theory in respect to the secondary qualities of objects. Not content with the doctrine that these qualities as they existed in objects could only be inferred, they had denied them even the inferential status which they accorded to primary qualities. The secondary qualities that we perceive are not even copies of what exists externally. They are the cloudy effects produced in the mind by combinations of primary qualities, and they resemble unreal objects in that they are merely subjective (1912: 6).

Kant is also viewed as an advocate of subjectivism, crucially responsible for present idealisms. Firstly, a reality beyond any possible experience (the things-in-themselves) as the ultimate cause of appearances is admitted. Secondly, not only the objects of perception are deemed subjective, but nature's laws are subsumed to the a priori forms of intuition and the

[30] For a collection of articles that summarise the realist-idealist debates in 1910-1920 see de Waal's three-volume collection (2001). For a rudimentary summary of new realist tenets see Kuklick (1977: 338-350). See also Scardicchio (2012).

[31] Notice once more how epistemological, ontological and perceptual problems are intertwined.

categories. Thirdly, there is a novel feature where the knower herself becomes a "twofold being, transcendental and empirical" (1912: 8). The transcendental self gives laws, while the empirical self is simply an object like any other without a privileged status. Post-Kantian idealists exploit all these subjectivist traits: first, the belief in a non-experiential reality is abandoned; secondly, the legislative power of the knower is further extended by assuming that all relations, not merely spatio-temporal ones, are grounded in it; thirdly, the duality of the transcendental and empirical self is hypostatized, as empirical selves and their own experiences are viewed as fragments of a "single, perfect, all-inclusive, and eternal self" (1912: 9).

As expected, the liberation from contemporary philosophical ills[32] demands a return to a form of naive realism:

> the escape from subjectivism…is prior to all other philosophical issues, such as monism and pluralism, eternalism and temporalism, materialism and spiritualism, or even pragmatism and intellectualism…It is essential to get rid of subjectivism. The new realists' relational theory is in essentials very old…In short, the new realism is, broadly speaking, a return to that naïve or natural realism which was the first of our three typical theories of the knowledge (1912: 10).

The realistic program was not simply construed as a polemic against subjectivism, but had a constructive side of its own. I shall mainly focus on those elements that appear relevant to Burtt's project. Firstly, the realists agree on the fallacy of the ego-centric predicament; this fallacy suggests that although it may be impossible of finding anything that is not known – hence related to a mind given the alleged 'mental' status of cognition – this realization simply reflects a predicament and tells us nothing about the actual nature of things (1912: 11-12).[33] Secondly, there is a fallacy of exclusive particularity, whereby an object that partakes in a particular system belongs to and can be exclusively explained by that system. Objects partake in numerous intellectual contexts, and no system of philosophy can claim exclusivity. For example, naturalism denotes a "naïve bias for the space-time order, or that historically series of bodily changes which constitute the course of nature. Naturalism asserts that this is the only system, and that its terms, the several bodily events, belong to it exclusively" (1912: 15). However, so-called bodily events, presume, non-bodily events like places, times, numbers, etc. Thirdly, there is a speculative dogma (1912: 18), according to which philosophy must be in search of ultimate explanations. The plausibility of such explanations should, at best, be treated as an open question.

The closer examination of these positive tenets highlights four main tendencies: firstly, i) there is the detachment of metaphysics and epistemology; metaphysics can be pursued without an explicit focus on epistemological or perceptual issues. Moreover, ii) there is a respect for intellectual contexts where no specialized inquiry might subordinate the rest.

[32] Idealism is not explicitly stated in this passage, but it is obvious that this is the realists' main target.

[33] The term 'ego-centric predicament' was coined by Ralph Barton Perry (1910), one of the co-authors of the 1912 manifesto. As Perry notes, "[s]cience has occasion to eliminate errors of judgment and relativities of sense, but has no occasion to eliminate consciousness altogether; and therefore has not discovered that it is impossible. We can not then, disagree, as to the fact, nor as to its peculiarly philosophical or epistemological significance" (1910: 7).

This admission dictates a significantly liberal conception of the real, or reality. Specialized disciplines, including philosophy, history, the sciences, etc., reveal numerous realities. Deciding which of these 'realities' is the absolute/final one is a derivative, and very likely misguided intellectual pursuit; inquiry commences with the prior acceptance of a respective reality. Relatedly, iii) philosophy should be viewed as a cooperative and pluralistic enterprise; the search for singular, exclusive, ultimate explanations may be a step in the wrong direction.[34] Finally, and more radically, iv) the call for a retreat to naïve realism, a view with obvious Aristotelian precedents, implies that modern philosophy is tragically misguided.

[Continued in Pt II. where I examine the intellectual outlooks of John Dewey and Frederick Woodbridge, while also offering a series of historiographical conclusions that render explicit the connections between *MF* and Burtt's philosophical context.]

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[34] These points may entail certain radical departures from British realistic developments. I cannot deny these. Russell's mature realistic endeavours, specifically his logical atomism and theory of perception, remain reductionist. As a young John Herman Randall noted:

> [Russell] recognizes the true meaning of reality, and like some medieval mystic he proclaims that all experience is appearance and mere sensibilia; the world of reality is not what it seems but is motionless and frozen in its icy precision. yet bathed withal in a wondrous light. One may not agree with him in overlooking man in his insignificance, but one can not help admiring the boldness with which he deifies that which for him has supreme value (1920: 345).

Still, there are numerous surprising similarities that I have omitted in my discussion. The new realists unanimously called for linguistic clarity, definitions and analysis (Holt et al. 1912: 21-30). And, despite their alleged pluralism, American realists expressed a preference for logic in philosophical theorizing.

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- Contextualizes a classic historical account of the Scientific Revolution
- Elaborates on key publications from Columbia's philosophy department during 1902-1926
- Outlines key incidents in the historical development of American realism and pragmatism
- Integrates the history and historiography of science, the history of philosophy and the philosophy of science