



Metaphysics and the **Philosophy** of **Science** NEW ESSAYS

Edited by Matthew H. Slater
and Zanja Yudell

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Author Bios

Katherine Brading is Professor of Philosophy at the University of Notre Dame. She works on topics in history and philosophy of physics from the seventeenth century to the present, including spacetime theory, symmetries and conservation laws, structuralist approaches to physics, and matter theory. Her current project concerns eighteenth century natural philosophy in the wake of Newton's *Principia*, with a particular focus on Émilie Du Châtelet.

Jenann Ismael is a philosopher of physics. She has written on probability, time, causation, modality, and quantum ontology. She has also engaged with issues in the philosophy of mind, applying the formal apparatus associated with symmetry to understanding interactions among perspectives, self-location, and consciousness. Recently she has been thinking about the relationship between physics and free will. She has been a professor at the University of Arizona since 1996 and held fellowships at Stanford, the National Humanities Center, and a QEII fellowship from the Australian Research Council.

James Ladyman studied pure mathematics and philosophy at the University of York, and then took a masters in history and philosophy of science and mathematics at King's College London. He completed his PhD, on the semantic approach to scientific theories and structural realism, under the supervision of Steven French at the University of Leeds in 1997. He has been assistant, deputy and co-editor of the *British Journal for the Philosophy of Science* and honorary secretary of the

British Society for the Philosophy of Science. He is professor of philosophy at the University of Bristol.

Juha Saatsi is an Associate Professor of Philosophy at University of Leeds. He works on a variety of topics in the philosophy of science, including scientific realism and theories of explanation.

Matthew H. Slater is an Associate Professor of Philosophy at Bucknell University, having received his PhD from Columbia University. He is the author of *Are Species Real?* (Palgrave, 2013) and has co-edited such volumes as *Carving Nature at its Joints*, *The Environment*, and *Reference and Referring* (MIT Press) and writes on issues in the philosophy of science and metaphysics.

P. Kyle Stanford is professor and chair of the Department of Logic and Philosophy of Science at the University of California, Irvine. He is the author of *Exceeding Our Grasp: Science, History, and the Problem of Unconceived Alternatives* and many further articles concerned with scientific realism and instrumentalism, as well as the philosophy of biology, the history of modern philosophy, and the philosophy of language. He is currently working on evolutionary explanations of human moral psychology and of cognition more generally.

Michael Strevens is a professor of Philosophy at New York University. He was born and raised in New Zealand. He moved to the United States in 1991 to undertake a PhD at Rutgers University; currently, he teaches philosophy of science at New York University. His academic work covers topics such as understanding, complexity, causation, and the social structure of science, as well as the philosophical applications of cognitive science.

Martin Thomson-Jones is a professor of Philosophy at Oberlin College. Before Oberlin, he taught at Princeton and then at the University of California, Berkeley. His current research focuses on a cluster of questions about representation in the sciences, including questions about the nature of models and modeling, and about the connections between scientific representation and “ordinary” fiction. He has also worked in the philosophy of physics and in related areas of metaphysics.

C. Kenneth Waters has held the Canada Research Chair in Logic and Philosophy of Science at the University of Calgary since 2014. Previously, he served as Director for the Minnesota Center for Philosophy of Science. His research examines the nature of knowledge in the context of scientific practices and the conditions that make this knowledge possible. Much of his work examines biological sciences and the way biologists seek to investigate, manipulate, and understand life.

James Woodward is distinguished professor in the Department of History and Philosophy of Science at the University of Pittsburgh. Prior to 2010, he was the J.O. and Juliette Koepfli Professor at the California Institute of Technology. Much of his work, including his 2003 book, *Making Things Happen: A Theory of Causal Explanation*, explores issues having to do with causation and explanation, but he also maintains an interest in scientific methodology more generally.

Zanja Yudell is an associate professor of Philosophy at California State University at Chico, having received his PhD from Columbia University. He works on topics in the philosophy of science, especially laws of nature and explanation.

METAPHYSICS AND THE PHILOSOPHY OF SCIENCE

Introduction

Zanja Yudell

HAVE WE PHILOSOPHERS of science come to bury metaphysics or to praise it? More than one observer has noted that the history of philosophy has followed a cycle in which metaphysics repeatedly falls out of favor, only to return again, characterizing this cycle using metaphorical language of death, burial, and resurrection (e.g., Callendar 2011, 35; Lowe 2011, 102–5; Price 2009, 322). Within the Anglo-American tradition, there is a fairly well-known story about a recent iteration of the cycle in the fortunes of metaphysics. The story begins in the early twentieth century with the empiricist rejection of metaphysics. As described by Ayer (1936), the logical positivists' and empiricists' rejection of metaphysics ultimately derived from the verifiability theory of meaning: strictly speaking, metaphysical claims are not verifiable and hence meaningless. By contrast, scientific claims offer themselves as clear paradigms of verifiability and hence meaningfulness. They aimed to make philosophy rise to the standard of science, and an essential component of that project was to expunge metaphysics from philosophy (Creath 2011). Thus, a line in the sand had been drawn: to claim the mantle of science (and scientific philosophy) was to deny that metaphysics could be profitably pursued.

As the story continues, Quine restores metaphysics in the middle of the century by denying the analytic/synthetic distinction, thus erasing the strict boundary between science and philosophy (whether such a boundary was policed by the logical empiricists or not) and eliminating verifiability as a standard by which the meaningfulness of metaphysical claims could be established. Metaphysics could now be respectably pursued again, but not as the free-floating, a priori exploration of the days of yore.

Quinean metaphysics is *naturalized*, which means in part that it must be responsive to the natural sciences. However, the continuity between philosophy and science that allows metaphysics back into polite company requires that metaphysics must submit its claims to the tribunal of science, if not experience.

Many philosophers have acquiesced to this requirement, and the decades since Quine have seen a flowering of metaphysical work in the Anglo-American tradition that is ostensibly naturalistic. Quine's naturalism favored a rather austere vision of metaphysics (Quine 1948, 23), but others claiming the mantle of naturalism have endorsed somewhat more extravagant landscapes (e.g., Dennett 1991). So-called analytic metaphysics can be yet more extravagant, placing center stage the modality (Lowe 2011) that Quine rejected (e.g., Quine 1960), and employing concepts such as atomless gunk that are not applicable to the *actual* world, according to our best science. Nonetheless, although oriented toward the a priori, many such metaphysicians seem to have accepted Quine's bargain in some measure, endorsing a continuity between metaphysics and science, if not in subject matter, then in methodology (Paul 2012; Sider 2008, 6). It is not uncommon to see metaphysicians endorse the standard virtues of scientific theories (simplicity, explanatory power, consistency, fruitfulness, and even empirical adequacy; see, e.g., Paul 2012) as applicable tests for metaphysical views as well.

The pendulum may now be swinging back away from metaphysics: Callendar (2011, 34–35) remarks that the type of self-examination that has recently sprung up in metaphysics and is known as metametaphysics (see Chalmers, Manley, and Wasserman 2009) is “[never] a good sign for a field.” Kuhn observed that one of the signs of a crisis in science is when practitioners begin asking methodological questions (Kuhn [1962] 1996, 88). We can all agree that analytic metaphysics is not a science, yet it certainly has many of the institutional characteristics of Kuhnian science. Moreover, prominent philosophers of science have recently attacked metaphysics (Ladyman et al. 2007, chap. 1) and stirred up some dust (Dorr 2010). Nonetheless, it is a bit too early to ring the death knell: after all, a Kuhnian crisis can resolve in a number of ways that result in the continuation of “normal science.”

Whatever its errors or oversimplifications, this story is useful for highlighting how much weight many give to science in our current discussions about metaphysics. Those who reject metaphysics outright do so in the name of science; others grudgingly give it room at the table as long as it respects the authority of science; but even many of those who assert the autonomy or primacy of metaphysics hitch their defense of its legitimacy to its methodological continuity or similarity with science.

If a proper understanding of the status of metaphysics involves taking a position on its relation to science, such an understanding requires a conception of science. Presumably, the more sophisticated the conception of science, the better the

understanding. Some have accused contemporary analytic metaphysicians of having an outmoded picture of science that contributes to misguided and empty metaphysical theorizing (Ladyman et al. 2007, chap. 1; Ladyman, this volume, chap. 7). To whatever extent that accusation is true, it should be uncontroversial that contemporary philosophers of science have views of science that are more deeply connected to the practices of science. Philosophers of science, then, should have much to contribute to the project of making sense of metaphysics. In this volume, we have assembled essays by philosophers of science who have reflected on the relation between metaphysics and science by coming from the “science end,” so to speak. A guiding idea behind this book has been that the perspective of philosophers of science will add a useful contribution to the current discussions about the status of metaphysics and allow readers to enter the debates from the variety of perspectives found within this community of thinkers.

Consider how Post-Quinean metaphysics has been undertaken by analytic metaphysicians as opposed to philosophers of science. If you look through the tables of contents of recent texts in metaphysics or collections of essays in metaphysics, you will see, for example, such topics as personal identity, free will, space and time, the nature of abstract entities, causation, modality, mereology, and ontological grounding (Sider, Hawthorne, and Zimmerman 2008; van Inwagen 2007). Many of these topics are, at least homonymically, traditional topics in metaphysics, although many of them are certainly now addressed by analytic metaphysicians in a more or less “Quinean” way, with explicit connections to contemporary science. And of course, some analytic metaphysicians explore these issues in ways that are arguably a bit less continuous with science (e.g., the aforementioned gunk).

If you look at philosophy of science texts and collections that purport to be about *general* philosophy of science, you will typically find a few topics that bear close relations to metaphysics: laws of nature, natural kinds, causation, and scientific realism (Balashov and Rosenberg 2002; Curd, Cover, and Pincock 2012). Laws of nature, natural kinds, and causation, although they may have a distinctive cast when discussed by philosophers of science, nonetheless have a fair amount of “crossover” with the discussions of such issues in metaphysics proper: metaphysics texts also give significant attention to these topics.

The truly *distinctive* metaphysical question within the philosophy of science for the past few decades has been scientific realism. It is common to distinguish the epistemic commitment of the realist from the metaphysical one (e.g., Psillos 1999, xvii), and sometimes from a semantic commitment as well. The metaphysical position is often expressed as the claim that the world investigated by the sciences exists independently of minds (Chakravartty 2011). Even van Fraassen, both an anti-realist and an opponent of (pre-Kantian) metaphysics (van Fraassen 1989, viii), accepts this

claim (van Fraassen 1980, 38). But the terms assigned to this distinction are misleading: although van Fraassen may share the “metaphysical” commitment with the realist, he is not wrong to accuse realism of “inflationary metaphysics” (van Fraassen 1980, 73) resulting from its *epistemic* commitment. This second plank of scientific realism holds that science at least aims to deliver truths about the unobservable realm, if not that it actually delivers some such truths. To take seriously scientific statements as candidates for truth means to take seriously not just unobservable entities like quarks and genes, but also laws of nature, natural kinds, causes, and other furniture of the metaphysician’s universe.

As scientific realism has evolved, some realists have sought a position with more modest commitments: entity realism (Hacking 1983), structural realism (Worrall 1989), and semirealism (Chakravartty 1998) are all attempts to selectively withdraw from endorsing everything imagined in our most successful scientific theories. But they all go beyond the world of experience, and in that sense go down the metaphysical road. Philosophy of science, in grappling with realism, thus apparently has no choice but to confront a metaphysical question. We might imagine that the metaphysics of scientific realism is the “gateway drug” that opens up young philosophers of science to other, more dangerous metaphysical questions.

Scientific realism is a thread that winds its way through at least half the papers in this volume explicitly. For example, in their own ways, Jenann Ismael (chap. 5) and Juha Saatsi (chap. 8) try to make sense of what kind of realism about science may be endorsed without opening the door too widely for more speculative metaphysics to follow in afterward. Ismael aims to provide a respectable empiricist understanding of modality and concludes that neither a pure instrumentalism nor realism can do the job. Saatsi focuses on philosophical methodology, arguing that the explanationist strategy for defending scientific realism does not carry over to the metaphysical realm. James Ladyman’s contribution reaffirms the structural and rainforest realisms of Ladyman et al. (2007), while working out the consequences of these (and other) views for the metaphysics of composition. Ladyman takes those realisms to imply that there is no general answer to the question—what science reveals is different criteria in different domains.

Realism may be the most prominent metaphysical issue in general philosophy of science, but philosophy of science is not just general philosophy of science; it is also philosophy of the specific sciences. Philosophers of physics have engaged with many metaphysical questions, both traditional and novel, in the general project of making sense of physical theories (and experiments). Space and time are perennial subjects of metaphysics. Metaphysicians have not only used physics to answer the traditional questions, but those questions have been transformed by engagement with physics. For example, in chapter 1, Katherine Brading argues that metaphysical

questions about the nature of time were able to be addressed empirically after Newton's *Principia*, although they did not suddenly cease to be metaphysical questions. Similarly, Ladyman, in chapter 7, discusses how the metaphysical question of special composition should be reconceived given contemporary physics. Kyle Stanford (chap. 6) calls such investigations of traditional metaphysical questions in light of scientific developments "scientistic metaphysics." But philosophers of physics have also been engaged in what he calls "metaphysics of science," which involves understanding the metaphysics inherent in scientific theories without seeking to determine whether the answers are correct descriptions of reality. Attempts to interpret quantum mechanics, give an ontology for field theories, or resolve the problem of the arrow of time might all be seen as metaphysics of science in Stanford's sense.

If metaphysics is more strongly associated with philosophy of physics than philosophy of biology or philosophy of the social sciences, it may be because one thinks of the relationship between metaphysics and science as primarily mediated by scientistic metaphysics. But one can undertake metaphysics of science with respect to any science. In this volume we have attempted to exhibit more of the relation between metaphysics and the special sciences than is commonly perceived. Matthew Slater, Kenneth Waters, and Michael Strevens all use examples from the life sciences to tease out novel insights about metaphysics and its relation to science. Slater examines three cases in which biology seems to dictate to metaphysics. In one of those cases, species essentialism, he agrees that the results of empirical work determine metaphysical claims to be false. But in two other cases, the thesis that species are individuals and Boyd's homeostatic property cluster proposal for analyzing natural kinds, he concludes that the metaphysical implications are not so easily drawn. Strevens argues that the success of science using "distributed ontologies" to explain complex systems implies a kind of ontological pluralism. Waters's chapter focuses on the nature of the gene and what contemporary genetics shows us about metaphysics. He concludes that a traditional metaphysics that pursues "the structure" of the world must be abandoned in favor of a new metaphysics that recognizes the inherent "messiness" of the world.

A common background as philosophers of science is perhaps the most significant unity to be found among the authors in this volume. This book is not a collection of essays by like-minded philosophers sharing a manifesto and a common vision of the proper pursuit of metaphysics. Nor is this volume, like *Scientific Metaphysics* (Ross, Ladyman, and Kincaid 2013), focused exclusively on the specific question of naturalizing metaphysics. Indeed, many of the authors here would call themselves naturalists, as would many philosophers of science today. But the questions they address are diverse, and collectively they give us a more general picture of the relationship between science and metaphysics.

Given the story I told earlier, one might naturally think that the collection of possible attitudes falls on a kind of spectrum ranging from the strict anti-metaphysics associated with the logical positivists to the extreme metaphysical imperialist who sees science flowing from the autonomous and fundamental activity of metaphysics, with the middle of the this spectrum occupied by attitudes according more or less priority to science or metaphysics. Although this spectrum is not a wholly useless way to think about things, a slightly more complex picture can better capture the available diversity of views concerning science and metaphysics, and help characterize something of the distinctive position held by philosophers of science, at least in this volume. Imagine a space with two axes. The horizontal axis represents the extent to which metaphysics depends on science, and the vertical axis represents the extent to which science depends on metaphysics. Thus, in the upper right are views on which the two are mutually interdependent; the lower left contains views on which they are largely independent of each other; on the lower right are the views on which metaphysics asymmetrically depends on science; and on the upper left we find the reverse. It would be taking this picture a bit too seriously to try to be precise about what “dependence” means here, but I think it is fair to say that in the relevant sense, a practice or activity *A* depends on *B* if the legitimacy or justification of *A* requires some degree of success in *B*. For example, in this sense of “dependence,” applying a certain statistical test depends on choosing a random sample, and prescribing medication depends on having the proper license. So metaphysics depends on science to the extent that (some) metaphysical activity cannot be justified in the absence of specific scientific achievements. If one thinks, for example, that metaphysics is never justified, then we might class that view as a trivial case of metaphysics depending on science.

Perhaps unsurprisingly, the philosophers of science contributing to this volume take a range of opinions on the extent to which science depends on metaphysics and vice versa, but there are none who think that science largely depends on metaphysics but metaphysics is independent of science. In other words, none occupy the upper left quadrant—none of our authors are Cartesian rationalists. I think Brading is the author most clearly located in the upper right—she explicitly describes the interdependence of metaphysics and physics in her piece. I am tempted to place Martin Thomson-Jones’s chapter in that corner as well, although it concerns the interdependence of metaphysics and the *philosophy* of science more than science, as discussed below. Indeed, nearly all of the essays in this volume belong on the right side of the space, as they argue in one way or another for the dependence of metaphysics on science. Fewer discuss precisely to what extent science depends on metaphysics, so one cannot always clearly locate them along the vertical axis. One clear exception is the dialogue by Woodward, in which the main character, Jim Woodward, argues

for the independence of philosophical questions about the practice of science from metaphysics.

It is worth adding a few epicycles and equants to this picture. One is the well-known ambiguity in the word “science,” which can refer to both an activity and the product of that activity. A similar ambiguity applies to “metaphysics.” So, in charting the interdependencies of science and metaphysics, one might take care to distinguish whether the dependency flows from, say, the methodology of science to that of metaphysics, or from the conclusions of metaphysics to the practice of physics, and so on. Within this volume, authors explore a variety of different relations between these two aspects. For example, Strevens’s chapter effectively argues that a certain scientific strategy for addressing complex systems, the construction of compositional models, is largely independent of any underlying fundamental ontology. Waters’s chapter also focuses on the practice of science, but argues that substantial conclusions about metaphysical issues can be drawn from this practice. Ladyman similarly argues for a connection between science and metaphysics, although he argues that it is the methodology of metaphysics that must be constrained by the conclusions of physics. Finally, Saatsi’s contribution focuses on the relationship between the practice of metaphysics and the practice of science, whether metaphysics can import the methods of science. His target is explanationism in metaphysics, which, like explanationism in science, seeks to justify inferences on the basis of their ability to explain the “phenomena.”

A second issue that complicates our framework for categorizing views is the relationship between science and *philosophy* of science. As the title of this volume indicates, these essays do not simply address the relationship between metaphysics and science, but how metaphysics relates to the philosophy of science as well. The aforementioned ambiguity between practice and product applies here as well, and so in exploring the role of philosophy of science here, we may also conceive of it as an activity or the fruit of that activity. As a product, philosophy of science gives us images of science (both as product and activity) that we use in understanding how science relates to metaphysics. The theoretical virtues of science that metaphysicians adopt (or not) for their metaphysical theories are the fruit not of science but of philosophy of science. The interpretation of quantum mechanics that grounds (or not) a metaphysical rejection of the principle of the identity of indiscernibles is not simply a deliverance of physics, but a result of philosophical engagement with physics (although I grant that here the boundary between physics and philosophy is not always clear). It is not implausible to say that the work of bringing together metaphysics and science is always underpinned by a philosophy of science, with philosophy of science conceived of as product.

But our dichotomy also allows us to conceive of philosophy of science as an activity, and so we can ask how the activity of philosophy of science relates to metaphysics, which is a question that is less often considered. In this volume, Woodward and Thomson-Jones both ask whether *doing* philosophy of science depends on metaphysics, and they give different answers, albeit in different domains. Woodward presents his concerns in the form of a dialogue in which the character Jim Woodward expresses his frustration with a metaphysician who insists that he cannot understand causation, explanation, and related ideas without a notion of metaphysical grounding, arguing that we need do no more than understand how scientists discover causes and construct explanations. Thomson-Jones, by contrast, argues that there is at least one kind of question of interest to philosophers of science that cannot be properly answered without engaging with metaphysics: describing how models relate to the world.

One way in which the above framework oversimplifies things is in presenting all questions about the relationship between metaphysics and science as concerned with the dependence of each on the other. I think this simplification is useful and can have a broad enough scope if dependence is understood loosely enough, but there are certainly other important questions about this relationship that cannot be fit into this schema. One important question that has arisen many times over the years is where science ends and metaphysics begins. In our tale, Quine launches ontology into respectability by showing it to be of a piece with science, and thus not sharply differentiated from science (Quine 1951; but see Price 2009 for a different story). More recently we have, for example, Paul (2012) characterizing the difference as one of subject matter, not method, and Morganti (2013) disagreeing. However, the authors in this volume do not consider the question in much depth, even as they discuss significant differences between metaphysics and science. Only Ladyman even addresses the question, and he characterizes the difference merely institutionally (following Ladyman et al. 2007). It is worth pausing to consider why this question has not captivated our assemblage of philosophers of science. Let me give a speculative answer, in two parts.

One part of the answer is that philosophers of science, more than others, are children of Quine, and consider the question settled: there is no substantive, sharp distinction between science and metaphysics (and other parts of philosophy), just as Quine said. After all, philosophers of science are specifically drawn to questions that involve detailed engagement with science, and are in the habit of thinking across the divide.

A second answer, compatible with the first, is that philosophers of science have learned not to worry about drawing such lines because of the history of the demarcation problem. Coming up with criteria to distinguish science from nonsense, or

pseudo-science, or non-science was an important task for philosophers of science throughout much of the twentieth century. By the end of a century in which no consensus was reached, although the question remained of great interest, few remained committed to developing precise criteria to characterize science and distinguish it from other things. Indeed, there has been far more consensus that things like astrology and creationism are not science than there has been on any general criteria, and philosophers of science have been more focused on arguments against such specific claims to scientific status (as they have focused more on specifics in general). So perhaps philosophers of science, happy to work with a conception of science that is not cleanly delineated from other forms of inquiry, have thus not seen the need to think hard about the distinction between metaphysics and science *in general*. Rather, as with pseudo-science, they recognize metaphysics when they see it, and that is good enough.

It is now common to draw a distinction between metaphysics and metametaphysics (although, just as a language may contain its own metalanguage, it seems that metaphysics contains metametaphysics). Similarly, we might draw a distinction between discussions that engage in metaphysics and philosophy of science and discussions that are about metaphysics and philosophy of science. This distinction provides a rough two-part structure to the volume. The first part contains essays that primarily engage with metaphysical questions that arise in the context of philosophy of science: philosophy of physics (Brading and Ladyman); philosophy of biology (Slater and Waters); philosophy of ecology (Strevens); and interpreting scientific statements of law and probability (Ismael). The essays in the second part are more methodologically oriented, and consider such questions as what kind of metaphysical philosophy of science is possible (Stanford); how the methods of science relate to the methods of metaphysics (Saatsi); and to what extent philosophy of science is independent of metaphysics (Woodward and Thomson-Jones). This division into two parts is a bit rough, as the more “ground-level” essays in the first part all draw methodological lessons from the specific questions they tackle, and the essays in the second part all illustrate their discussions by appealing to details of science and philosophy of science. Indeed, I am not sure Ladyman’s contribution can be very easily assigned to only one category. Nonetheless, the division provides one more useful conceptual distinction for thinking through the relation between metaphysics and the philosophy of science.

It is not for philosophy of science to render a verdict on metaphysics. All previous efforts to make philosophy “scientific” were not able to kill metaphysics, and doubtless the contemporary resurgence of criticism will not either. But metaphysics in the twentieth century certainly evolved under the pressure of developments in science and philosophy of science, and we should expect further evolution in

this century as well. We hope that the essays in this volume are able to play a role in that evolution.

REFERENCES

- Ayer, A. J. 1936. *Language, Truth and Logic*. New York: Penguin.
- Balashov, Yuri, and Alexander Rosenberg, eds. 2002. *Philosophy of Science: Contemporary Readings*. New York: Routledge.
- Callendar, Craig. 2011. "Philosophy of Science and Metaphysics." In *The Continuum Companion to the Philosophy of Science*, edited by Steven French and Juha Saatsi, 33–54. New York: Continuum.
- Chakravartty, Anjan. 1998. "Semirealism." *Studies in History and Philosophy of Science* 29: 391–408.
- Chakravartty, Anjan. 2011. "Scientific Realism." In *Stanford Encyclopedia of Philosophy*. Stanford University, 1997–. Article published April 27. <http://plato.stanford.edu/archives/spr2014/entries/scientific-realism/>.
- Chalmers, David, David Manley, and Ryan Wasserman, eds. 2009. *Metametaphysics: New Essays on the Foundations of Ontology*. Oxford: Oxford University Press.
- Creath, Richard. 2011. "Logical Empiricism." In *Stanford Encyclopedia of Philosophy*. Stanford University, 1997–. Article published April 4, revised September 19. <http://plato.stanford.edu/archives/spr2014/entries/logical-empiricism/>.
- Curd, Martin, J. A. Cover, and Christopher Pincock. 2012. *Philosophy of Science: The Central Issues*. New York: Norton.
- Dennett, Daniel. 1991. "Real Patterns." *The Journal of Philosophy* 88 (1): 27–51.
- Dorr, Cian. 2010. Review of *Every Thing Must Go: Metaphysics Naturalized*, by James Ladyman, Don Ross, David Spurrett, and John Collier. *Notre Dame Philosophical Reviews*. <http://ndpr.nd.edu/news/24377-every-thing-must-go-metaphysics-naturalized/>.
- Kuhn, Thomas. (1962) 1996. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- Hacking, Ian. 1983. *Representing and Intervening*. Cambridge: Cambridge University Press.
- Ladyman, James, Don Ross, David Spurrett, and John Collier. 2007. *Every Thing Must Go: Metaphysics Naturalized*. New York: Oxford University Press.
- Lowe, E. J. 2011. "The Rationality of Metaphysics." *Synthese* 178: 99–109.
- Morganti, M. 2013. *Combining Science and Metaphysics: Contemporary Physics, Conceptual Revision and Common Sense*. London: Palgrave Macmillan.
- Paul, L. A. 2012. "Metaphysics as Modeling: The Handmaiden's Tale." *Philosophical Studies* 160: 1–29.
- Price, Huw. 2009. "Metaphysics after Carnap: The Ghost Who Walks?" In *Metametaphysics: New Essays on the Foundations of Ontology*, edited by David Chalmers, Ryan Wasserman, and David Manley, 320–46. New York: Oxford University Press.
- Psillos, Stathis. 1999. *Scientific Realism: How science tracks truth*. New York: Routledge.
- Ross, Don, James Ladyman, and Harold Kincaid. 2013. *Scientific Metaphysics*. Oxford: Oxford University Press.
- Quine, Willard Van Orman. 1948. "On What There Is." *Review of Metaphysics* 2 (5): 21–36.

- Quine, Willard Van Orman. 1951. "Two Dogmas of Empiricism." *Philosophical Review* 60 (1): 20–43.
- Quine, Willard Van Orman. 1960. *Word and Object*. Cambridge, MA: MIT Press.
- Sider, Theodore. 2008. "Introduction." In *Contemporary Debates in Metaphysics*, edited by Theodore Sider, John Hawthorne, and Dean W. Zimmerman, 1–7. Malden, MA: Blackwell.
- Sider, Theodore, John Hawthorne, and Dean W. Zimmerman, eds. 2008. *Contemporary Debates in Metaphysics*. Malden, MA: Blackwell.
- Van Fraassen, Bas C. 1980. *The Scientific Image*. New York: Oxford University Press.
- Van Fraassen, Bas C. 1989. *Laws and Symmetry*. New York: Oxford University Press.
- Van Inwagen, Peter. 2007. "Metaphysics." In *Stanford Encyclopedia of Philosophy*. Stanford University, 1997–. Article published September 10. <http://plato.stanford.edu/archives/win2013/entries/metaphysics/>.
- Worrall, John. 1989. "Structural Realism: The Best of Both Worlds?" *Dialectica* 43: 99–124.

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Time for Empiricist Metaphysics

Katherine Brading

1. INTRODUCTION

To what extent are the details of empirical enquiry relevant for the metaphysics of time? I shall argue that they are deeply, utterly, and inextricably entwined, and moreover that they became so as a consequence of philosophical moves made by Newton in his *Principia*.¹ Prior to the *Principia*, general questions about the nature and structure of time, such as whether or not time is merely an aspect of material change, whether there is one time or many, whether time is inherently metrical, and so forth, could be (and were) appropriately addressed via arguments based on broadly a priori considerations. In the wake of Newton's *Principia*, this is no longer the case. Newton showed how the answers to these questions depend on the intricate details of empirical enquiry. Those of us who are interested in the metaphysics of time are not free to pretend that the philosophical moves made by Newton were never, in fact, made. He made these moves, and this paper is about their implications for the metaphysics of time.

In the recent *Blackwell Companion to Philosophy of Time* (2013), there is a section on "The History of the Philosophy of Time," and there, between a chapter on creation and eternity in medieval philosophy and one on classical empiricist discussions of time, we find a chapter on Newton. In this chapter, Eric Schliesser asks us to pause with Newton, and to look in more detail at his contributions to

¹ References are to Newton (1999).

the philosophy of time. Instead of taking Newton's physics, and then looking at what other philosophers have to say about time in the light of his physics, we look at what philosophical moves Newton himself made. I think Schliesser is right that this is worth doing, and I claim that Newton's empirical methods reach deeply into metaphysical questions concerning the nature and structure of time. For philosophers with an interest in the metaphysics of time, Newton's *Principia* needs to be read as a philosophical text, offering contributions to an empiricist metaphysics of time.²

I begin from three distinctions that Newton made at the beginning of his *Principia*, in the famous scholium on time, space, place, and motion. There, he said that we should distinguish between absolute and relative, true and apparent, and mathematical and common, for each of time, space, place, and motion. I outline these distinctions as they apply to time (section 2), and then discuss Schliesser's (2013) interpretation of Newton's distinction between absolute and true time (section 3), explaining why I think a different approach is needed. I then build toward the positive conclusions that I want to draw. I begin by offering an alternative interpretation (section 4), according to which Newton is drawing on existing terminology and implicit conceptual distinctions in order to make explicit and systematic a three-way set of distinctions concerning the nature and structure of time. In so doing, he makes a contribution to the philosophy of time. I then argue that (a) these distinctions are empirically accessible (see section 5), and (b) all three distinctions are necessary for setting up the project of the *Principia* (see section 6). It follows from this, I argue, that certain questions concerning the nature and structure of time become empirically tractable through the pursuit of that project, or some appropriately similar project. By situating Newton's *Principia* in the appropriate philosophical context (section 7), we can read the *Principia* as a direct contribution to the metaphysics of space, time, matter, and motion, and as offering an empiricist metaphysics of a particular kind. I claim that Newton refined the conceptual distinctions appropriate for asking questions about the nature and structure of time, and transformed the methodology by which such questions should be addressed, and I show this in detail for each of the three distinctions he makes at the outset of the *Principia* (see section 8). I conclude by drawing together the results of the preceding sections, and then use the specific example tackled in this paper to suggest some more general lessons about how philosophers should approach the relationship between metaphysics and empirical science (section 9).

² I take the phrase "empiricist metaphysics" from Janiak (2008, 29) who, in describing the re-appraisal of Newton due to Stein, writes, "The result is not an anti-metaphysical Newton but a kind of empiricist metaphysician." See also Stein (1970).

2. THREE DISTINCTIONS

Newton's *Principia* (published in 1687) opens with a series of definitions of the terms that he will use, including "quantity of matter," "quantity of motion," "inherent force of matter," and so forth. Immediately following these definitions he turns his attention to time, space, place, and motion, in a scholium that begins as follows (Newton 1999, 408):

Although time, space, place and motion are very familiar to everyone, it must be noted that these quantities are popularly conceived solely with reference to the objects of sense perception. And this is the source of certain preconceptions; to eliminate them it is useful to distinguish these quantities into absolute and relative, true and apparent, mathematical and common.

The literature has largely focused on absolute versus relative motion, and absolute space, with comparatively little discussion of time,³ and nothing that I know of about why Newton has this *three-fold* set of distinctions.

However, Schliesser's (2013) discussion of Newton on time was inspired by Huggett (2012), who offered an interpretation of the distinction between absolute and true *motion*.⁴ I differ from both in my interpretation of the terminology, and therefore in the distinctions that Newton is drawing. In this paper I focus on the case of time.

Newton introduces his discussion of time as follows:

Absolute, true, and mathematical time, in and of itself and of its own nature, without reference to anything external, flows uniformly and by another name is called duration. Relative, apparent, and common time is any sensible and external measure (precise or imprecise) of duration by means of motion; such a measure—for example, an hour, a day, a month, a year—is commonly used instead of true time. (Newton 1999, 408)

Thus, Newton is explicit in applying to time the three distinctions of absolute versus relative, true versus apparent, and mathematical versus common. What does he mean by these distinctions, and why do they matter?

³ Arthur 1995; Gorham 2012; McGuire 1978; Palmerino 2013.

⁴ The disagreements that I have with Schliesser and Huggett are small compared to the overall content of their papers, from which I learned much. As so often happens, the many points of agreement and enlightenment I pass over in silence, to focus on what we may learn from a point on which we disagree.