

THE MULTIVERSE: A PHILOSOPHICAL INTRODUCTION

by Jeremy Butterfield

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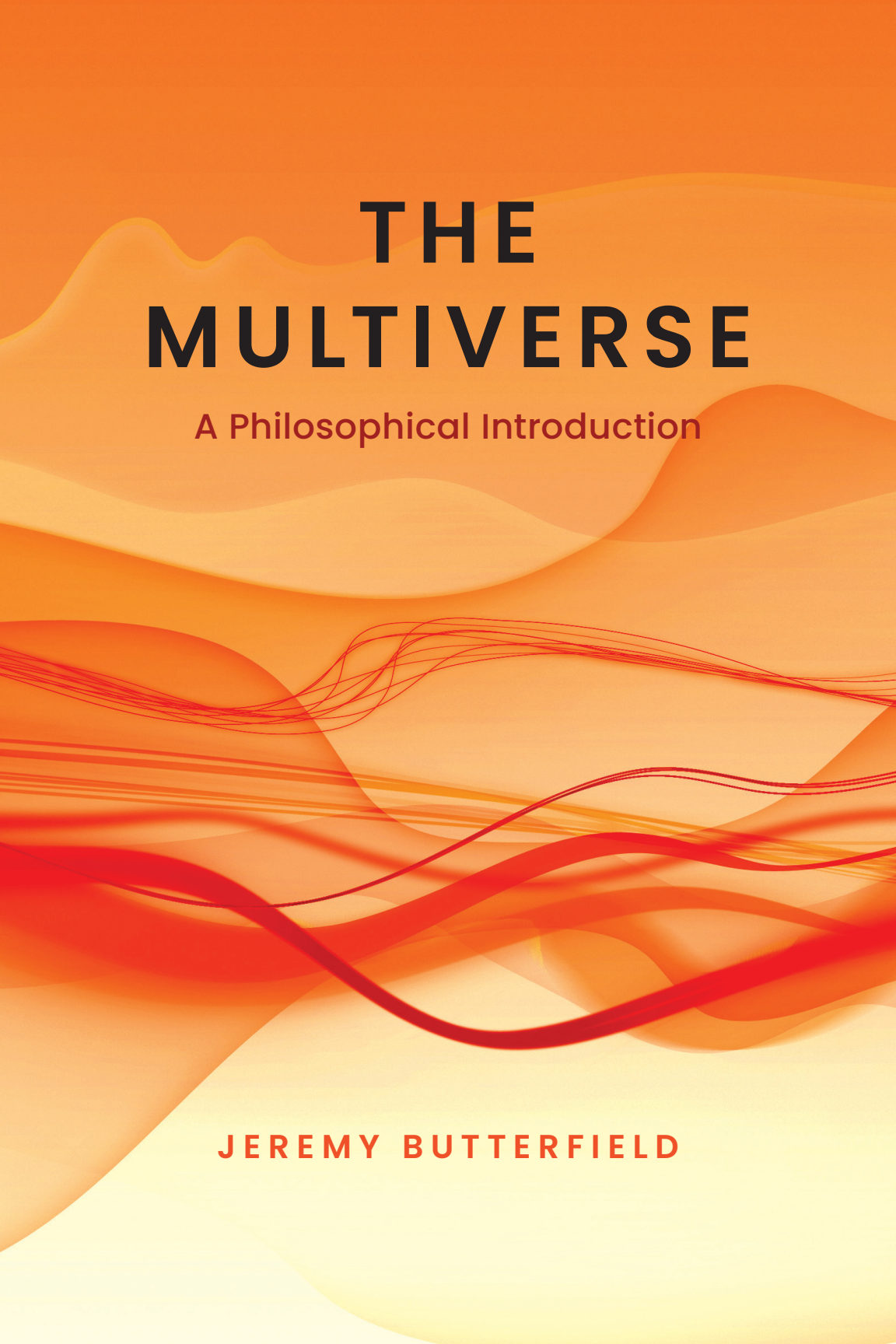
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JEREMY BUTTERFIELD

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To Mari

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First, I introduce the idea that our universe is just one of many universes. Then I announce the book’s plan. I will present and assess three versions of the idea that have been proposed: one from philosophy and two from physics. In short, the proposals are all the logically possible worlds, all the branches of the quantum state, in an Everettian interpretation of quantum theory, and all the bubbles of inflationary cosmology. For each proposal, I choose one main philosophical question to discuss in depth. They are, respectively, what is a possible world, what is chance, and what is explanation. My treatment of these proposals and their associated questions is in my main central chapters 3, 4, and 5. Before that, chapter 2 will set the stage by reviewing physics and philosophy from around 1600 to 1900. And the final chapter 6 will compare and contrast the proposals. The rest of chapter 1 is a statement of my philosophical method and temperament in addressing these proposals. I also admit in advance that I do not outright believe these proposals. But I argue that this is a merely autobiographical fact, and that the reader must, of course, make their own assessment of them.

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This chapter reviews the development of physics and of philosophy, and their increasing separation from each other, from the mid-seventeenth century onwards. I stress three themes. The first is how counter-intuitive and opposed to the preceding mechanical philosophy Newtonian mechanics is, especially as regards action at a distance. My second theme is the effect on philosophy of the success of Newtonian mechanics, especially in prompting Hume's modest conceptions of inductive inference and of empirical knowledge, which I endorse. My third theme is that within philosophy, logic was downplayed from the seventeenth century to the mid-nineteenth century, after which it revived, in part due to the crisis in the foundations of mathematics. Both the revival and the crisis were crucial in placing logic centre-stage in twentieth-century philosophy—and so in preparing us for chapter 3's philosophical multiverse.

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The philosophical multiverse is, in short, the set of all the logically possible worlds, i.e., all the ways the universe could be. My discussion has four stages. First, I review logic's role in twentieth-century philosophy. Second, I stress that our thought and language, both everyday and scientific, constantly deal with possibilities, i.e., ways that some fragment of reality could be other than the way it actually is. Thus, I emphasize logic's treatment of

modality, i.e., of necessity and possibility. Thirdly, I report how postulating a framework of possible worlds, i.e., maximally specific possibilities, has the benefit of providing clear and persuasive accounts of various notions that are important for philosophy. Examples include laws of nature, counterfactual conditionals, supervenience, and determinism. Fourthly, I discuss the philosophical question: What exactly is a possible world? My discussion is inconclusive. I consider four answers. I criticize the first three as wrong, and although the fourth—David Lewis’ famous modal realism—is coherent, I admit that I cannot believe it.

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The first of my two multiverse proposals from physics is the Everettian interpretation of quantum theory. So, I first sketch the ideas of quantum theory. I emphasize how different quantum states are from states in classical physics. Indeed, they are problematic: for they are assignments of (square roots of) probabilities to each of a class of classical states; and these probabilities are understood in an instrumentalist way, as probabilities for measurement results. Hence, we arrive at the measurement problem, epitomized by Schrödinger’s cat. In short, the problem is that the quantum state is indefinite for (in the terminology, is a superposition for) the quantities, such as the position of macroscopic objects that appear definite. I briefly list some main responses to the measurement problem, but expound in detail only the Everettian view. The Everettian’s key idea is that the quantum state is a sum of states that are definite for such quantities, and we

should take all these states as physically real, i.e., actual. This implies that in Schrödinger’s cat example, there are indeed two cats, one alive and one dead. Nowadays, Everettians defend this proposal by invoking the rapid and ubiquitous process of decoherence. The main idea is that decoherence prevents one from seeing the other cat, in the other world. Finally, I discuss the philosophical question of how we should understand probability in the context of the Everettian interpretation.

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The second of my two multiverse proposals from physics is the bubbles, or domains, that inflationary cosmology postulates in the very early universe. Since inflationary cosmology, of course, uses quantum theory, my first job is to relate this proposal to the previous chapter’s Everettian multiverse. (I also relate it to the landscape of string theory, though this landscape is a multiverse proposal that I consider only for cosmology.) I then describe how, in about 1980, cosmology, despite its great successes, faced some pressing why-questions about the values of some of its parameters, and how postulating a very short and very early period of accelerating expansion (called “inflation”) promised to answer these questions. This leads into my chosen philosophical topic: explanation. About this topic, I distinguish between two main strategies: (i) explaining the value of a parameter by showing the value to be generic or typical, and (ii) explaining it as likely to be observed, even though it is not generic or typical. The second strategy leads to discussions of (a) selection effects and the anthropic principle, and (b) how we might confirm a cosmological multiverse.

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In this concluding chapter, I gather the threads in various ways. First, I say what I myself believe about the three proposals. Then I address the question of, for each proposal, why we do not experience the other worlds, which, of course, bears on the question of whether we could have evidence for them. Then I turn to the question of whether one of the multiverse proposals could encompass one or both of the other two. I focus on the proposal that the Everettian multiverse encompasses the other two, especially the philosophical multiverse—as advocated by Alastair Wilson. This proposal has advantages, but I do not endorse it. Finally, I end with some closing quotations.

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Preface

This is an introduction to the idea that our universe is just one of many universes, that it is part of a multiverse. This idea is very topical. A multiverse of one kind or another is seriously advocated by many philosophers. And similarly for physics: many physicists advocate a multiverse—usually of a different kind than that of the philosophers. So, the time seems ripe to assess the various versions of this idea. In this book, I will assess three versions of the multiverse. One is from philosophy, more specifically, from logic’s treatment of possibility. The other two are from physics, more specifically, from the Everettian interpretation of quantum theory, and from inflationary cosmology. I will discuss these in order, and then, in my final chapter, I’ll compare them and relate them to each other.

I should declare at the outset that the book has three main limitations. First, I completely set aside the treatment of the multiverse in countless novels, plays, and films. I agree that the parallel worlds (so-called) in, for example, the films *Sliding Doors* (1998) and *Everything Everywhere All at Once* (2022), raise plenty of philosophical issues. But in this book, I will pursue the issues in themselves, in an academic manner. I have no aptitude for literary matters, so I set aside (albeit with some regret) these entertaining examples.

Second, within physics and philosophy, I should mention that there are multiverse proposals other than the three I will assess. But among these, there are two that I will discuss during my assessments of my main three. The first of these is the multiverse of string theory (string theory is a speculative physical theory). This proposed multiverse, often called “the landscape,” gives the main rationale for the cosmological multiverse, and so I will discuss it in that context. The second is the “Pythagorean” proposal that all of reality is mathematical, and that for this reason our universe is

one of many universes. I will discuss this toward the end of my assessment of the philosophical multiverse, which, as I mentioned, is based on logic's treatment of possibility.

Third, this book is a philosopher's introduction. I mean this both in the sense that I am a philosopher, not a physicist, and that my intended readership is people who are interested in philosophy and the philosophical aspects of physics—but who are newcomers to it. So, I endeavour to explain every term that is “in-house” for the disciplines of either physics or philosophy. For example, I will explain the terms “truth table” (in philosophy) and “wave function” (in physics). But the tone is brisk and breezy. References are few, and almost entirely confined to suggested readings at the end of each chapter. Thus, it will be evident throughout that my discussion is inconclusive, and my conclusions are tentative.

Of course, being inconclusive is hardly surprising. For a subject as large in every sense (and more importantly, multifaceted) as the multiverse, even a learned and exhaustive investigation must surely be inconclusive. No human mind could know all the relevant strands of evidence and argumentation, from all of physics and philosophy. And even if one did know all that, the process of weighing them against each other—for there are bound to be conflicts—would involve judgments that could no doubt be disputed.

So, while I admit that my discussion is inconclusive, I console myself with the thought that a brief and non-exhaustive investigation can serve a purpose. Indeed, I hope it can satisfy the curiosity of the newcomer reader and prompt their own thinking as well as a long and learned book can. (In chapter 1, I will say more in defence of this philosophical outlook: namely, that one should “dive in” and speculate, even when one's evidence is minimal and perhaps defective.)

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JNB
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