

The Multiverse: a Very Short Introduction

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Chapter 1: Introduction

I write these words, believing that I have always lived in one world: and that it is the same world in which my family, friends, historical figures, all humankind, including you, dear reader, live or have lived or will live. But our topic is the speculation, made by many authors past and present, that this world is by no means all there is: that it is one of a vast collection of worlds---dubbed a multiverse.

Here and throughout this book, I will use the word ‘world’, not for a planet, but for a cosmos, a universe, extended throughout all of space and all of time. So the actual world---as I will use that phrase---contains all objects and events that are at some distance, no matter how great, from us here on Earth. And it contains all objects and events that are in the distant past or distant future, as well as those that are now. As one might put it: the actual world contains all objects and events at any ‘temporal distance’, no matter how great, from us now, just as it contains all objects and events at any spatial distance.

So our topic is the idea that the actual world, though very inclusive, is not all of reality. Indeed, it is only a tiny part of reality. Let me say this a bit more precisely. The idea is that there is a vast collection of worlds, i.e. universes, differing in myriad ways one from another. The actual world---the universe, as we usually use that word---is just one member, one element, of this vast collection. And it is no more real than all the other members. Agreed: it seems “especially real” to us. But, so the idea goes, that is only because we are in it, rather than in another world.

This is supposed to be rather like how in the actual world, any place---such as Westminster Abbey, London, or the Sydney Opera House---can seem especially real to a person at it. But such a person will readily agree that other places are equally real. They are just spatially distant: and therefore they are usually hard to know about since, for example, they are not visible. Similarly, the idea is that the proposed other worlds are just as real as the actual world: though they are in general harder to know about than the actual world. This vast collection, or multitude, of universes is the multiverse. (Some people say ‘pluriverse’, but I will always say ‘multiverse’.)

The multiverse is a timely topic. For in the last thirty years, ‘multiverse’ has become a buzz-word in both physics and philosophy. In both disciplines, it has been proposed that our universe is just a tiny part of a multiverse.

Of course, what is meant by a multiverse, and therefore the reasons given for it, differ between the disciplines. Besides, even within a discipline, authors differ about their reasons for believing in a multiverse.

Broadly speaking, these differences are as one might expect. Physicists who propose a multiverse tend to take their reasons for it to be empirical. Here, ‘empirical’ does not just mean ‘derived from experience’. It also includes data from experiments, maybe very advanced or delicate ones. Thus physicists tend to argue for a multiverse on the grounds that postulating it explains---or explains better than rival suggestions do---some significant physical facts, that would be otherwise puzzling, even mysterious. But in propounding these arguments, physicists tend to down-play how conceptual, i.e. non-empirical, considerations bear on the explanation.

On the other hand, philosophers who propose a multiverse tend to take their reasons for it to be conceptual, i.e. non-empirical, even with ‘empirical’ understood in a wide or liberal sense that includes data from arcane experiments. Thus philosophers proposing a

multiverse tend to argue that it provides the best account of some problematic concepts. The main example is the concept of possibility. Thus they say: How can you understand possibility, except by countenancing alternative ways the world could be, i.e. other possible worlds? But philosophers tend not to consider whether any empirical considerations---in particular, physicists' reasons for their notion of a multiverse---bear on the account of the concepts they focus on.

But in fact, the various proposals share important common themes. Besides, the reasons for (and against) each proposal combine empirical and conceptual considerations. So the topic calls for an interdisciplinary treatment. Thus my aim will be to assess these proposals, by comparing them with each other and by articulating common themes. Among these themes, there will be major open philosophical problems.

Chapter 1 Section 1: The plan: three multiverse proposals

My plan will be to discuss, in order, three different multiverse proposals. There will be one from philosophy, and two from physics. For each proposal, I will explain it, and the reasons why people advocate it. But I must admit at the outset that each proposal has been met in some quarters with incredulity, and even indignation. For each proposal, I will also emphasize a question that it raises, which then moulds my discussion of the later proposals. Each question will be a major philosophical problem---a problem which is unsolved.

So there will be six Chapters (including this one): as follows. The three main Chapters, discussing my three multiverse proposals, are Chapters 3, 4 and 5. Chapter 3 is about the philosophical multiverse, Chapters 4 and 5 about the two proposals from physics. But before these central Chapters, I need to do some stage-setting. In this Chapter, I will describe how one assesses such proposals---or at least, how I propose to assess them. This will largely be a matter of being wary of pitfalls, and being self-conscious about one's assumptions. In Chapter 2, I will review those aspects of physics and philosophy from 1600 to 1900 that we will need, in order to understand how in both physics and philosophy, the ground was fertile, by about 1970, for multiverse proposals. Then follow the three central Chapters. In the final Chapter, Chapter 6, I review the relations between the multiverse proposals, and conclude.

To give a glimpse of what follows, here is a bit more detail about the three proposals, and the three questions they raise.

The first proposal I consider is from philosophy (Chapter 3). It says that all the logically possible worlds---all the myriadly many ways that the universe could be, without contradiction---are equally real. We 'just happen' to be in one of these worlds. This proposal's most famous advocate in recent decades is David Lewis. As we shall see, he defended it with great imagination and resourcefulness, notwithstanding the incredulity it often meets. (Although Lewis' name is unknown to the general public, unlike e.g. Bertrand Russell and Ludwig Wittgenstein, he is generally agreed by philosophers to be one of the greatest philosophers of the twentieth century. He died in 2001, at the age of 60.)

But of course, the idea of a set of all the possible worlds goes back much further than the recent decades of philosophy. It goes back at least to Leibniz: and as we will see, it is a very useful, even indispensable, idea in several branches of philosophy.

Philosophy is of course a subject in which any topic leads rapidly to several others. So this proposal raises various philosophical questions. But I will emphasize the obvious one: what exactly are these different 'ways' the universe could be? That is: what exactly is a possible world, or a possibility?

The two proposals from physics are from quantum theory and from cosmology. Quantum theory is famous---one might say: notorious---for the conundrums about how to interpret it. Above all, there is the measurement problem. It is about how an indefiniteness of properties that quantum theory attributes to the objects it successfully describes, e.g. atoms, can be transmitted from the atomic realm to the everyday macroscopic realm---where such indefiniteness seems ludicrous. The problem is summarized iconically by Schroedinger's cat. In a famous paper in 1935, Schroedinger described how in principle, an atomic indefiniteness could be transmitted so as to render a cat indefinite as to the property of being alive. That is: at the end of the process Schroedinger describes, the cat is neither alive nor dead---and this is not due to the vagueness of our words 'alive' and 'dead', but concerns the cat in itself. It is somehow "in limbo".

Thus the second multiverse proposal (Chapter 4) is that the best way to interpret quantum theory, and especially to solve the measurement problem, is along the lines suggested (in 1957) by Hugh Everett. Nowadays, this is often called the 'many worlds interpretation' of quantum theory. The idea is that there is a quantum state of the multiverse as a whole; and this state encodes many different macroscopic worlds (sometimes called branches or realms). So in particular, for Schroedinger's thought-experiment, the quantum state at the end of the process encodes (at least) two macroscopic worlds. There is one with a cat that is alive, and one with a cat that is dead. Besides, and here is the punch-line: all these macroscopic worlds are equally real. As we will see, this proposal links back to the philosophers' proposal; and it raises many conceptual, indeed philosophical, questions.

But I will emphasize one question: namely, what is chance? Here, 'chance' means objective probability, made true by the subject-matter concerned. The standard example is radioactivity: e.g. the chance of this Uranium atom decaying in the next hour. So chance is contrasted with subjective probability, which are degrees of belief about a subject-matter, e.g. my degree of belief that this horse will win the race. Such degrees of belief are made true by my state, not the horse's. (For they are shown in my behaviour, for example by what odds I would be willing to accept in a bet on the race.)

The third proposal (Chapter 5) is from cosmology. The last sixty years have been a golden age for the science of cosmology. Our understanding of the structure and evolution of the universe has grown immeasurably. So it is now an established fact that the universe we see, and see to be expanding, originated some 13.8 billion years ago in a very hot dense fireball---which itself originated, perhaps, in a singularity of infinite density, dubbed 'the Big Bang'. However, since the early 1980s, cosmologists have also speculated (prompted by good empirical reasons) that very early on, there was a brief phase of rapidly accelerating expansion, called 'inflation'.

It is this conjectured inflationary epoch that leads to the multiverse proposal. For the natural mechanism driving inflation also yields countless bubble, or pocket, domains (so called) that branch off from all that then expanded to become the observable universe we now see. And each of these domains would themselves expand and become universes; so that the whole collection is a multiverse. Again, this proposal links back to the previous ones, and raises many questions, including philosophical ones. Of these, I will emphasize the question: what counts as an explanation?

So that is the overall plan. There will be three multiverse proposals, and three associated questions. Throughout the book, I will also briefly discuss how various themes which the book downplays---such as other multiverse proposals, like that of string theory, and other philosophical questions, like the justification of induction---fit in.

Chapter 1 Section 2: What do I believe?

So much by way of a prospectus. You will want to know—maybe so as to gauge my sanity, before deciding whether to read what follows---where I stand about these speculations.

I began this Chapter by saying I believe that I have always lived in one world. Of course, that could be so, even while there are many other worlds. It could even be so, while there are many other worlds and also, we can have some knowledge of them; or at least, we have some warranted beliefs about them. So you will want to press the question: do I believe there are such worlds?

To cut a long story very short: my answer is ‘No, No and Maybe’. That is: I do not believe in the philosophical multiverse. Nor do I believe in the Everettian multiverse. For the cosmological multiverse, I say, as the film producer Sam Goldwyn is meant to have done: ‘a definite Maybe’.

In Chapter 6, I will discuss these verdicts in more detail, in the light of the evidence and arguments we will by then have in hand. But for the moment, I want to emphasize two points. The first is about what I mean by ‘belief’. The second is about what my beliefs imply for you, the reader: which will take a longer discussion.

First: here and throughout the book, I use the word ‘believe’ in an everyday sense: a belief is a conviction, on which I am willing to bet a great deal, even my life. We all make these kinds of bet all the time. I believe the plane will fly safely, so I get on it without worrying. Agreed, some people have their doubts about planes. But the same point is made, even more vividly, by even more humdrum examples. As I walk across the room, I believe the floor will continue to support me; as I eat the bread, I believe it will not poison me. And so on. Agreed: we all have, for many propositions, degrees of belief that fall short of conviction. Recall the example above, of my degree of belief (subjective probability) that this horse will win the race. But for most of this book, we can set subjective probabilities aside, and so take belief to involve a subjective probability so close to 1 (100%) that the difference is negligible. Hence my word above, ‘conviction’.

So I intend my beliefs as reported above, ‘No, No and Maybe’, in this everyday sense. But stated so briefly, they are also “merely autobiographical”. They just report that after surveying the evidence and arguments, I cannot believe this (e.g. the philosophical multiverse), while I could believe that.

Chapter 1 Section 3: What should you believe?

This leads to the second point. Being “merely autobiographical”, these verdicts should have little weight with you, the reader. While I am happy to tell you straight-up what I believe, you should, and of course will, make up your own mind. You may well reach more positive conclusions about these multiverse proposals than I have. For as we will see: much deeper thinkers than I have believed in a multiverse, and made an extended case for the multiverse they believe in. I only hope that my survey of the evidence and arguments is open-minded and clear-headed enough to give you good material for reaching your own conclusions.

The reason you and I may differ is that in the current state of knowledge, and combining the insights of both physics and philosophy, it is impossible to now know for sure about any of the three multiverse proposals. Thus I do not give my two No’s, to the first two multiverse proposals, on the basis of some evidence or argument that I take to be irrefutable, or ‘knock-down’. Indeed, I doubt that we could get such irrefutable evidences or arguments, either for or against these proposals.

Within philosophy, this situation---of admitting that while one finds some evidence or argument cogent, and even persuasive, it is certainly not conclusive or irrefutable---is of course familiar. It is also to be expected. For philosophy is by its nature controversial.

Since the problems it addresses are abstract and general, it is hard to pinpoint what evidence, or considerations, would definitively solve them. (Or if one prefers to think of philosophy as asking questions: it is hard to pinpoint what evidence, or considerations, would give a definitive answer.)

Of course, to say that philosophy's problems are abstract and general makes it sound like mathematics, or perhaps physics. But there is a difference. Philosophy's problems are also about concepts that are either not completely precise, and-or are contested, i.e. rejected as bad concepts by some people. (Here, 'bad' means, roughly speaking, 'useless and even misleading', e.g. because the concept has a mistaken presupposition.) This is obvious for concepts that are the focus of moral and political philosophy: concepts like freedom, responsibility, equality, justice, class, and just war. For example, someone might reject the concept of political equality, in the sense that they maintain its only role is to mislead: namely, the ruling elite uses it as a slogan to deceive the ruled that they have a say in how politics and government are run.

But as we will discuss, imprecision and being contested are similarly features of concepts that are a focus of philosophy of science, and so of this book---even within its discussion of the multiverse proposals from the less controversial discipline of physics.

For example, think of the concepts in the three questions that I listed as being raised by the three multiverse proposals: namely, possibility, chance and explanation. Each of these concepts is not precise; and even when it is made precise, philosophers disagree over claims involving it; and some philosophers reject the concept (even once made precise) as bad. Besides, we shall see that there are several other such concepts: that is, concepts that are apparently valuable for making philosophical sense of science, but are not completely precise, and-or are contested. Two examples are the concept of a law of nature, and the concept of causation: to both of which we will return.

So for any problem whose formulation uses an imprecise and perhaps even contested concept, it is inevitably controversial how we should assess proposed solutions to the problem. For there will be no prior agreement on the kinds of evidence, either empirical or conceptual, to which a solution should be answerable. And as I said: this is as expected---all in a day's work---within philosophy.

Agreed: physics is, by and large, far less controversial than philosophy. Its concepts are more precise, and less contested; and so its problems are better defined. And so also are the kinds of evidence to which a proposed solution is answerable.

But obviously, for physics' two multiverse proposals, these contrasts with philosophy fall away. The Everettian multiverse is one proposal of several in the debate about the best way to interpret quantum theory. That debate still rages, with a mixture of empirical and conceptual reasons for and against the various proposals. So assessing the Everettian multiverse is as controversial as most of philosophy.

The cosmological multiverse is also controversial, though for rather different reasons. It is not in the first instance an interpretative proposal, in the way that the Everettian multiverse is. So one would expect the empirical evidence, or indeed conceptual considerations, that would count for or against the proposal to be easier to state, i.e. to be better defined---easier for different people to agree on. But any relevant empirical evidence is fearfully hard to get: as of course one would expect, since the proposal is precisely that there are universes other than---beyond---all that we can observe. And it is also hard to agree on the relevant conceptual considerations that would weigh one way or the other. For as we will see, the proposal raises interpretative, and therefore controversial, issues; even though it is not primarily an interpretative proposal. One main way that it raises such issues is that it turns out to be closely related to the debate about the best way to interpret quantum theory. (Hence it will be clearest if we discuss it after the Everettian multiverse.)

So in short: my personal assessments of the three proposals, ‘No, No and Maybe’, will be tentative. I do not urge them as definitive. For we must recognize that different people are very likely to disagree about how to weigh the various pieces of evidence and lines of argument; not least because they may disagree about the usefulness of the concepts in which the evidence or argument is formulated.

Besides, it seems too much to hope that all such disagreements could be resolved in principle, by arranging some resolutely open-minded exchange of opinions that was allowed to last “as long as it takes”. If to resolve such a disagreement, you were to lock “the jury” in a room with coffee and refreshments, and let them out only when they agree---argh, the jury might never come out. Agreed, some such disagreements might be thus resolved. For example, a conflicting assessment of some specific line of argument might be shown to turn on people using different versions of some controversial concept such as explanation. But I doubt that all can be thus resolved.

But this is not a bland or indifferent agnosticism. I agree that it would be good---indeed, wonderful---to know whether any of the three proposals is true. Or if knowledge is not to be had: at least to have conclusive reasons for belief, one way or the other. But we must recognize that enquiry about these proposals is both inconclusive and fallible; (as it is also, no doubt, for many topics). For these multiverse proposals, the best we can do is to marshal the available evidence, both empirical and conceptual, and to try to be open-minded and clear-headed in assessing the proposals.

Chapter 1 Section 4: What would you risk? Confidence vs. caution

I have just delivered a right-minded sermon about what one might call ‘cognitive modesty’. The summary is: we should accept that our views are tentative, not conclusive; that even the concepts with which we formulate our views may be contested by other people; and that maybe some of our disagreements with them could not be resolved by an open-minded exchange of opinions, no matter how long we allowed the exchange to go on.

But there is another aspect of cognitive modesty that I should also register---and extoll. It arises from the fact that people differ in their attitude to risk, i.e. in how willing they are to take a risk. We will see that these attitudes influence people’s views, especially about the topics of this book.

We are all familiar with the fact that what is an unacceptably large risk to one person can be a tolerably low, or even negligible, risk to another. We are also all familiar with the fact that, although to some extent one can urge reasons on someone to change their attitude to risk: beyond a certain point, such attitudes are a matter of basic temperament, and one cannot expect reasons to change the person’s attitude.

The same goes, say I, for enquiry. People differ in their attitude to risk in enquiry, just as much as in action. It is just that in enquiry, the risk is of error, of false belief, rather than of some traumatic event. (Of course, false belief can engender traumatic events.) So each of us, when pursuing abstract and general questions, that cannot be easily settled by some well-defined body of evidence, takes a stance about how tolerant, or how averse, we are to ending up with a false belief. (Of course, the falsity may seem harmless as regards our personal safety and well-being, just because the topic of the belief lies so far from practical matters.)

Of course, this stance is almost never a matter of a decision being made consciously. Did anyone, even a philosopher, ever say to themselves: ‘I hereby decide that I am too cautious, too averse to having a false belief, to either endorse or reject this philosophical proposition (about, say, a multiverse proposal)---I must remain entirely agnostic?’ I doubt it. Nevertheless, each of us, when we engage with philosophical

debates, in particular the debates in this book, thereby endorses or rejects, or at least assesses, various philosophical propositions. And we thereby adopt some stance, in the spectrum from tolerance to aversion, about the risk of false belief.

I believe that like the everyday examples of attitude to risks about actions, rather than about beliefs, this stance is ultimately a matter of temperament. And this is even so, for beliefs whose topic is far-removed from practical matters; such as philosophical beliefs.

Like the everyday examples, your stance can be changed, to some extent, by reasons. Other people engaged in the same philosophical debate, i.e. assessing the same philosophical propositions as those you are focussed on, can offer you reasons to change your stance. Thus they might say to you: ‘You should be more willing to endorse this proposition about the multiverse, because your background philosophical beliefs about possibility (or about explanation, or what-not) make it more plausible.’ Or they might say: ‘your background beliefs are such that, even if it is false, this would spell little damage to---force only a minor revision of--- your other philosophical beliefs.’ (These examples show that the reasons urged for being less risk-averse can concern either a specific proposition, or the coherence of the pattern of one’s beliefs. Similarly of course for reasons for being more risk-averse.)

But I maintain that beyond a certain point, such reasons cannot persuade. Your stance cannot be wholly determined by discursive reasoning, i.e. by reasons that can be put in a discourse of words and arguments. It is ultimately a matter of what I would call ‘intellectual temperament’. So when the words give out in this way, the most that can be reasonably asked of you is that you should be self-conscious about this matter of temperament. And *a fortiori*, you should not be dogmatic about it: you should not proclaim that it is the only stance that is defensible, or rational.

Because a person’s attitude to the risk of false belief, as moulded both by reasons and by their individual temperament, will be a factor in---will play a role in---the position they take in various debates throughout this book, it will be convenient for us to have a label for the range of attitudes. That is: I recommend adopting a label for this spectrum of risk-tolerance through to risk-aversion. So I will say: ‘confident’ vs. ‘cautious’. (Another possible label is: ‘ambitious’ vs. ‘modest’.)

Besides, this discussion of one’s attitude to the risk of false belief---confidence vs. caution---can be generalized. Hitherto, I discussed the topic simply in terms of whether a belief is true or false, without distinguishing whether the proposition believed is: (i) “mildly” or “merely” false in that, though it is false, all the concepts it involves are correct, or at least are concepts that the agent herself does not reject or contest; or (ii) “more sickly” false, or wrong-headed, in that some of the concepts it involves are rejected or contested, at least by the agent herself.

But we must allow for (ii). That is: we must allow that someone might be cautious about using a concept, whatever claim is then made using it; (and so they will be tempted to reject it). So one can be cautious about a concept, as well as about a claim or proposition. In subsequent Chapters, we will see several examples of philosophers and physicists (including myself, and maybe you the reader) being cautious about, or definitely rejecting, some concept or other.

For the moment, let me give an example of this distinction between (i) and (ii), by considering the broad enterprise of “making sense” of physical science. Think of how physicists go about their business. They invent general theories; they specialize them in various ways with models and approximations; and they do experiments, to help improve the theories, the models and the approximations. Now let us ask: does making sense of this overall enterprise *need* the concept of a *law of nature*? Of course, ‘law of nature’ is vague, and different advocates will make it precise in different ways. But the main idea is

that a law of nature is an especially informative proposition about how the natural world “works”: a proposition that is true, but which can be unknown, even un-formulated, by us humans. Some philosophers accept this concept (making it precise in one way or another). And some even say that it is a central goal of physics, or of all of science, to discover laws of nature.

But the point here is: a person might reject the very concept of a law of nature. That is: a person might reject the idea of a true and especially informative proposition about nature: especially one that is not yet formulated, but is the goal of enquiry. They might say it is an illusion, a will of the wisp. So according to this view, we can, and should, make sense of the overall enterprise of physics---the theorizing, modelling, approximating and experimenting---without ever invoking the idea of a law of nature, in any precise version. Using my jargon of ‘confident’ vs. ‘cautious’: such a person, such a view, is cautious. (Chapter 3 will return to this example.)

Again, I should come clean about my own attitudes, my own position in the spectrum from confidence to caution. In later Chapters, I will give details in the context of each discussion. But to try and be honest and clear-headed about my intellectual temperament: let me say in advance that broadly speaking, about the dozen or so contested (usually philosophical) concepts that arise in multiverse proposals, I am inclined to be:

(i): confident, i.e. accepting, of concepts that are proposed within physics, or in logic or in metaphysics; examples of such concepts include: the quantum state of the universe, logical necessity, possible world, supervenience; but:

(ii): cautious, i.e. rejecting, about concepts proposed within epistemology and methodology; examples include: the idea of a law of nature, the idea of explanation.

As the book proceeds, it may be useful to you, the reader, to know that these are my tendencies. But again, this report of my intellectual temperament is “merely autobiographical”. So do not let them have undue weight. As I said above: each of us must, in the end, decide their position for themselves.

Chapter 1 Section 5: Beware the beguiling power of words

I have just followed my sermon about ‘cognitive modesty’ with an admission of the role of intellectual temperament, and a confession of my own temperament. I turn to giving a warning about how confusing words can be.

The warning is this. Once one has a word to use, one readily falls in to thinking that it represents a concept in good order: that one understands, or can explain, something---though often one doesn’t understand, and cannot explain anything. This warning is of course of a piece with my previous point that a person may reject a concept as bad, because misleading: recall the example of rejecting the concept of political equality, on the grounds that it is only the elite’s tool for duping those they rule.

This is a time-honoured warning. Sometimes, it is expressed as a joke. In Moliere’s play The Hypochondriac, the target of the joke is doctors who give a learned label, suggestive of understanding, to something they do not understand at all. When asked to explain why opium induces sleep, they answer in a learned tone of voice---as if they knew something---that opium has a ‘dormitive virtue’. (Here, derived from Latin: ‘virtue’ means ‘causal power’, so that ‘dormitive virtue’ means ‘tendency to induce sleep’, and the doctors’ answer merely repeats the question.)

This warning also occurs in some great philosophical texts. Since the next Chapter will discuss the natural philosophers, i.e. philosophers-cum-physicists, of the seventeenth century, let us enjoy the prose of one such author, John Locke, in a famous passage.

Locke, in the 'Epistle to the Reader' at the start of his An Essay Concerning Human Understanding (1690) praises the contemporary great physicists (as we would now call them), Huygens and Newton; for whom Locke sees himself as an under-labourer, who can help by doing what one might call 'conceptual house-keeping'---and in particular by seeing through beguiling words. Thus he writes:

'The commonwealth of learning is not at this time without master-builders, whose mighty designs, in advancing the sciences, will leave lasting monuments to the admiration of posterity: but every one must not hope to be a Boyle or a Sydenham; and in an age that produces such masters as the great Huygenius and the incomparable Mr. Newton, with some others of that strain, it is ambition enough to be employed as an under-labourer in clearing the ground a little, and removing some of the rubbish that lies in the way to knowledge; which certainly had been very much more advanced in the world, if the endeavours of ingenious and industrious men had not been much cumbered with the learned but frivolous use of uncouth, affected, or unintelligible terms, introduced into the sciences, and there made an art of ... Vague and insignificant forms of speech, and abuse of language, have so long passed for mysteries of science ... that it will not be easy to persuade either those who speak or those who hear them, that they are but the covers of ignorance, and hindrance of true knowledge. ... Few are apt to think they are deceived in the use of words; or that the language of the sect they are of has any faults in it ...'

By the way: similar sentiments, also famous, can be found in Francis Bacon, who warns against the danger of being misled by what he calls the 'idols of the market-place': i.e. false ideas engendered by human communication and abuse of language. He also warns against three other idols, i.e. sources of false ideas. Roughly speaking, they are: (i) universal human tendencies, such as relying uncritically on perception, and jumping to conclusions (called 'idols of the tribe', where 'tribe' means humankind); (ii) idiosyncratic or communal prejudices and other deficiencies of judgment (called 'idols of the den', where 'den' refers to a benighted community, as in the metaphor of the cave in Plato's Republic); (iii) being misled by abstract, general and high-falutin' theories (called 'idols of the theatre', where 'theatre' connotes a fantastical representation).

In short: we have been warned ...

Chapter 1 Section 6: Can we be sure that we are in the same universe?

Finally, let me broach the question: if there is a multiverse, how can we be sure that we are in the same universe? In particular, how can I, as I write this book, be sure that you the reader are in the same universe as me?

Of course, this question is more pressing for advocates of a multiverse, than for agnostics. But it needs to be addressed. For if the answer is 'One cannot be sure', then advocacy of a multiverse is in some way undermined. For in such a case, there might be a multiverse, and you might believe it. But your advocating it would surely be a very different activity than you usually take it to be, if some (surely the vast majority?) of your audience is in a different universe.

But rest assured. On the three multiverse proposals I will consider, there is no such undermining. For each proposal can make a good case that any two objects, or events or states of affairs, that are linked by a causal process---like people writing and reading books, or talking back-and-forth in a conversation---must be within the same universe.

So the overall situation about whether writer and reader (or speaker and hearer) are in the same universe is as follows. Agreed: any or all of these multiverse proposals may

be very weird, and-or very hard to believe, and-or plain false. But at least there is nothing paradoxical, or even problematic, about an advocate of such a proposal believing that you, dear reader, are in the same universe as them (and as me). And accordingly, they write their books . . .