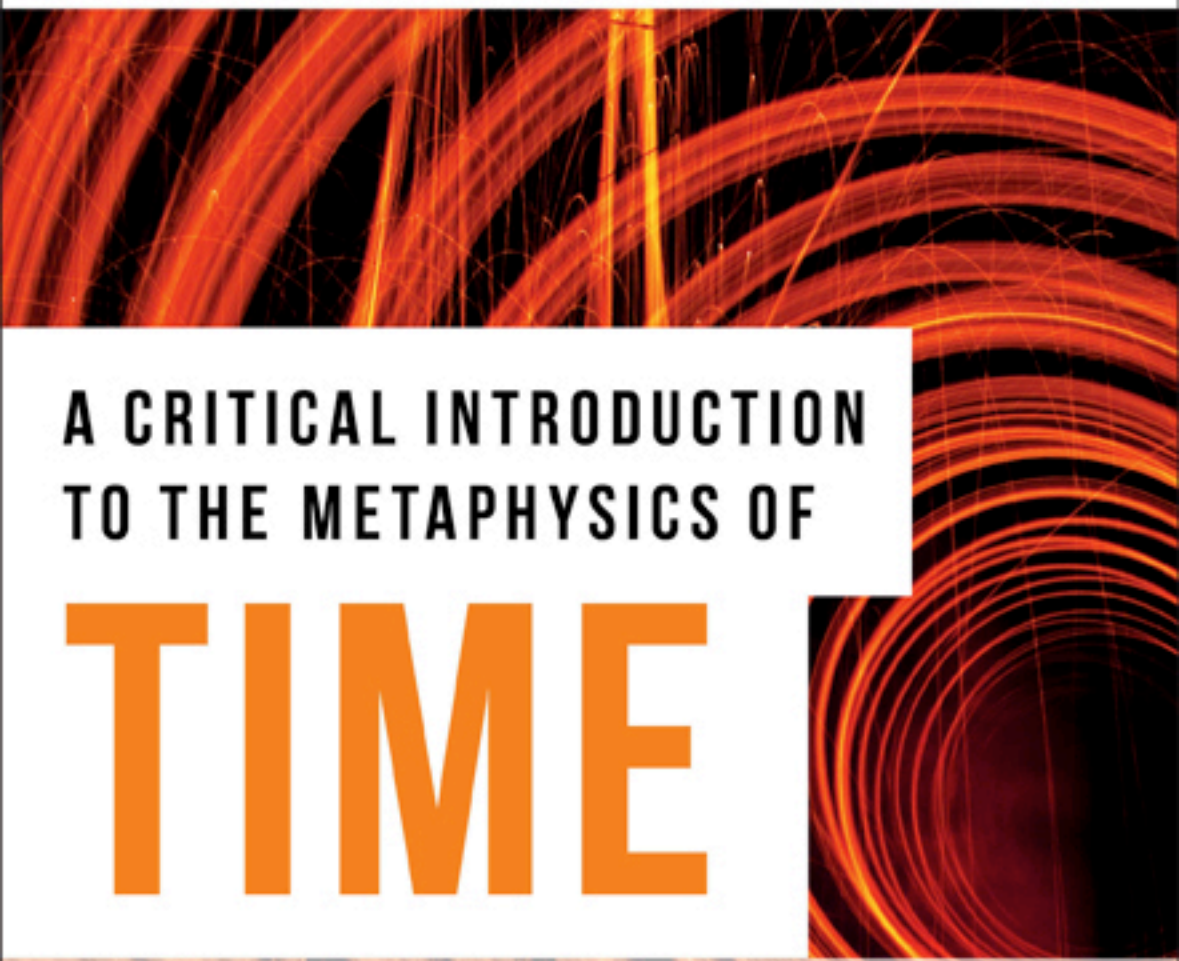
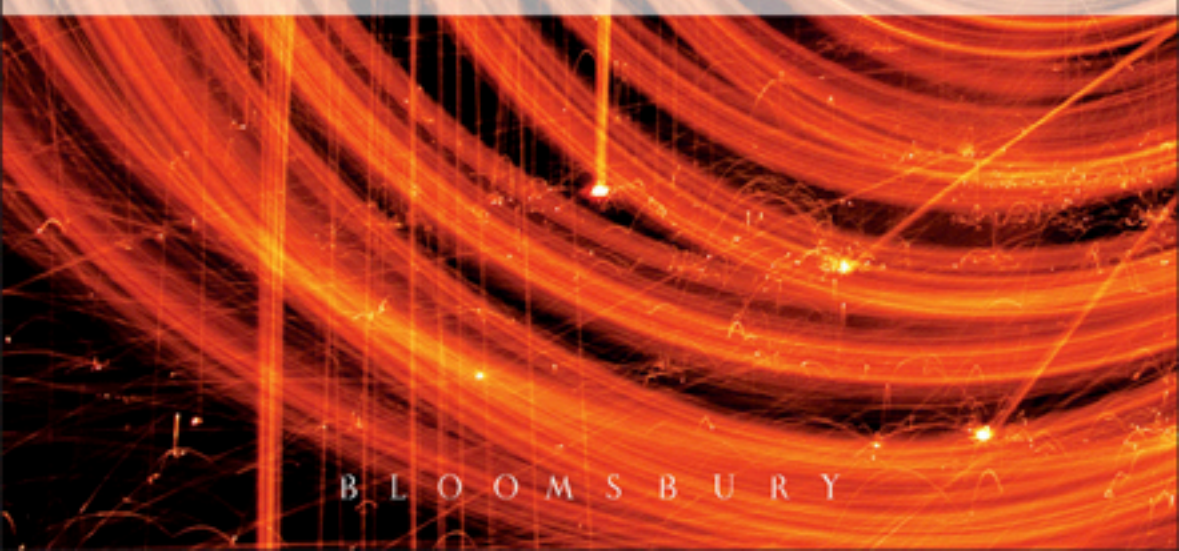
CRITICAL INTRODUCTIONS TO CONTEMPORARY METAPHYSICS



A CRITICAL INTRODUCTION TO THE METAPHYSICS OF TIME

BENJAMIN L. CURTIS AND JON ROBSON



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A Critical Introduction to the Metaphysics of Time

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A Critical Introduction to the Metaphysics of Time

BENJAMIN L. CURTIS AND JON ROBSON

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Introduction

The philosophy of time is a central area of contemporary metaphysics and it is not difficult to understand the fascination that many philosophers feel for the subject. Our everyday talk and thought is full of claims about the nature of time. We claim that time passes (or flows), that everyday objects persist through time, that the present is somehow privileged compared to the past and future, that people change as time passes, that the past is fixed in a way in which the future is not and much more besides. Yet, as we will see in later chapters, it is all too easy for attempts to explain these apparently everyday phenomena to lead quickly into confusion and paradox. For this reason philosophers addressing these issues have often been led to sympathize with Augustine of Hippo who famously responded to the question 'what is time?' by claiming that as 'long as no one asks me, I know; but if someone asks me and I try to explain, I do not know' (2001: 271). In this book we aim to provide a comprehensive overview of the most important issues in the area, bringing the reader up to date with the current literature. We cannot guarantee that the reader will have an answer to Augustine's query by the time they reach the end of this book but we hope that they will, at least, have a better understanding of the question.

In Chapter 1 we survey the ancient history of the philosophy of time, from the pre-Socratics to the dawning of the medieval period. Our presentation will be selective, and those views and arguments that bear on the contemporary literature will be highlighted. In particular, the focus will be on the work of Parmenides, Zeno, Plato, Aristotle and Augustine. Our survey of the history of the philosophy of time continues in Chapter 2 where we examine some key figures from the seventeenth century to the beginning of the nineteenth century. Again, our focus will be on those views that bear on the contemporary literature. The main figures discussed will be Descartes, Newton, Leibniz and Kant. In the context of this chapter the debate between those who think that time is a genuine entity in its own right (substantivalists) and those who deny this (relationalists) is also introduced.

Chapter 3 focuses on McTaggart's famous 1908 paper 'The Unreality of Time' which is viewed by most contemporary philosophers of time as marking the beginning of the subject in its modern guise. Much of the contemporary literature deals with issues that are raised, either directly or indirectly, by the

argument presented in McTaggart's paper. McTaggart distinguishes between what he calls 'the A series' and 'the B series'. The A-series is an ordering of positions in time in terms of their possession of tensed monadic properties (such as *being in the future, being present* and *being in the past*). The B-series is an ordering of positions in time in terms of their standing in tenseless two-place relations (such as *being earlier than*, *being simultaneous with* and *being later than*). His argument (very roughly) is that the A-series is required in order for time to be real, but the A-series is contradictory, so time cannot be real. In this chapter McTaggart's argument will be discussed in detail and some of the main responses to it will be outlined.

Despite the fact that McTaggart's conclusion that time is unreal is often rejected, his argument for that conclusion is generally taken to be important. Some have taken the lesson of McTaggart's argument to be that time consists in the B-series alone (such people are known as B-theorists). B-Theorists believe that all talk about tensed A-properties can be reduced to talk about untensed B-relations, and that time cannot be said to flow in any meaningful sense. Others continue to maintain that time is dynamic and that it does flow in some sense. They either try to make sense of time's flow metaphysically by arguing that the world really does have something like an A-series structure, or take the fundamental lesson of McTaggart's argument to be that we must take tense seriously, i.e. that tensed A-properties are primitive and unanalysable (such people are known as A-theorists). The debate between A-theorists and B-theorists has, however, developed well beyond their respective responses to McTaggart's argument and Chapter 4 centres on the debates between these rival camps.

Chapter 5 addresses a related, though importantly distinct, debate concerning the *ontology* of time. Nearly all contemporary philosophers of time agree that the present time exists but there is substantial disagreement concerning the existence of the past and the future. Presentists believe that only the present exists. Eternalists believe that all times are equally real. Growing block theorists believe that the past and the present exist, but that the future does not. We outline these views and consider some of the motivations for believing in them. The two main views defended in the contemporary literature – presentism and eternalism – will form the main focus of the chapter, and the bulk of it will be taken up with considering objections to presentism, which is usually thought to be the default common-sense position. We also address the claim that the dispute between these two camps is 'merely verbal', and the question of how the so called 'Truthmaker' debate bears on this controversy.

It is often held that while all statements about the past are either true or false, the same does not hold with respect to all statements concerning the future. In Chapter 6 we ask whether this commonly held view is correct, and

consider the consequences of rejecting or endorsing it. We also consider the following questions: (i) Does rejecting this view lead to fatalism? (ii) Can we reject this view and still allow that human beings possess free will? (iii) How does endorsing the view affect the logical systems that we use in our reasoning? (iv) What ontological consequences does endorsing the view have? (v) Is it possible to maintain the view that some statements about the past are also neither true nor false?

Objects persist through time. This much seems clear. There are, however, some radically different philosophical views about what such persistence consists in. In Chapter 7 we consider some of these accounts, focusing primarily on the two most prominent contemporary views: endurantism and perdurantism. According to endurantists objects persist by being wholly present at each time at which they exist, while according to perdurantists objects persist by having distinct temporal parts at each moment at which they exist. In this chapter these two views will be explained and the main arguments for and against each view will be presented. We will also examine a new contender on the scene – the stage theory – and ask how well it stacks up against the traditional views. Finally, we ask whether these debates concerning persistence have any bearing on the controversies concerning the ontology of time which we considered in Chapter 5.

In Chapter 8 we consider some issues relating to our experience of time. The way in which we experience the world is temporal in a number of ways. In this chapter the nature of our temporal experiences will be examined and the metaphysical implications of it discussed. The focus will be on three important and related aspects of our temporal experience: (i) that our experiences seem to have a temporal breadth, (ii) that we seem to experience changes directly and (iii) that our experiences are stream-like – they seem to flow (the first two of these are taken to be aspects of what William James has called 'the specious present'). Recently, a head of steam has been building around the view that these aspects of our experience have metaphysical implications for both the A-theory/B-theory debate and the presentist/eternalist debate. These recent developments will be outlined.

The possibility of time travel seems to lead to paradoxes. It appears, for example, that if time travel is possible then I can travel back in time and kill my younger self. But, I did not in fact kill my younger self. So, because the past is fixed, I cannot kill my younger self. It seems, then, that the possibility of time travel leaves us with the contradictory result that I both *can* and *cannot* kill my younger self. As such we must, on pain of contradiction, reject the claim that time travel is possible. Paradoxes such as this form the primary focus of Chapter 9. The classic discussion of arguments of this kind – and the main focus of our chapter – is Lewis (1976b). Lewis argues, within an eternalist and perdurantist framework, that the argument above – along

with some other putative paradoxes we consider – fails and that time travel *is* possible after all. The chapter begins with an outline of some arguments against the possibility of time travel before considering Lewis's responses to them. We then consider some more recent developments in the debate concerning time travel. The issue of whether time travel is possible within a presentist or endurantist framework will also be addressed.

Throughout this book we raise a number of objections against various views that appeal to facts about current physics (e.g. the objection that the A-theory and presentism are incompatible with the truth of special relativity's denial of absolute simultaneity). In Chapter 10 we offer an assessment of these objections. We also return to the substantivalism/relationism debate introduced in Chapter 2 and ask how current developments in physics impact upon it. Finally, we very briefly comment on more recent developments in fundamental physics (i.e. on quantum mechanics and quantum gravity).

FURTHER READINGS

As the bibliography for this volume should illustrate, the literature regarding the philosophy of time (both historical and contemporary) is vast. For some key texts in the history of the discipline see the further readings from Chapters 1 and 2. For further readings on other topics, see the suggestions at the end of each chapter. Some influential texts in the contemporary debate worth noting here are Prior (1968/2003), Mellor (1981), Le Poidevin (1991), Hawley (2001) and Sider (2001). We also draw the reader's attention to Oaklander (2008). This excellent six volume collection contains many important papers covering all aspects of the philosophy of time.

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1

The ancient history

This chapter begins our survey of the history of the metaphysics of time. We start in ancient Greece looking at the views of two 'pre-Socratic' philosophers (Parmenides and Zeno) before briefly examining the views of the two giants of Western philosophy: Plato and Aristotle. Finally, we discuss some famous work on the metaphysics of time by the African philosopher and theologian Augustine of Hippo. The works of all of these thinkers are far richer than this brief survey can fully convey and we strongly encourage interested readers to pursue their views further by consulting the further readings.

In this chapter we cover the ancient history of the philosophy of time from its origins in ancient Greece to the beginning of the Middle Ages. As mentioned in the introduction, we do so selectively, focusing upon the most important historical views, and upon those arguments that bear on the themes developed in later chapters. Even with such a delimited scope, however, there is a difficulty in presenting the history of the subject in a short chapter. The views of historical philosophers (and especially the Greeks) are subject to varying and often contradictory interpretations in a way that the views of contemporary philosophers are not. In order to combat this difficulty, we present those interpretations that seem most plausible to us, but note where significant disagreement occurs, and direct the reader to the sources of the disagreement. In this chapter we focus specifically on the work of five key philosophers: Parmenides, Zeno, Plato, Aristotle and Augustine. First, though, we will take a brief look at some of the very earliest discussions of time in Western philosophy.

1.1. The pre-Socratics

The philosophy of time begins, as does Western philosophy itself, with the pre-Socratics. The pre-Socratics are those ancient Greek philosophers who lived in the sixth and fifth century BC and who were uninfluenced by the views of Socrates (so, even some of Socrates's contemporaries are known as *pre*-Socratics). What binds them together, and distinguishes them from many earlier thinkers, is their rejection of the view that since the world is governed by the actions of the gods it is ultimately incomprehensible to mere humans. Instead they believe that the world can be understood in terms of intelligible overarching natural principles that explain its operation and features. Unfortunately, little remains of the writings of the early pre-Socratics, and of what does remain, the fragments on time are scant. Nevertheless, it is clear from those fragments that for the early pre-Socratics the concept of time is intimately bound up with the concept of change. In the sole surviving fragment of a work by Anaximander of Miletus (c. 610–546 BC) he expresses the view that everything that comes to be and passes away arises from and falls back into an unchanging substance that he called *to apeiron*. As Anaximander thinks that all changes are constituted by the coming to be or passing away of something, his thought seems to be that for change to occur, there must be something that remains constant underlying those changes, and that anything that changes is necessarily of limited duration. Anaximenes (c. 585–528 BC) similarly held that change requires there to be an underlying unchanging substance, but on the basis of empirical observation, he identified that substance with air. At least some of the surviving passages of the work of Heraclitus (fl. c. 500 BC) suggest that he held a contrary view, namely that there is no constant substance that underlies change, and indeed that nothing ever remains the same for even a limited period. Rather, the passages suggest, everything is in a state of constant flux, continuously changing from one state to another. But other surviving passages suggest that he held a different view, *viz.* that things can remain the same *by* changing. This is one interpretation that is given (by e.g. Marcovich 1967) to a famous doctrine attributed to Heraclitus by Plutarch (45–120 AD):

> It is not possible to step twice into the same river according to Heraclitus, or to come into contact twice with a mortal being in the same state. (Plutarch, *B91* in Robinson 1987)

On this interpretation Heraclitus's point here is that rivers and mortal beings are things that remain identical over time despite, or perhaps even in virtue of, the changes that they undergo. If this interpretation is correct, Heraclitus's

point is one of considerable import. We will return to this issue in Chapter 7 where the issue of identity over time (and through change) will be explicitly considered.

1.2. Parmenides

The first philosopher for whom substantial fragments of his writings survive is the late pre-Socratic Parmenides of Elea (fl. c. 450 BC). Of the 800 or so verses of his philosophical epic poem (known now as 'On Nature') around 160 survive as fragments (see Gallop 1984). The most substantial fragment, fragment eight, comes from the first part of the poem ('The Way of Truth') and is 62 verses long. In it Parmenides offers an argument for the conclusion that time does not exist. In giving this conclusion Parmenides places himself first among an illustrious list of philosophers who concluded similarly, including J. M. E. McTaggart, whose argument for this conclusion we will consider at length in Chapter 3. And in fact, properly understood, the argument that Parmenides gives for this conclusion heavily foreshadows McTaggart's. Before coming to the argument, however, it is worth commenting on the nature of the conclusion itself.

As will be seen shortly, Parmenides's conclusion has as a corollary that change is impossible. Both this corollary and the original conclusion are *prima facie* so incredible that it is tempting to dismiss any argument for them before one has even seen their premises. That is, it is tempting to think of any argument with either of these conclusions as having the form of a *reductio ad absurdum*, and thus as constituting an argument against (at least one of) their premises. But to do so would be hasty. The first part of Parmenides's poem where the arguments for the non-existence of time and the impossibility of change are presented is supposed to reveal to us the way that reality *really is*. But Parmenides's poem has a second part ('The Way of Opinion') that is supposed to describe the way that reality *appears to be*. Very little survives of this second part, but what can be gleaned from what does remain is that Parmenides there presents a view of the world – the view of the ordinary folk – that is radically at odds with the conclusions he reaches in the first part. In particular, he presents a view of the world according to which changes occur constantly. Parmenides is thus perfectly aware of how incredible the conclusions of the first part of his poem *seem* to be, but considers this to be no objection. It is part of Parmenides's position that we are apt to fall into error regarding how things are by taking our experiences of how things seem to be too seriously. And he takes his argument for the non-existence of time to show that this is just what happens with our experiences of time and

change. So, it is reasonable to maintain that rejecting his conclusions about how things really are purely on the basis of how things appear to be would be to beg the question against Parmenides. This point is a perfectly general one. If someone offers an argument that is intended to show that things are not really as they appear to be, it is reasonable to maintain that one cannot refute them by appealing to appearances alone. Instead one must either (i) engage directly with their argument, or else (ii) offer a counterargument to the effect that, given that things seem to us to be a certain way, they must really be that way.

It is worth noting, briefly, that whether or not time and change really do exist, the fact that our experiences represent it as existing and as (in some sense) flowing needs to be explained. This raises further questions about precisely *how* our experiences represent time as existing. Do we have direct experiences of time and its flow? Or can our experiences be explained in some other way? We will take these questions up in Chapters 4 and 8, where it will be seen that some think our experiences of time can only be explained if time really does exist and has a certain metaphysical structure.

So what, then, is Parmenides's argument for the conclusion that time does not exist? There is some controversy about this. Parmenides begins by affirming that to think of what is, that it is not, or of what is not, that it is, is contradictory. And to think something contradictory, he argues, is in fact to think nothing at all; it is to try to think something that is literally unthinkable (in Parmenides's terms it is to engage in 'two-headed' thinking that is 'backward turning'). He also affirms that whatever is, can be thought of. And it follows from this that if something is not thinkable, then it must be that it is not the case. He then presents the following (rather obscure) argument:

> It never was nor will be, since it is now, all together, one, continuous. For what birth will you seek for it? How and whence did it grow? I shall not allow you to say nor think from not being: for it is not to be said nor thought that it is not; and what need would have driven it later rather than earlier, beginning from nothing to grow? Thus it must either be completely or not at all … And how could what is be in the future? How could it come to be? For if it came into being, it is not; nor is it if it is ever going to be in the future. Thus coming to be is extinguished and perishing unheard of. (Parmenides, in Kirk et al. 1987: 249–50)

Some (e.g. Matson 1987) take Parmenides's main argument here to be that nothing can come from nothing because all things must have a sufficient cause for their existence. But while it is true that Parmenides does express something like this causal argument here, it cannot be his main argument, for two reasons. First, the argument has no bearing on the future or whether things can go out

of existence, and so does not explain why Parmenides thinks that these things are just as problematic as the past and coming into existence. Secondly, this argument makes no mention of the difficulties that Parmenides thinks arise when we try to think of what is, that it is not, or of what is not, that it is. So it also does not explain why Parmenides places such a heavy emphasis on these difficulties. The most common interpretation of Parmenides's argument does explain both of these things. According to it, the main argument expressed in the passage has something like the following structure:

(1) To think of nothing is to think of nothing as being something (i.e. to think of what is not, that it is). [Premise]

(2) To think of nothing as being something is contradictory, and so is to try to think something that is not in fact thinkable. [Premise]

(3) So it is not possible to think of nothing. [From 1 and 2]

(4) To think that things come into or go out of existence is to think that they arise from nothing, or that they pass away into nothing. [Premise]

(5) So to think that things come into or go out of existence requires that one thinks of nothing. [From 4]

(6) So to think that things come into or go out of existence is itself to try to think something that is in fact unthinkable. [From 3 and 5]

(7) So it is not possible to think that things come into or go out of existence. [From 6]

(8) Whatever is, is thinkable. [Premise]

Therefore,

(9) Nothing ever comes into or goes out of existence. [From 7 and 8]

This interpretation (or something very close to it) can be found in Russell (1945), Copleston (1946) and Turetzky (1998), among other places. Note that on this interpretation Parmenides does not argue directly against the existence of time. Rather, the argument is directed against the idea that things come into and go out of existence (i.e. it purports to show that nothing ever changes). Of course, if temporal passage requires change, then the argument does also establish that time does not exist. But it is not obvious that temporal passage requires change, so it at least leaves open the possibility that our world is one in which time passes although nothing ever changes. (The issue of whether this is possible is related to the substantivalism/relationism debate, which we consider further in Chapter 2.)

The major problem with Parmenides's argument, on the above interpretation, is with premise 1. What is it to think that nothing is something? If it is to be contradictory, as premise 2 requires, then it must be to think of nothing as being some *entity* that fails to exist. It is plausible that this is indeed contradictory, because it is plausible that the concept of an entity is just the concept of an existing thing, and of course no existing thing can fail to exist. But now the problem with premise 1 becomes clear. To think of nothing, it is usually thought, is *not* to think that there is some entity named by the term 'nothing' that does not exist. Rather, it is to entertain the simple thought that no entity exists, *viz.* the thought that it is not the case that an entity exists. (Here, an analogy helps. Suppose Smith tells us the following: 'Nobody is coming to the party.' Smith is not telling us that there is a person called 'Nobody' who will be attending the party. Rather, he is telling us that it is not the case that there will be a person at the party.) So premise 1 is false. And moreover, while it is plausible that it *is* contradictory to think there is a non-existing entity named by 'nothing', it is *not* plausible that it is contradictory to think it is not the case that an entity exists. So, there is no way of recovering Parmenides's argument once premise 1 has been rejected.

Often unsuccessful arguments are interesting. In diagnosing where they go wrong we can learn something new or important about the subject matter of the argument. But if the interpretation above is correct, then Parmenides's argument is ultimately uninteresting. It is an instance of a fallacy that is (now) well-known, and diagnosing it as such reveals nothing interesting about time. However, despite it being the most common interpretation, it is in fact doubtful that the interpretation above *is* correct. In a somewhat neglected paper Ronald Hoy has argued forcefully that Parmenides's argument has a quite different form (see Hoy 1994: 582–3). Hoy maintains that Parmenides's main argument is supposed in fact to show that common beliefs about the past and the future are contradictory. The argument, so construed, has something like the following form:

(1) The future is supposed to be where things that do not exist issue from, and the past is supposed to be where things that cease to be go. [Premise]

(2) But the future and the past are also supposed not to exist. [Premise]

(3) So the future and the past are supposed both to be, and not to be, which is contradictory. [From 1 and 2]

(4) What is contradictory is unthinkable. [Premise]

(5) It is not possible to think of the future or the past. [From 3 and 4]

(6) What is, is thinkable. [Premise]

Therefore,

(7) The future and the past do not exist. [From 5 and 6]

That change is impossible now becomes a corollary, which is reached as follows:

(8) If things come into and go out of existence, there is a future from which they issue, and a past into which they go. [Premise]

Therefore,

(9) Nothing comes into or goes out of existence. [From 7 and 8]

This argument is much more interesting than the previous one, and raises issues that cannot be so easily dismissed. One might have qualms with premises 4 and 6. (If one thinks something that is contradictory, then one certainly does not have a thought that can be true, but does one really think *nothing at all*? And is it not possible for there to be things that lie outside of human understanding, and thus things that cannot be thought of?) But if the first two premises capture, as they seem to, something about our common-sense thinking about time, then whether premises 4 and 6 are true is relatively unimportant. The point reached at step 3 of the argument is bad enough. If our common-sense conception of time is contradictory, then there is something wrong with it, and it needs to be revised in some way. We will return to the issue of the viability of our common-sense picture of time in various chapters throughout this book, and in particular in Chapters 3, 4 and 5.

1.3. Zeno

Parmenides's student Zeno (often known as Zeno of Elea to distinguish him from a number of other ancient philosophers who share the same name) also put forward a number of influential arguments for the claim that change is impossible. Indeed, some of Zeno's contemporaries seemed to take his views to be little more than echoes of those already expressed by his mentor – most notably Socrates, who is said to have remarked to Parmenides that Zeno has 'written to much the same effect as you but by changing tactics he tries to mislead us into thinking he's saying something different' (Plato 1997: 5). However, rather than focusing – as his teacher did – on questioning the possibility of objects coming into and going out of existence, Zeno focused primarily on denying the possibility of motion. Without doubt his most famous argument for this conclusion – often known

simply as 'Zeno's paradox' – concerns a hypothetical race between the Greek hero Achilles and a tortoise. Max Black outlines the argument as follows:

> Suppose Achilles runs ten times as fast as the tortoise, and gives him a hundred yards start. In order to win the race Achilles must first make up for his initial handicap by running a hundred yards; but when he has done this and has reached the point where the tortoise started, the animal has had time to advance ten yards. While Achilles runs these ten yards, the tortoise gets one yard ahead; when Achilles has run this yard, the tortoise is a tenth of a yard ahead; and so on, without end. Achilles never catches the tortoise, because the tortoise always holds a lead, however small. (Black 1951: 91)

Zeno's argument is not, however, intended to demonstrate that the tortoise would win the contest in question but, rather, to show that the very possibility of such a contest leads to paradox. Consider a case where the two race for exactly two hundred yards. Achilles has to cover the full distance whereas the tortoise – thanks to Achilles's sportsmanship in offering it a considerable head start – only has to cover half of it. Still, since Achilles is moving ten times as fast, travelling twice the distance should be no problem and we should expect him to win a comfortable victory. It looks, then, as if we have the contradictory result that Achilles cannot possibly win the race (since he can never overtake his opponent) and that he can win it easily (since he is moving so much faster than his opponent). The moral of this story, Zeno maintains, is that a contest of the kind he describes and, by extension, motion in general is impossible.

What should we make of these claims? Although almost all subsequent writers on the subject have agreed that Zeno's arguments fail, responses to the paradox have been notably varied. Some have taken it to be a piece of obvious sophistry worthy only of derision whereas others classify it as a profound – though ultimately mistaken – contribution to philosophy which has proven invaluable to our understanding of notions such as change and infinity. Bertrand Russell – himself very much in the second camp – famously remarked that.

> In this capricious world, nothing is more capricious than posthumous fame. One of the most notable victims of posterity's lack of judgment is the Eleatic Zeno. Having invented four arguments [for the impossibility of motion], all immeasurably subtle and profound, the grossness of subsequent philosophers pronounced him to be a mere ingenious juggler, and his arguments to be one and all sophisms. (Russell 1903/2010: 352)

However, Russell goes on to claim that – caprices of posthumous fame notwithstanding – the recent rediscovery and reappraisal of Zeno's paradox provided 'the foundation of a mathematical renaissance' (ibid.). So, while Russell, ultimately, agrees that the argument is unsound he also believes that careful study of Zeno's work was crucial in developing a number of important nineteenth century advances in mathematics which led to the paradox's ultimate resolution. And this view of Zeno's paradox, according to which it is somehow dissipated by developments in modern mathematics, has become something akin to orthodoxy since the time of Russell's writing (though Alba Papa-Grimaldi (1996) offers an argument against this view). There is, however (as the further readings for this chapter clearly illustrate), no clear consensus as to exactly what the correct mathematical resolution of the paradox is.

Although the case of Achilles and the tortoise has proven to be easily the most influential of Zeno's paradoxes, some of his other paradoxes have also drawn significant attention from later philosophers. We will only consider one such paradox here: Zeno's Arrow. Ofra Magidor (2008: 360) presents the Arrow argument as follows:

Let *l* be an interval of time, in which a flying arrow is in motion.

(1) Everything is at rest when it occupies a space equal to itself. [Premise]

(2) At every instant *t* contained in *l*, the arrow occupies a space equal to itself. [Implicit premise]

(3) At every instant *t* contained in *l*, the arrow is at rest at *t*. [From 1 and 2]

(4) The arrow is always 'at an instant'. [Premise]

Therefore,

(5) The arrow is motionless in *l*. [From 3 and 4]

As it stands there are, no doubt, a number of premises in this argument which strike you as in need of some defence. Why, for example, should we accept that 'everything is at rest when it occupies a space equal to itself' or that the arrow is 'always at an instant'? And there are ongoing debates concerning both how these claims of Zeno's should be interpreted and whether all (or any) of them are defensible. We do not, however, intend to evaluate these claims concerning the Arrow argument and how it is best interpreted here (though see further readings for details). Rather, we mention the argument only to illustrate an important connection with a contemporary debate which we will cover in later chapters. The debate in question concerns whether 'change' of the kind the arrow undergoes – being in one place at one

instant and another at some later instant – is sufficient for genuine change (or genuine motion) or whether something more is required. Zeno clearly favours the latter answer but – as we will see in Chapters 3 and 7 – others have demurred.

1.4. Plato

Plato (428–347 BC) is, of course, a towering figure in the history of philosophy, and his influence on the discipline is perhaps second only to that of his most famous pupil, Aristotle. It is this that justifies a brief treatment of his views on time. However, although much of Plato's work is still relevant today, his writings on time are rooted in an outdated cosmology, and so will be of primary interest to us only insofar as they cast light on the views of those who follow.

Plato's views on time are presented most fully in *Timaeus*, whose main protagonist is a character of the same name. The physical universe, according to Plato, is a realm of appearances that is real insofar as it resembles (in some sense) those objects that are fully real, the unchanging eternal forms. In *Timaeus* the titular character tells a story about how the universe was created by a divine Craftsman, Demiurge, who imposed order on chaos to form the intelligible world in which we live. He supposedly did so by using the eternal forms as a guide, and is said to have created time as part of this undertaking, with time introducing order into the world in virtue of its resemblance to the eternity of the forms. (There is some controversy over whether this is to be taken as expressing Plato's literal view, or whether it is meant to be metaphorical – see Vlastos 1965.) Time is, says Timaeus, 'the moving image of eternity'. In giving this account Plato took himself to reconcile the two views about time that Parmenides took to be contradictory, *viz.* that it both exists and does not exist. Time is real and intelligible, according to Plato, insofar as it resembles eternity, but also has a certain degree of unreality insofar as that resemblance is imperfect.

Plato's view rests on a number of dubious assumptions. The assumption that is most obviously so, of course, is that the universe was created to resemble a realm of eternal forms. But only slightly less dubious is the more general metaphysical assumption that there are degrees of reality. Although a few contemporary metaphysicians (e.g. Smith 2002) demur, the vast majority believe that existence does not come in degrees. Even if we allow that existence comes in degrees, though, it still doesn't engage with Parmenides's argument, at least as we have suggested it should be interpreted. Parmenides's point is that the past and the future, *as they appear to*

us, are taken to both exist and to not exist. And nothing that Plato says has any bearing on this point.

One significant point that can be extracted from Plato's writings on time is his distinctive conception of eternity. It is perhaps most natural to conceive of eternity as an unending period of time. But this is not Plato's conception. The forms are not eternal in the sense that they go on forever. Rather, they have a mode of existence that is unconditioned by time. They are literally time*less* and so temporal concepts simply do not apply to them. So the forms are conceived of as unchanging entities not because they happen not to change, but because it makes no sense to suppose that they do change (at least if we take the existence of change to be sufficient condition for the existence of time).

Time is introduced into the universe, we are told, as the moving image of eternity. But in light of the above understanding of eternity, one might be puzzled. Given that the forms are timeless and unchanging, how precisely is time supposed to resemble them? In order to understand Plato's answer to this question, one must first understand that in Plato's view the universe is a great sphere, with the Earth at its centre, that undergoes perfect cyclical movement: the celestial bodies follow a repeating regular pattern, always returning to exactly the same positions. He considers each cycle of the universe to be a basic unit of time, and thus identifies the passage of time with the movements of the celestial bodies. For Plato, this means that time itself moves and undergoes change, just as the celestial bodies do. It also means that time is divisible into parts, or sub-units, which are identified with the sub-cycles of the celestial bodies. But, precisely because the movements of the celestial bodies are perfectly cyclical, there is a sense in which time considered as a whole does not change. Each unit of time is qualitatively identical with every other unit, and so the series of cycles considered as units do not change from one cycle to the next. It is in this sense that time resembles the eternal forms, for Plato.

1.5. Aristotle

Aristotle (384–322 BC) presents his account of time in *Physics*. He begins with some brief remarks that suggest that Parmenides's conclusion (i.e. that time does not exist) is true. He says that time is made of two parts, the past and the future. But, he says, the past has been and is not, while the future is going to be and is not yet. So, time is made of two parts, neither of which exists, and so it is reasonable to suppose that time itself does not exist. He doesn't seem to take this problem too seriously, however, as he quickly

moves on from it to give a positive account of what time is. Although there is some disagreement among commentators, the likely explanation for this is that Aristotle takes his positive account of time to dispel the worries that Parmenides raises. Once one gets clear about the nature of time, Aristotle likely thinks, one will see that Parmenides's arguments are confused.

In giving his positive account of time Aristotle first rejects the view that the passage of time can be identified with motion (i.e. the movements of any bodies), and thus rejects Plato's view that the passage of time can be identified with the cyclical movements of the heavenly bodies. He gives a number of reasons for this, but the main one is that distinct bodies undergo distinct motions (the motion of a body is, he says, 'in the moving body' itself), but temporal passage occurs everywhere (and so cannot be in the moving bodies themselves). He nevertheless acknowledges his teacher's wisdom on this matter by endorsing the view that there is an intimate connection – as Parmenides and Zeno would also maintain though for very different reasons – between time and motion, and more generally between time and change. He maintains that all motion, and all change, involves a continuous transition from an initial state (a 'before') to a distinct final state (an 'after'). A continuous transition does not consist of a succession of discrete states that follow one after another. Rather, it consists of an ordered succession of states such that between any two of them there are infinitely many others. Each motion (and change) is thus a transition from a before to an after, and in each transition an object passes through a continuous succession of intermediate states that together constitute the transition as a whole. When we experience any motion (or change), Aristotle further maintains, we are able to assign successive numbers to the succession of intermediate states that constitute it, and thus arrive at a numerical value that numbers the motion (or change). And this, maintains Aristotle, is what time is: 'Time is the number of motion [or change] with respect to before and after.' As it is conscious beings who number things, Aristotle thus seems to endorse the view that time depends for its existence on the operations of conscious beings, and so is in some sense subjective. In addition, although he disagrees with Plato that time can be identified with the motions of bodies, he does seem to endorse the view that all talk about time can be reduced, in some sense, to talk about motion and change. One may suppose, therefore, that he thinks Parmenides's argument for the non-existence of time errs in taking time to be something that exists independently of conscious observers and the motions of bodies.

The core of Aristotle's view described above is that time is a numerical quantity that can be applied to, and thus measures, change. But there is a complication. If, as Aristotle held, changes consist in a continuous succession of states from a before to an after, then in fact it is difficult to see how the

successive states *can* be counted by conscious beings. As was just now mentioned, if changes are continuous, then each is constituted by an infinite number of successive states, so it cannot be that we count each of them. But if we do not count each of them, what is it that we count, and how do we so count them? In answer to this problem Aristotle appeals to what he calls the 'now'. This is a curious concept that serves a double purpose in Aristotle's thinking. Although, as we have seen, Aristotle seems to espouse the view that time depends for its existence upon the operations of conscious observers, he also seems to think of the now as being an independently existing entity that is in one sense unchanging and in another undergoes change. Thought of as an unchanging thing, the now is an enduring present that exists wholly and completely throughout each change's continuous succession of states. Thought of in this way the now plays a similar role to the *to apeiron* of Anaximander, as a constant that underlies change. Indeed, Aristotle maintains that the now cannot itself be in time because it is unchanging. Why is this? Because, he says, if it did undergo change then it would be possible to assign to it some number that measures it. But, as it does not undergo change, this is not possible, and so the concept of time does not apply to it. Nevertheless, Aristotle insists, there is a sense in which the now *does* undergo change. It does so in the sense that it stands in different relations to the changes that it underlies. And it is by so doing that the now divides continuous changes and makes counting them possible.

One can perhaps illuminate Aristotle's view here by considering some specific change, i.e. an occurrence involving an object that undergoes a transition from an initial state to a final state, passing through a continuous succession of states along the way. At the beginning of this transition the now is related to the initial state of the change, but as the transition takes place the now becomes related to later states in the succession until it ends up related to the final state. More specifically, at each stage of the transition the now stands in a relation to the continuous succession that divides it into two discrete parts – the part that is in the past and the part that is in the future. (It does so by standing as the end-point and start-point of two distinct open intervals whose union is the whole succession.) So, as a change occurs, the now divides the succession of states that constitute it on an ongoing basis, and when we experience a change it is these ongoing divisions that we count, one after another. So, the unchanging now divides those changes that it underlies (which are themselves continuous successions of states) into discrete countable parts. One might be tempted to conclude on the basis of the foregoing that although change is continuous, time is discrete. But Aristotle denies that this is so. He maintains that because changes are continuous, time itself must also be continuous. When we use the now to divide and number changes, we are thus dividing and numbering time itself.

We have explained the main features of Aristotle's view, but it must be admitted that its details remain obscure. (We note that even recent commentators who have given book-length treatments of Aristotle's views on time have fundamental disagreements about how we are to make sense of them (see e.g. Coope 2005 and Roark 2011).) Nevertheless, it is possible to see that Aristotle's view raises questions that many are still attempting to answer today. One such question is whether time, or its flow, is something that depends upon the operations of conscious observers. We will consider this question again in Chapters 2, 3, 4 and 8. Another question is whether time is reducible in some sense to something more basic (as we will see in Chapter 2, Descartes appeared to take this Aristotelian view). We can also ask whether it makes sense to suppose that anything can strictly *endure* through time (i.e. exist wholly and completely at different moments), as Aristotle in places suggests that the 'now', when considered as an entity in its own right, does. We will consider this question in Chapter 7. Although Aristotle denied that the present (i.e. the 'now') is properly thought of as being in time, he certainly thought that the present itself in some sense changes as time passes. The view suggested is that the present moment is just one point (or, a dividing point) in a series of times that run from the past, through the present, and into the future. On this view, the present moment moves along this series as time passes, but each part of the series is just as real as each other. This and related views will be discussed in Chapters 3, 4 and 5. And there is one final important aspect of Aristotle's view that we haven't mentioned in this survey chapter – his views regarding the open future. We will discuss these in Chapter 6 where they will serve as the starting point into our examination of this topic.

1.6. Augustine

Augustine's most famous work, *The Confessions* (Augustine 2001), is also one of the hardest to classify texts in the history of philosophy. The majority of the work takes the form of an autobiographical reflection concerning, among other things, Augustine's conversion to Christianity but it also contains some extended philosophical discussions. The most important of these is found in chapter 11 of *The Confessions* and concerns the nature of time. There are a number of features of this chapter worthy of discussion but we will content ourselves here with noting two points which tie in closely to some of the issues we will discuss in later chapters.

The first of these concerns the puzzle of why God created the world when he did (a puzzle which has clear links to some of the debates between

substantivalists and relationists which we will discuss in the next chapter). Augustine and his contemporaries accepted a view according to which God is eternal and has always existed while the universe, by contrast, was caused to exist at some point in the past by divine action. Given this, though, we might reasonably be inclined to ask what God was doing during the infinite stretches of time before he created the universe, and why he didn't create the universe a moment, or a millennia, earlier (or indeed later) than he actually did. It seems as if we must say either that God had some reason for choosing the precise moment at which he created the universe or else that he did not. Yet, neither option looks appealing. If we say that God acted without good reason in choosing the moment he did then this seems to undermine some important theological claims concerning God's wisdom. Surely, an all-wise being would not (indeed could not) act in such a capricious fashion. If we say that God did have some reason, though, then we are faced with the perplexing task of determining what this reason could be. What could possibly make *that* precise moment stand out from the infinity of moments which preceded it as the best time to create a universe?

In deciding how to respond to this challenge Augustine (ibid.: 269) quickly rejects the famous response that God spent his time before creating the universe 'preparing hell for people who ask questions too deep for them' (correctly noting that such a flippant dismissal is unworthy of serious philosophical inquiry). Instead, he suggests that the way in which the problem is set up misrepresents God's relation to time. We should, Augustine thinks, deny that there was any period of time at all (let alone an infinite period of time) before God created the universe (ibid.: 270). Rather, we should hold that the first moment of creation was the first moment *simpliciter*. It was not only the moment at which God created the universe but also the moment when he created time. To say that God is eternal, then, is not – as the hypothetical objector mistakenly supposes – to claim that God occupies an infinite number of past and future times. (Rejecting such a view of divine eternity is exceedingly important for Augustine, not only because it provides a response to the worry we are considering but also because, as we will see below, Augustine takes both the past and future, and their contents, to be unreal. Parts of our ordinary human lives pass into non-existence as time passes but, Augustine claims, such an existence would be unworthy of a divine being.) If we are not to think of God's eternity in terms of his occupying an infinite number of past and future times, though, then how should we think of it? Augustine's answer to this question is rather difficult to decipher and he relies heavily on some rather opaque metaphors concerning God's relationship to time: claiming, for example, that we should say of the different 'moments' of God's existence that they 'abide together at once' and that all times are equally present for him. This view of God's eternity is certainly a puzzling one,

and there have been enduring controversies concerning both the best way in which to interpret Augustine's view of divine eternity and whether that view is, all things considered, a plausible one. We will not, however, address these controversies here (though see the further readings at the end of the chapter) but merely note that, whatever else can be said about this view, it certainly resolves the puzzle in hand. If it is not the case that there were any moments of time prior to the first moment of creation then it makes no sense to ask why God didn't create the universe at one of those earlier moments.

The second aspect of Augustine's philosophy of time which we want to highlight is his previously mentioned denial of the reality of the past and future. In Augustine's view (ibid.: 271) it is a mistake to think that certain events and objects exist in the past and future, or that these other times themselves exist. The only time that exists is the present (that Augustine takes to be an instantaneous moment which divides the past from the future; we return to this view in section 8.3). We should not say, then, that certain objects and events are in the past or the future. Rather, we should say that it *was* the case that certain objects are present and that it *will be* the case that certain other objects are present. This constant passing into and out of existence which different times and their contents undergo is what distinguishes our temporal existence from God's eternal existence (ibid.: 268).

Depending on how you interpret these claims of Augustine's they may strike you either as obvious pieces of common sense or as profoundly implausible philosophical fantasies. And, as we will see in Chapter 5, there is considerable debate as to how we can explicate a claim like 'only the present time exists' in a way which is neither trivially true nor obviously false. One obvious worry about such a view (one which we will return to in a number of later chapters) is how those who accept it are able to account for the fact that various claims about the past – and perhaps the future – are presently true. What makes it the case, for example, that it was true that the sun rose yesterday if yesterday, along with its sunrise, no longer exists? Augustine's own answer to this questions seems (as we will discuss further in Chapter 8) to rely very heavily on some aspects of human psychology. He maintains (ibid.: 274–5) that truths about the past find their basis in our memory of past events whereas those about the future are rooted in our anticipation and prediction of future events (along with – for a blessed few – prophetic insight into those events).

Augustine's claim that the past and future are unreal is, as we will see in Chapter 5, defended by a number of contemporary philosophers and the majority of these philosophers are also highly sympathetic to the kinds of translations Augustine proposes for claims which apparently quantify over past and future objects. Yet, these philosophers are typically unwilling to allow that what is true of other times depends on anything as fragile and fallible as

human memory. As to what truths about the past and future *do* depend on according to such philosophers, this is a topic we will return to at length in Chapter 5.

1.7. Summary

In this chapter we have offered an overview of the work of some key figures in the philosophy of time from the birth of Western philosophy until the beginning of the Middle Ages. In the next chapter we move forward over a thousand years to look at some key figures in the modern history of the philosophy of time (beginning in the seventeenth century). The intervening centuries were certainly not without substantial contributions to the philosophy of time and many of the key philosophical figures of the Middle Ages – most obviously Boethius, Ockham and Aquinas – produced some excellent works on the metaphysics of time. We will not, however, discuss their works here for two reasons (though those who are interested in the work of these philosophers are encouraged to consult Boethius (1969: 116–38), Adams (1989: 853–903) and (Brower 2014: 57–103) respectively). First, because much of the work on the metaphysics of time in this period was intricately connected to issues in the philosophy of religion which fall outside the focus of this work. Second, because there have (with some exceptions we highlight in later chapters) tended to be fewer links – or at least fewer which are explicitly acknowledged – between work in the medieval period and the contemporary issues in the philosophy of time which will form the main focus of this book.

Study Questions

1. What two interpretations of Parmenides's argument do we consider? Which, if either, do you find most persuasive?
2. Are you convinced by either of Zeno's arguments that there is something paradoxical about motion?
3. What are Plato's and Aristotle's views regarding the reduction of time to motion? Are either of them coherent?
4. What is Augustine's response to the question 'why didn't God create the universe earlier than he did?' Do you find this response satisfactory?

FURTHER READINGS

General
For a general overview of the history of philosophy during this period we recommend Russell (1945), Copleston (1946, 1950) and Kenny (2012). Sorabji (1983) and Turetzky (1998) cover this period too, focusing on the philosophy of time.

Pre-Socratics
Kirk et al. (1983) provides a good selection, with discussion, of surviving pre-Socratic texts concerning time.

Parmenides
Gallop (1984) provides the full text of Parmenides's fragments and a translation. In addition to Russell (1945) and Copleston (1946), the standard interpretation of Parmenides's argument for the non-existence of time is also found in Owen (1974). For the interpretation we prefer, see Hoy (1994). Owens (1974) offers a discussion of the apparent conflict between the two parts of Parmenides's poem, and Graham (2002) compares Heraclitus's views with Parmenides's.

Zeno
For some useful overviews of the debates concerning Zeno's paradoxes of motion see Huggett (2010) and Salmon (2001). The most famous discussions of Zeno's paradoxes in the history of philosophy are probably those in Aristotle (1984) and Russell (1903/2010). For more recent discussions of some proposed mathematical solutions to the paradoxes see Grünbaum (1967) and Alper and Bridger (1997). Influential discussions of Zeno's Arrow include Lear (1981) and Magidor (2008). Le Poidevin (2002) offers an ingenious argument for the claim that the Arrow paradox causes problems for the presentist view we discuss in Chapter 5.

Plato
Taylor (1928) provides a classic scholarly discussion of Plato's *Timaeus*. A more recent (but no less scholarly) discussion is contained within Zeyl (2000). Broadie (2012) gives a fresh interpretation of many aspects of *Timaeus* in her book-length treatment of the dialogue.

Aristotle
Coope (2005) and Roark (2011) give book-length competing interpretations of Aristotle's writings on time (Roark also draws some interesting parallels between Aristotle's view of time and the contemporary literature in chapter 12). Coope (2001) and Roark (2004) are shorter articles which outline some of their disagreements. Bostock (1980) describes the interpretative issues (and offers his own diagnosis of what Aristotle meant).

Augustine

Some important discussions of Augustine's view of time include Hausheer (1937), Russell (1945: 239–31) Wetzel (1995), Gross (1999) and Carter (2011). For discussions concerning the relationship between God and time see Helm (1988), Craig (2001) and Ganssle (2001).

2

The modern history

This chapter continues our examination of the history of the metaphysics of time. Our primary focus is on the important debate in early modern philosophy between Substantivalists and Relationists about time. To this end we consider the views of three of the most influential figures in this debate: Newton, Descartes and Leibniz. We end the chapter with a brief discussion of Kant's view of the metaphysics of time. As with the previous chapter our brief survey cannot do justice to the subtlety or insight of the works we discuss, and we encourage interested readers to consult the further readings.

We continue our survey of the history of the philosophy of time in this chapter, starting in the seventeenth century and ending in the late eighteenth century. Again, we do so selectively by focusing on a few key figures. Specifically, we focus on the views of Descartes, Newton and Leibniz, and also give a brief account of Kant's view of time. By focusing on Descartes, Newton and Leibniz we introduce a question that dominates much of the history of the philosophy of time in this period, *viz*. the question of whether time (or points in time), along with space (or points in space), are entities in their own right, or whether they are instead constituted by the properties possessed by and/or relations that hold between material objects. On the first view, known as 'substantivalism', space and time are like a container in which material objects are located, or inhere, and so space and time exist independently of those material objects. On the second view, known as 'relationism', space and time have no independent existence – although material objects stand in spatial and temporal *relations* to each other, the only physical entities that exist are the material objects themselves. It should be noted, however, that the moniker 'substantivalism' is something

of a misnomer. The term 'substance' is used in various ways in the history of philosophy, and although some substantivalists think that space and time are best thought of specifically as *substances*, others (including Newton) deny this. We nonetheless retain the traditional moniker here, noting that it is to be understood to mean that space and time have an independent existence from, and act as a container for, material objects, whether or not space and time are best thought of as being substances if this is true.

The debate between substantivalists and relationists is an important philosophical debate that continues to this day, and has consequences for a variety of other views in the contemporary philosophy of time. However, although this debate does concern time and so is of importance in the philosophy of time, it is one that, at least historically, focuses more on philosophical considerations to do with *space* than with time itself. And in fact, there is a sense in which it is more properly located within the philosophy of physics rather than the philosophy of time, as much of the literature concerns the correct formulation and interpretation of physical theories. In addition, disputes regarding the major topics in the philosophy of time that are discussed in Chapters 3 to 9 of this book are mostly orthogonal to the dispute between substantivalists and relationists. Nonetheless, given its importance, no book on the philosophy of time should ignore this debate, so we introduce it here, mention it briefly at those points where it has consequences for the other views we consider in Chapters 3 to 9 and then take up the debate again in Chapter 10, when we consider whether modern physics has anything important to tell us about the metaphysics of time. Readers who are interested in pursuing the substantivalist/relationist debate further are encouraged to consult a number of excellent textbooks whose focus is on this very topic. They are given in the further reading sections at the end of this chapter and the end of Chapter 10.

In section 2.1 we discuss Descartes's view of time. Section 2.2 focuses on Descartes's view of motion, which serves to introduce Newton's view of motion which was developed in direct opposition to that of Descartes. Newton's view of motion itself is then considered in section 2.3, and his view of time is then discussed in light of it in section 2.4. We then turn to Leibniz's criticisms of Newton's view in section 2.5. In section 2.6 we then give a very brief summary of Kant's views on space and time, before summarizing in section 2.7.

2.1. Descartes's view of time

Descartes's remarks on time focus, as did Aristotle's and Plato's before him, on its relation to motion and change. But they are given in the context of an

espousal of various laws of nature (which on Descartes's view, are underpinned by God) formulated in mathematical terms. The remarks are few in number and scattered throughout his writings, but the majority occur in his *Principles of Philosophy,* published in 1644, three years after *Meditations*. There, for example, he defines motion quantitatively such that the motion of a particular body is obtained by multiplying its size by its speed. He then argues that God conserves the total amount of motion in the universe, and concludes that 'if one part [of matter] slows down, we must suppose that some other part of equal size speeds up by the same amount' (Descartes 1985: 240). Despite their mathematical nature, however, Descartes's remarks, at least taken at face value, seem to commit him to views very similar to Aristotle's and Plato's. He says in *Principles*, for example, that time is nothing but a 'mode of thought' suggesting he holds the following view in agreement with Aristotle:

(i) Time is dependent for its existence on the operations of the mind.

And he also says that time is the name we give to 'the duration of the greatest and most regular motions which give rise to years and days' (Descartes 1985: 212) suggesting that he holds the following view in agreement with Plato:

(ii) Time can be identified with the regular motions of the celestial bodies.

However, we should be wary of understanding Descartes's statements as expressing (i) and (ii), for doing so saddles him with views that are both inconsistent with each other (given his other views), and individually inconsistent with what he says elsewhere. To see that (i) and (ii) are inconsistent with each other (given Descartes's other views), note that if time is identified with the motion of the celestial bodies, then it cannot depend for its existence on the operations of the mind unless the movements of the celestial bodies themselves do, which Descartes certainly denies. To see that (i) and (ii) are individually inconsistent with what Descartes says elsewhere takes a little more work, but doing this work reveals that Descartes's position is much more interesting than being a mere restatement of Aristotle's and Plato's views, and in fact pre-empts both some of Newton's views of time and plausibly some contemporary views regarding the nature of persistence over time.

The scholastics were those philosophers writing in the Christian tradition in medieval Europe, and Descartes was himself educated in this tradition. Many scholastics make a distinction between what they call '*tempus*' and '*duratio*'. The latter corresponds to the notion of duration itself, understood as a property that can be possessed by anything that exists. The former

corresponds to the notion of *measured* duration, that can be applied to things that change and whose existences can be split into temporal parts. God, for example, according to the scholastics and to Descartes, is a being who exists in an eternal and unchanging state, and whose existence therefore cannot be split into parts. So God possesses an eternal *duratio*, but does not possess *tempus*. Human beings, by contrast, do change, and their lives can be split into parts – for example, youth, middle age and old age (this example is taken from Gorham 2007: 34–5). So they possess both *duratio* and *tempus*. Descartes himself uses just this distinction, and in fact takes the term '*tempus*' to mean what we ordinarily mean by 'time'. But this is a purely linguistic thesis, and should not lead us into error regarding his substantive views regarding the existence and nature of temporality. Indeed, we would ordinarily say that if something has a duration, whether or not it can be measured, then it exists over time. And if we take this view, and thus reject Descartes's linguistic thesis, it becomes clear that Descartes's view does not entail that time is mind-dependent. When he says that time is nothing but a mode of thought, he is talking about *tempus,* and not *duratio*. So what he means is that although material objects can exist over time (i.e. can have a duration) independently of the mind, any *measurement* of their duration (i.e. an assignment of *tempus* to them) must be done by some conscious observer by reference to some perceived change, whether it be in the object itself or some other object. So his view is not the controversial view that time depends upon the operations of the mind, but the uncontroversial view that the *measurement* of time depends upon the operations of the mind. And in fact, once this is understood, the import of Descartes's comment that time is the name we give to the duration of 'the greatest and most regular motions which give rise to years and days' becomes clear. Here again he is talking about *tempus* (i.e. the *measurement* of time) and not *duratio* (i.e. time itself). That is, he takes the motions of the celestial bodies, regular as they are, as being standard measures of time, and not as constituting time itself.

There are two consequences of interest that follow from Descartes's position, now properly understood. The first follows immediately from what has already been said: that time itself can exist in the absence of any change. In an unchanging universe, Descartes thinks, it would be impossible to measure the passage of time (and so nothing can possess *tempus*) but this is perfectly consistent with the universe being one in which time passes (and so contains things that possess *duratio*). As we will see, this view pre-empts Newton's view that the passage of time is an objective matter that does not depend upon the motions or activities of any material thing. This view entails that time itself could speed up or slow down without any perceptible change occurring. However, as we will see, Newton also thinks that time is an entity in its own right that can exist in the absence of any persisting thing. (He

likewise thinks that space is an entity in its own right that can exist in the absence of any extended thing.) On this score, Descartes is in disagreement. His view is that duration is a property of persisting things, and so that time cannot exist if no persisting thing does. (And he likewise thinks that extension is a property of extended things, and so that space cannot exist if no extended thing does.) This is sufficient to classify Descartes's view as being a form of relationism about both space and time.

The second consequence of interest arises in combination with another apparent aspect of Descartes's view that we have so far not mentioned. Descartes often speaks as if he thinks that time itself is composed of discrete parts that follow one after another and are not causally related. In *Meditations*, for example, he writes that 'the whole duration of life is divisible into countless parts, all mutually independent' (Descartes, *Meditation Three*, in Anscombe and Geach 1970: 88). Some have taken this passage, and other similar passages, to indicate that Descartes thinks that time itself comes in discrete parts, and have even attributed to him the view that these parts are instantaneous (see, e.g. Smith 1902: 72–4). But given the comments above, it is clear that Descartes thinks of time as a property of persisting things, and so it is more accurate to say that Descartes thinks persisting things *themselves* are non-continuous and composed of discrete parts that follow on one after another. He talks, for example, of things in time 'immediately preceding' one another, which would not make sense if time were continuous. (See Secada (1990) for references and for an opposing interpretation.) If this is right, then Descartes holds what is known as a 'perdurantist' view of persistence according to which objects exist over time by having temporal parts at each time at which they exist. This is a view that we will consider in detail in Chapter 7.

2.2. Descartes on motion

As we will see, Newton develops his view of space, time and motion in direct opposition to Descartes. So by way of leading into a consideration of Newton's view, it is worth returning once more to Descartes's account of motion, understood now in light of the comments above. We said that, according to Descartes, duration is a property of persisting things, and extension a property of extended things. But, in fact Descartes goes further than this. According to Descartes, duration is a *necessary* property of persisting things and extension a *necessary* property of extended things. Given that all extended things *are* also persisting things, it follows that for Descartes every individual material body possesses extension *and*

duration essentially. However, Descartes also says that material bodies are substances, and that each substance is a thing which has precisely *one essential property* which is its 'principal property which constitutes its nature and essence, and to which all its other properties are referred' (Descartes 1985: 210). Descartes believes that for material substances this principal property was extension rather than duration. His reason for saying this is that he thinks immaterial substances (e.g. minds) can also possess duration, and that no property that can be possessed by distinct substances can be essential to either. Nonetheless, Descartes certainly thinks of duration as being analogous to extension, and so thinks of material bodies as things that are necessarily 'extended' in four dimensions, i.e. the three spatial dimensions and the one temporal dimension. But, we may ask, what are individual material substances? Are planets individual material substances? Are sticks and stones? Or are they smaller atom-like things? In fact, Descartes is unclear on this point. But while some have interpreted Descartes to hold that the only material substance that there is, is the entire material universe (e.g. Cottingham 1986: 84–5), most interpret him as holding that parts of the universe are also material substances in their own right. The following extract from a letter written by Descartes to the theologian Father Gibeuf in 1642 strongly supports this interpretation:

> From the simple fact that I consider two halves of a part of matter, however small it may be, as two complete substances … I conclude with certainty that they are really divisible. (Descartes, quoted in Skirry 2005: 72)

Here Descartes argues that material substances are infinitely divisible, and that every part of a material substance is itself a material substance, from which it follows that there are no ultimate material substances at all. However, we may take Descartes to hold that there are certain 'clumps' of matter which are substances that, despite being infinitely divisible into further substances, naturally stick together and form the basic substances that undergo motion. This, at least, is what is suggested by the following passage from *Principles* where Descartes gives a succinct statement of the view mentioned above, *viz.* that the quantity of motion in the universe is conserved:

> From what has already been said we have established that all the bodies in the universe are composed of one and the same matter, which is divisible into indefinitely many parts, and is in fact divided into a large number of parts which move in different directions and have a sort of circular motion; moreover, the same quantity of motion is always preserved in the universe. (Descartes 1985: 256)

We are to think of Descartes's view, then, as follows: the universe comprises nothing other than small parcels of matter that are necessarily extended both spatially and temporally, and that motion occurs when they move relative to one another. Because Descartes thinks that there could be no extension in the absence of matter, his view entails that a vacuum, i.e. a space devoid of matter, is impossible, and so that space itself is necessarily constituted by a packed-in mass of such parcels (space, on such a view, is known as a 'plenum'). Descartes also thinks that all extended things are impenetrable, and so his view also entails that as one small parcel of matter undergoes motion, other parcels of matter must move out of the way to make way for it, with another parcel of matter taking its place. Motion, then, is nothing more than the rearrangement of parcels of matter relative to each other.

The above view raises the following question: if a parcel of matter undergoes motion merely by moving relative to other parcels of matter, then can any parcel of matter ever be said to be undergoing motion (or to be at rest) in any privileged sense (i.e. can the motions of some parcels of matter be distinguished from the motions of others in some principled manner)? This question is important for Descartes because such privileged motions were thought of as being causally relevant, and many of his scientific laws of nature (which he calls 'Rules') are formulated in terms that only make sense if there can be such privileged motion (and rest), which Descartes calls 'motion/rest in the strict sense' and has subsequently become known as 'true motion'. *Prima facie*, however, the answer to the question is that no motion can be privileged. The problem is, it seems, that nothing can serve as an absolute reference frame relative to which things can be said to be at motion or at rest. Space cannot serve this purpose, for space is not an independently existing thing relative to which bodies can move. And no parcel of matter can serve this purpose either, for if one particular parcel of matter is taken to be in motion relative to some other parcel considered as being at rest, one can equally well take the latter parcel of matter to be moving relative to the former considered as being at rest. In other words, no parcel of matter, and so no motion, can be privileged over any other parcel of matter or any other motion. Nonetheless, Descartes finds a way to distinguish the motion of certain bodies from others without appealing to an absolute reference frame. He defines true motion to be where one parcel of matter *moves relative to its immediately contiguous surrounding matter* (see Descartes 1985: 234–5). To illustrate, consider the Earth's movement around the sun. We are accustomed to think of this movement as one in which the Earth moves *through* space, but on Descartes's view the space surrounding Earth is in fact an extended substance that stretches out for a great distance on each side of it. And so, he thinks, the Earth moves around the sun in a great vortex, encased within huge swathes of immediately contiguous surrounding matter that move

along with it. So, because the Earth is not in motion relative to its immediately surrounding matter on this view, this enables Descartes to say that the Earth does not undergo true motion (and so is at true rest), which in turn means that his laws of nature, formulated in terms of true motion and true rest, can be applied to it. (Some, e.g. Dainton (2001: 162) suggest that Descartes did not really believe this account, but instead concocted it to avoid conflict with the Catholic Church which had previously censured Galileo for thinking that the Earth really does move.)

2.3. Newton's substantivalism about space

Isaac Newton published his scientific masterpiece, *Philosophae Naturalis Principia Mathematica* (known as the *Principia*), in 1687. There he expounds classical mechanics and his theory of universal gravitation. Underlying this great work are certain philosophical views regarding space, time and motion, which he fully expounds in an essay, the *General Scholium*, which was appended to the second and (with slight modifications) third editions of the *Principia* published in 1713 and 1726 respectively. A further work, *De Gravitatione*, apparently written around ten years before the *Principia*, remained unpublished until 1962 (in Hall and Hall 1962), but it contains precursors to the arguments of the *Scholium* and makes clear that the philosophical views defended there (and that underpin the *Principia*) were developed as a direct response to, and so should be understood in the context of, Descartes's views (see Rynasiewicz 1995a, 1995b). We begin with an account of Newton's view of motion and space, before outlining its implications for his view of time.

The basic argument contained within the *Scholium* can be summarized quite simply in *modus ponens* form as follows:

(1) Material bodies undergo true motion.

(2) If material bodies undergo true motion then they must move relative to absolute space that exists independently of any material body.

Therefore,

(3) Absolute space exists independently of any material body.

As we have seen, Descartes accepts premise 1 but rejects premise 2. And in fact Newton accepts premise 1 for much the same reason as Descartes; he thinks he needs true motion in order to correctly formulate the laws of nature he lays down (Newton justifies this in the *Scholium* by reference to various

physical phenomena). More interesting for our purposes is his argument for premise 2. There is a sense, however, in which it will not be possible to give a full account of Newton's argument for it without reproducing the whole of his *Principia*, for his argument for premise 2 ultimately rests upon his contention that the laws that he lays down, together with the assumption that there is absolute space relative to which things undergo true motion, explains in a coherent and simple manner *all* observable phenomena to do with motion in a way that other views cannot. We can certainly get a feel for Newton's argument without going to such lengths, though, for in the *Scholium* he describes a number of observable phenomena that are specifically selected to illustrate this contention. As we have seen, Descartes defines true motion in terms of bodies moving relative to their immediate surroundings. Newton's most celebrated argument in the *Scholium,* his ingenious 'bucket' argument, specifically targets this view. It is intended to show that this view must be false, and that his view (that absolute space exists) is the only viable alternative. It relies upon the following fact (that Newton established experimentally):

> *Newton's Bucket*
> If an observer hangs a bucket on a cord and then winds the cord up tightly before filling it with water, when the observer lets go of the bucket the following sequence of events occurs. First, the bucket starts to spin relative to the observer while the water inside the bucket remains stationary. At this point the water inside the bucket remains flat. After a time, however, the water inside the bucket will start to rotate relative to the observer along with the bucket, and as it does so the water inside the bucket takes on a concave appearance as the water at the interior edge of the bucket starts to climb its walls. The water reaches its highest point around the edge of the bucket when it is spinning at the same rate as it.

Newton's question is: can we explain this fact if we understand true motion in the way Descartes does? Newton argues that we cannot. He first notes that, as the bucket begins to spin, the water is undergoing true motion in Descartes's sense (for it is in motion relative to its immediate surroundings, i.e. the bucket). And yet, Newton argues, its undergoing true motion has no causally relevant effect on the water inside the bucket – in particular, it does not display any disposition (which he calls an 'endeavour') to move away from the centre of the axis around which it is spinning. However, as the water begins to spin along with the bucket, its true motion in Descartes's sense gradually decreases until finally it is at true rest (i.e. it is at rest relative to the spinning bucket because it is spinning at the same rate as it). And yet, Newton argues, its gradually decreasing true motion has a greater and

greater causal effect on the water in the bucket, with the greatest effect seen when it is at true rest – at that point it displays its greatest disposition to move away from the centre of the axis around which it is spinning. So, the presence and quantity of true motion in Descartes's sense is *anti*-correlated with its observed causal effects.

Although he does not explicitly spell it out in the *Scholium*, Newton's view, by contrast, can explain this effect in a perfectly simple manner. First we suppose that there is absolute space and that material things undergo motion relative to it. We do not have to suppose at the start of the experiment that the water inside the bucket is at rest relative to absolute space, but only that as it begins to spin along with the bucket its velocity *changes* relative to absolute space (i.e. that it undergoes *acceleration*). It is this *change in the water's velocity* relative to absolute space that Newton thinks explains the effects we see. At the start, before the water has undergone any acceleration relative to absolute space, no causal effect is observed and the water remains flat, but as it accelerates relative to absolute space we begin to see a greater and greater effect. So it is acceleration through absolute space, on Newton's view, that gives rise to forces whose effects can be clearly seen. So true motion, according to Newton, should not be defined as Descartes defines it, but should instead be defined in terms of a change of velocity relative to absolute space. (It should be noted that this 'inference to the best explanation' interpretation of Newton's argument is the most common one, but that some deny it (e.g. Huggett and Hoefer 2015). However, we think the interpretation is a plausible one, and even if it is not Newton's actual argument, it is certainly one that was available to him.)

According to Newton, then, absolute space exists and pervades the entire universe. But what are the properties of absolute space? It can be thought of as an invisible three-dimensional grid, marked out by uniform units, across which material objects are spread. Newton explains in the *Scholium* as follows:

> Absolute space, in its own nature, without relation to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies; and which is commonly taken for immovable space; such is the dimension of a subterraneous, an aerial, or celestial space, determined by its position in respect of the earth. Absolute and relative space are the same in figure and magnitude; but they do not remain always numerically the same. For if the earth, for instance, moves, a space of our air, which relatively and in respect of the earth remains always the same, will at one time be one part of the absolute space into which the air passes; at another time it will be another part of the same,

> and so, absolutely understood, it will be continually changed. (Newton, in Cajori 1934: 6)

It is important to realize that none of the properties that are here ascribed to absolute space is directly measurable. Although it exists immovably, and pervades the entire universe, Newtonian space cannot be observed in any sense. It is known to exist purely on the basis that its existence has an explanatory role in Newton's system, and is as such a theoretical posit. This made many of Newton's contemporaries suspicious, and led to a number of serious criticisms of the notion of absolute space. One of the foremost critics, as we will see, is the German philosopher Gottfried Wilhelm Leibniz. Leibniz argues that Newton's theory, by admitting the existence of absolute space, has consequences that cannot be empirically tested, and so should be rejected. We will examine his argument in more detail shortly, but it is worth noting here that one might well react to it as follows: even if a theory has consequences that cannot be empirically tested, if that theory is the only one that explains the physical phenomena, we nevertheless have good reason to accept it. One might hold, that is, that even if Leibniz is right that Newton's theory has untestable consequences, this is only a reason to abandon Newton's theory if we have some *other* theory that works just as well as it. As we will also see, Leibniz is well aware of this point, and as a consequence attempts to offer an explanation of the observed effects seen in *Newton's Bucket* that does not rely upon positing absolute space. Before we come to this, however, let us consider Newton's view of time itself.

2.4. Newton's substantivalism about time

Newton's comments on time in the *Scholium* explicitly commit him only to the view that the passage of time is an objective matter that does not depend upon the motions or activities of any material thing. He says:

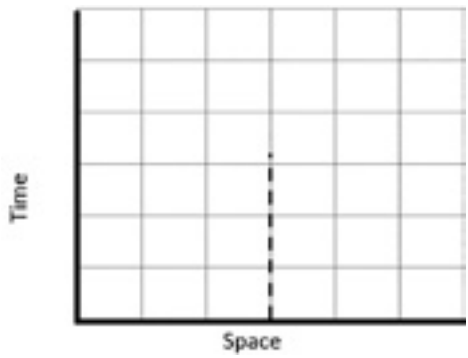
> Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year. (Newton, in Cajori 1934: 6)

However, as we have seen, Descartes also holds this view, and Descartes was a relationist about time. Does this mean that Newton's view, despite

being substantivalist about space, is compatible with relationism about time? In fact, it does not. The other views that Newton holds mean that, unlike Descartes, Newton's commitment to the absolute passage of time commits him to substantivalism about time as well as space. The simplest way to see this is to consider that Descartes holds that the passage of time is absolute because he thinks that duration is itself a property of material bodies which things can possess even within an unchanging universe. And this also implies that duration, and so time, cannot exist in the absence of material bodies themselves. On Newton's view, by contrast, absolute space exists independently of material bodies, and itself persists through time. So, on Newton's view, it is possible for there to be a universe containing nothing but absolute space persisting through time. Such a universe would be one in which time exists in the absence of material bodies. And so Newton is committed to substantivalism about time.

Reflecting upon this further serves as a natural way to introduce Leibniz's criticism of absolute space. Consider once more that, as illustrated by *Newton's Bucket*, it is *acceleration* relative to absolute space that is empirically significant and that gives rise to the operation of forces, rather than motion itself. But acceleration, understood in Newton's way, is a change in velocity relative to absolute space *over time*. And, indeed, a body's having a certain velocity in the first place is a matter of it undergoing a change of absolute spatial position *over time*. So, in order to make sense of Newton's view we must be able to make sense of how a body can be in two *distinct* positions of absolute space at different times, which in turn requires that we can make sense of how a body can remain in the *same* position of absolute space at different times (for being in a distinct spatial position at different times entails not being in the same spatial position at those times). So what makes a position in absolute space at one time the same as a position in absolute space at another? Newton's answer is evident from the quote given above about the nature of absolute space. There he says that it is 'always similar and immovable'. What this means is that positions in absolute space persist over time without altering in their spatial relations to each other (i.e. the spatial distance between any two points in absolute space is always the same). So, as time flows 'equably' (i.e. at a constant rate) on Newton's view, just as space can be thought of as an invisible three-dimensional grid, marked out by uniform units, time can be thought of as an invisible line marked out by uniform units, and so space and time together form what can be thought of as an invisible four-dimensional grid, marked out in each dimension, across which material objects are spread and trace their paths as they undergo motion. We can picture this by reducing the spatial dimensions to one, and arranging the points of space and time on different axes across a two-dimensional graph. Then focusing on point-sized objects (for ease of exposition) we can then say that:

1. A point-sized material object is at rest if it traces a straight path at right angles to the spatial axis following the path of an enduring spatial point:

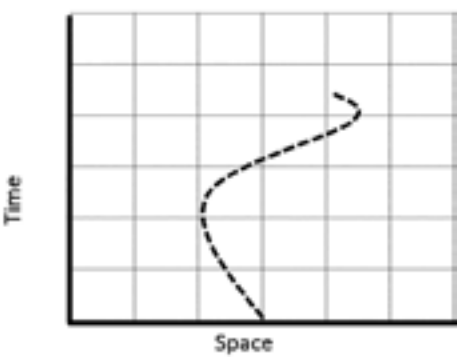


- The dotted line represents the *spacetime* path of a point-sized material object at rest in a Newtonian universe
- Persisting points of absolute space follow paths parallel to the time axis of the grid, and so here the object follows the path of such a point

2. A point-sized material object is travelling at uniform velocity if it traces a straight path that intersects the spatial paths of any enduring spatial points:

- The dotted line represents the *spacetime* path of a point-sized material object undergoing uniform velocity in a Newtonian universe
- The object's path intersects the paths of points of absolute space at a constant rate as it moves over time

3. A point-sized material object is undergoing acceleration if it traces a path that is curved relative to the paths of the enduring spatial points:



- The dotted line represents the *spacetime* path of a point-sized material object undergoing acceleration in a Newtonian universe
- The object's path intersects the paths of points of absolute space at a non-constant rate as it moves over time

The important point to note here is that time is structurally analogous with space in Newton's theory – it functions as an independently existing 'container' for material objects in exactly the same manner as space, and it is this that makes Newton a Substantivalist about time as well as space.

2.5. Leibniz's relationism about space and time

Leibniz criticizes Newton's view that absolute space exists and puts forward his own opposing views in many places. One particularly transparent argument against absolute space occurs in his 1715 correspondence with Samuel Clark, the British scientist and clergyman (who apparently was often directed in his responses to Leibniz by Newton). In his letters to Clark, Leibniz argues that because Newton thinks that only acceleration is empirically significant and that objects either at rest relative to absolute space or moving with a uniform velocity give rise to no forces or observable effects, then the notions of 'uniform velocity' and 'rest' are empirically vacuous. In short, Leibniz points out that if Newton is right, although there is a fact of the matter about whether a non-accelerating object is undergoing a uniform motion at a particular rate relative to absolute space or is at absolute rest, there is no way to empirically test which of these it is. So Newton's theory has consequences that are not empirically testable. Leibniz illustrates this consequence of Newton's view with a clear example. He imagines another possible universe that is identical to this one in every respect except for the fact that absolute space is shifted into another position relative to the material objects within it so that all the material objects retain their *relative* spatial positions but shift in their *absolute* spatial positions. This universe, he observes, would be empirically indistinguishable from ours. In other words, we do not know which world we are in, and no empirical test can ever tell us. And this, Leibniz thinks, is an unacceptable consequence of any physical theory. He writes:

> [T]he fiction of a material finite universe moving forward in an infinite empty space cannot be admitted. It is altogether unreasonable and impracticable. For besides that there is no real space out of the material universe, such an action would be without any design in it: it would be working without doing anything … There would happen no change which could be observed by any person whatsoever. These are imaginations of philosophers who have incomplete notions, who make of space an absolute reality. (Leibniz, in Ariew 2000: 42)

Leibniz, in fact, has an independent argument for why the untestable consequences of Newton's view are unacceptable. The argument is based upon his acceptance of a version of what is known as 'the Principle of Sufficient Reason' according to which there must be some reason for God to create the universe in one way rather than other. Leibniz thinks that if Newton's view is correct, then God would have no reason to create the universe by embedding it within absolute space in one way rather than another, and so the Principle of Sufficient Reason would be violated. This particular argument, however, has not stood the test of time, and so we do not consider it any further here.

Despite the fact that Leibniz's argument based upon the Principle of Sufficient Reason is no longer thought to be a good one, there is definitely something right about Leibniz's criticism of Newton's view. There is something suspicious about an empirical theory that has untestable consequences. However, as mentioned above, although such consequences are not to be welcomed, unless there is a better theory available it may be reasonable to tolerate them. Leibniz, though, thinks that he does have at least the beginnings of a better theory. And although it is an ultimately untenable one, it does at least show that there is another possible explanation of *Newton's Bucket* distinct from Descartes's and Newton's.

Consider first that there is a lacuna in Newton's bucket argument, which can be seen by considering that it has the following form:

(1) The effects seen in *Newton's Bucket* cannot be explained by Descartes's account of true motion.

(2) The effects seen in *Newton's Bucket* can be explained by Newton's account of true motion.

(3) Newton's account of true motion implies that absolute space exists.

Therefore,

(4) Absolute space exists.

This is not a deductively valid argument. In order to turn it into such an argument we need an extra premise to the effect that the observed phenomena in *Newton's Bucket* cannot be explained by *any* other theory. (Strictly speaking, we also need another extra premise, i.e. one that says that the observed phenomena are in some sense veridical and in need of explanation, but we suppose these to be implicit.) Leibniz, noting this missing premise, argues that Newton has given us no reason to believe that it is true, and offers a brief sketch of an alternative explanation that he thinks is more plausible than that which Newton offers. His idea seems to be that one can give an explanation of true motion in terms of innate forces that are present within objects themselves:

> For when the immediate cause of the change is in the body, that body is truly in motion, and then the situation of other bodies, with respect to it will be changed consequently, though the cause of that change is not in them. (Leibniz, in Ariew 2000: 49)

The suggestion is that all motion can be traced back to an original motion of some body that undergoes true motion from a force inside itself and that starts off a chain reaction of motions in nearby objects. We can only guess precisely how Leibniz would have applied this account to *Newton's Bucket* (for Leibniz died shortly after raising this suggestion and so never developed it further), but the following is a reasonable suggestion: in *Newton's Bucket* the water obtains its motion from the bucket which is spinning about it, which obtains its motion from the rope that is uncurling above it, which obtains its motion from the person who wound it up, and so on, until we end up at a body which obtains its motion from a force contained within itself. If one can make sense of there being such a thing (perhaps, for example, conscious beings are such things), it is perhaps plausible that this chain would terminate in such a motion.

Leibniz's account, then, by grounding true motion within material bodies themselves, eschews absolute space: there is simply no need for it, on his view. This allows him to defend a relationist view according to which space, and also time, are constituted by material bodies and the relations that they stand in to one another. There is a complication, however. In various places Leibniz defends (according to the usual interpretation) a position according to which the only things that truly exist are immaterial simple substances called 'monads', which include among them minds. Our experiences of the material world (the 'ideas' that occur in our minds, as Leibniz puts it), including all of our experiences of bodies in motion, are 'confused' representations of these monads and their properties. Moreover, he holds that the relations that we take to hold between material bodies as they occur in our experiences are *mind-dependent* in some sense. That is, strictly speaking, according to Leibniz, only immaterial monads and their properties exist, but when they are represented in our experiences (as 'units') we construct relations between them using a certain power of our minds (our 'understanding'). So because space and time are themselves supposed to be constituted by the relations that hold between material bodies, there is a definite sense in which space and time are themselves mind-dependent in Leibniz's view, and so have no objective reality. However, Leibniz thinks that to say this would not be quite right. He is at pains to emphasize that although our experiences of material bodies, and the relations that hold between them, are mind-dependent, they do accurately represent, albeit in a confused manner, the structure of the underlying reality of monads. Consider, for example, the following passage from Leibniz's *New Essays Concerning Human Understanding*:

> Units are separate, and the understanding gathers them together however dispersed they be. Yet, although relations are from the understanding, they are not groundless or unreal. For in the first place understanding is the origin of things; and indeed the reality even of all things, simple substances excepted, ultimately consists only of perceptions of the phenomena of simple substances. (Leibniz 1896: 148)

How are we to square all of this with Leibniz's criticisms of Newton's view of absolute space? If, as he thinks, material objects do not strictly speaking exist, then neither relationism nor substantivalism can be true. So why does Leibniz go to great lengths to show that relationism is superior to substantivalism? The answer is that Leibniz had a conception according to which reality has different levels, or 'spheres', and that when investigating one sphere of reality the other levels can be legitimately ignored. That is, although Leibniz thought that reality at the fundamental metaphysical level is constituted by monads and their properties, when we do physics we are not concerned with this ultimate sphere, but are concerned rather with the sphere of physical reality. Physical reality is, for sure, grounded in the underlying ultimate reality of monads, but our investigations into physical reality can, and should, proceed using only empirical methods. In other words, Leibniz thinks that when we are doing physics we can quite legitimately ignore the underlying metaphysical reality and proceed as if physical reality is the only reality there is. Leibniz makes this clear in the following passage from his *Discourse on Metaphysics*:

> [A]s the geometer does not need to encumber his mind with the famous puzzle of the composition of the continuum, and as no moralist, and still less a jurist or a statesman has need to trouble himself with the great difficulties which arise in conciliating free will with the providential activity of God … so in the same way the physicist can explain his experiments, now using simpler experiments already made, now employing geometrical and mechanical demonstrations without any need of the general considerations which belong to another sphere [i.e. the sphere of the underlying reality of monads] … [And if he does so encumber his mind] he goes out of his path quite as much as that man who, when facing an important practical question would wish to enter into profound argumentations regarding the nature of destiny and of our liberty … (Leibniz 1908: 16)

2.6. Kant's transcendental idealist view of space and time

We finish this chapter by considering Immanuel Kant's view of both space and time (as both are treated in a very similar manner). Our justification for doing so is, as it was with Plato, that Kant is a towering figure in the history of philosophy whose influence has been great. But, as it is with Plato, his views on time do not have any major impact on contemporary debate in the philosophy of time (at least within the analytic tradition, which is the focus of this book). So we content ourselves here with a very brief overview of his key claims. (We give some further readings at the end of the chapter for those interested in pursuing Kant's views further.)

Kant develops his views on space and time in conscious opposition to the views of Newton and Leibniz, each of which he was well versed in. In very broad outline, Kant distinguishes sharply between things in themselves and subjective appearances, and maintains that time and space are features only of the latter, and so lack a mind-independent existence. This, in fact, is the central thesis of his transcendental idealism as outlined in his monumental *Critique of Pure Reason*. The *Critique*, and his other writings, contain criticisms explicitly directed at both Newton's and Leibniz's views, and it is clear that he means his view to stand apart from both of theirs. But while it is clear how Kant's view differs from Newton's (who certainly does not think that space and time are mind-dependent), it is not entirely clear quite how it differs from Leibniz's, given the latter's idealism and the further fact that Kant also thinks that physics can be pursued empirically using mathematical and experimental methods. Indeed, Kant himself develops a system of mechanics in his *Metaphysical Foundations of Natural Science* that deals with the motions and forces that hold between bodies in motion, and offers up his own solution to Newton's bucket argument that avoids a commitment to absolute space (he suggests that true motion is measured relative to the centre of mass of the universe; see Kant 2004: 100–2).

To fully assess the differences between Kant's view and that of Leibniz's, and to give even an overview of Kant's arguments for holding the view that he does, goes beyond the scope of this short discussion (Kant's views and arguments are, like those of the Greek philosophers considered in the previous chapter, subject to varying and often contradictory interpretations). But the key point of difference can be stated quite simply: while Leibniz conceives of our experiences of space and time as being confused representations of an underlying ultimate reality independent of us and subject to correction by the understanding, Kant thinks that the ultimate reality underlying our experiences is (or at least has features that are) in principle unknowable. However, he does not consider our experiences of space and

time to be confused in any sense. Rather, for human beings, he thinks, it is a necessary precondition of having experiences that events are represented as being in space and time. That is, things in themselves, as they appear to us, *must* appear to us as being situated in both space and time. Space and time, he thus thinks, are (necessary) artefacts of how we experience or perceive reality, and consequently are not in any sense part of reality as it is in itself:

> We have therefore wanted to say that all our intuition is nothing but the representation of appearance; that the things that we intuit are not in themselves what we intuit them to be, nor are their relations so constituted in themselves as they appear to us; and that if we remove our own subject or even only the subjective constitution of the senses in general, then all constitution, all relations of objects in space and time, indeed space and time themselves would disappear, and as appearances they cannot exist in themselves, but only in us. What may be the case with objects in themselves and abstracted from all this receptivity of our sensibility remains entirely unknown to us. We are acquainted with nothing except our way of perceiving them, which is peculiar to us, and which therefore does not necessarily pertain to every being, though to be sure it pertains to every human being. We are concerned solely with this. Space and time are its pure forms, sensation in general its matter. (Kant 1998: 185)

So, according to Kant, reality in itself is not as it appears to us in experience (as we 'intuit' it to be), and neither do things in themselves stand in the relations that we perceive to hold between things as they appear to us. Spatial and temporal relations, in particular, do not exist in reality as it is in itself, but exist only in us. However, it is a necessary fact about us that we experience things as being in space and time (it is the 'pure form' of our experiences). So because we can know nothing of how reality is in itself, we must content ourselves with reality as it must appear to us to be.

2.7. Summary

In this chapter we have considered the history of the philosophy of time from the seventeenth century to the early nineteenth century. We have focused on the substantivalist/relationist debate. We began with Descartes's relationist view of space and time, and then turned to his account of motion. This led into a discussion of Newton's opposed account of motion, which Newton took to entail a substantivalist view of space and time. Leibniz's criticisms of Newton's view, and his alternative relationist view, were then considered. We

finished with a brief look at Kant's view of space and time. In the next chapter we leave the history of the philosophy of time behind, and begin explicitly to consider issues that continue to exercise contemporary philosophers working on the metaphysics of time. Our starting point is a famous argument, put forward in 1908 by J. M. E. McTaggart, that has as its conclusion that time is unreal. The issues that McTaggart's argument gives rise to will then be our major concern in Chapters 4 to 9. But we will return to the substantivalist/relationist debate in Chapter 10 where we will discuss the impact that modern physics has had upon it, and upon the other contemporary debates considered in the intervening chapters.

Study Questions

1. What is the difference between substantivalism and relationism?
2. How does Descartes's account of true motion differ from Newton's? Which account is more plausible?
3. Newton believes that his bucket argument supports substantivalism. Why does he think this? Is he right?
4. Descartes is a relationist about time, and Newton is a substantivalist. Explain how their respective views are both consistent with the view that the flow of time is an objective matter that does not depend upon the motions or activities of any material thing.
5. What is Leibniz's main criticism of Newton's substantivalist view? Does it have any force? What is his alternative view? Is it plausible?

FURTHER READINGS

Readers interested in pursuing the history of the substantivalist/relationist debate further are recommended to consult either van Fraassen (1970) or Dainton (2001). See also the further reading section in Chapter 10.

Descartes

The most thorough and accessible English edition of Descartes's writings is in Cottingham et al.'s (1984–91) three volume collection. In addition to Secada (1990) and Gorham (2007), see Levy (2005), Gorham (2008a, 2008b) and Schmaltz (2008) for Descartes's views on time

Newton

Newton's *Scholium* is widely available. We recommend the version available online in Rynasiewicz (2014), who also gives an excellent overview of Newton's views

on space and time. For the influence that Descartes's views had on Newton see Rynasiewicz (1995a, 1995b). Schliesser (2013) is an accessible piece that focuses on Newton's account of time.

Leibniz

For Leibniz's views on time the most important source is his correspondence with Arnauld. We recommend the edition by Mason (1967). Those interested in pursuing Leibniz's views of time are recommended to consult Arthur (1985) and Glenn and Cover (1988).

Kant

Kant's *Critique of Pure Reason* is available in many editions. The best is probably Guyer and Wood (1998). The secondary literature on Kant's views on space and time is voluminous and often difficult. A good accessible place to start is with Hatfield (2006).

3

McTaggart and the unreality of time

This chapter presents and assesses McTaggart's famous 1908 argument for the conclusion that time is not real. We first lay out the premises of McTaggart's argument and the reasons he gives for holding those premises, before considering what can be said in opposition to each of the premises. Section 3.7 contains some difficult material, and readers are encouraged to supplement their reading of this section in particular with selections from the further readings.

J. M. E. McTaggart's famous 1908 paper 'The Unreality of Time' is viewed by most contemporary philosophers of time as marking the beginning of the subject in its modern guise. Much of the contemporary literature deals with issues that are raised, either directly or indirectly, by the arguments he presents in that paper. The main line of argument, as the title of the paper suggests, is for the conclusion that time does not exist. It is presented again in Volume II, Book V, chapter 33 of McTaggart's magnum opus *The Nature of Existence*, published posthumously in 1927. In this later source much of the text of the earlier paper is reproduced, but there are some significant additions, and in this chapter we draw on both sources in order to present McTaggart's views on time.

McTaggart's main line of argument can be given in a rather simple form that we call '*McTaggart One*':

McTaggart One

(1) If time exists then changes must occur.

(2) If changes occur then positions in time (or 'moments') must form a particular series, the A-series.

(3) The A-series is contradictory, and so moments cannot form such a series.

Therefore,

(4) Time does not exist.

In sections 3.1 to 3.3 we will be largely concerned with explaining the reasons McTaggart has, and the arguments he gives, for holding each of the premises of *McTaggart One*. In section 3.4 we consider reasons for thinking premise 1 to be false, and ask whether McTaggart can do without it. This will lead into section 3.5 where we draw out from McTaggart's work a secondary argument for his conclusion that time is unreal, which we call '*McTaggart Two*'. In section 3.6 we consider an objection to the second premises of both *McTaggart One* and *McTaggart Two* that suggests that the real lesson to be learnt from McTaggart's arguments is not that time is unreal, but rather that the true nature of time is quite different from our naïve view of it. Finally in section 3.7 we consider a response to his argument for premise 3, before summarizing the chapter in section 3.8.

3.1. Premise 1 of McTaggart's argument

McTaggart opens both his 1908 and his 1927 works with a distinction between two ways of putting moments of time into an order, *viz.* in terms of what he calls an 'A series' and a 'B series'. He then asks whether it is a necessary condition for the existence of time that moments form an A-series. He answers this question affirmatively in two stages. First, he writes in support of premise 1 (that time requires change). Second, he argues for premise 2 (that change requires that moments form an A-series). We will explain what it means for moments to form an A-series and a B-series in the next section. But first, what does McTaggart say in support of premise 1? In his 1908 paper, the following are the only explicit comments that McTaggart makes regarding this premise:

> It would, I suppose, be universally admitted that time involves change. A particular thing, indeed, may exist unchanged through any amount of time. But when we ask what we mean by saying that there were different moments of time, or a certain duration of time, through which the thing was the same, we find that we mean that it remained the same while other things were changing. A universe in which nothing whatever changed (including the thoughts of the conscious beings in it) would be a timeless universe. (McTaggart 1908: 459)

In his 1927 paper, a somewhat different passage appears:

> It would, I suppose, be universally admitted that time involves change. In ordinary language, indeed, we say that something can remain unchanged through time. But there could be no time if nothing changed. And if anything changes, then all other things change with it. For its change must change some of their relations to it, and so their relational qualities. The fall of a sand-castle on the English coast changes the nature of the Great Pyramid. (McTaggart 1927: 11–12)

McTaggart seems to endorse slightly different claims in these passages. But it seems clear that in both he is talking about change as something that happens to objects, i.e. particular things such as persons, cats, trees, tables or pyramids. And it seems equally clear that he endorses the view that in order for an object to undergo a change, time must exist. So one would be forgiven for thinking that McTaggart not only endorses something like the following principle, but also takes it to capture the meaning of the claim that time requires change (i.e. the meaning of premise 1):

> Change Principle 1 (CP1): Necessarily, if time exists, then some object undergoes change.

Furthermore, given what he says about relational qualities in the second quoted passage, one could easily take McTaggart to be suggesting that an object undergoes a change iff (if and only if) it is true at one time that the object has a certain property F, and false at another that it has F (where 'F' can be taken to include relational properties). So, one would also be forgiven for thinking that the following principle captures the meaning of premise 1 for McTaggart:

> Change Principle 2 (CP2): Necessarily, if time exists, then for some object *x*, *x* has a property *F* at time *t1*, and it is not the case that *x* has *F* at time *t2*.

But, in fact, to interpret McTaggart as endorsing either CP1 or CP2 as capturing the meaning of premise 1 would be to misunderstand him. This becomes apparent when considering the objections he raises to Bertrand Russell's view of change.

According to Russell (1903/2010), a change occurs whenever a proposition of the form 'at time t1, a is F' is true and a corresponding proposition 'at time t2, a is F' is false. This view of change seems to be precisely the same kind of view that was just now attributed to McTaggart. Yet McTaggart roundly rejects it, offering the following diagnosis of where it goes wrong:

> It will be noticed that Mr. Russell looks for change, not in the events in the time-series, but in the entity to which those events happen, or of which they are states. If my poker, for example, is hot on a particular Monday, and never before or since, the event of the poker being hot does not change. But the poker changes, because there is a time when this event is happening to it, and a time when it is not happening to it.
>
> But this makes no change in the qualities of the poker. It is always a quality of that poker that it is one which is hot on that particular Monday. And it is always a quality of that poker that it is one which is not hot at any other time. Both these qualities are true of it at any time – the time when it is hot and the time when it is cold. And therefore it seems to be erroneous to say that there is any change in the poker. (McTaggart 1927: 14–15)

What McTaggart makes clear in this passage is that, his previous quoted comments notwithstanding, he understands genuine change to be something that involves changes in *events* rather than merely changes in *objects*. So CP1 and CP2 do not, for him, capture the meaning of premise 1. Instead, it is captured by something like the following principle:

> Change Principle 3 (CP3): Necessarily, if time exists, then some event undergoes change.

So when McTaggart says that a universe without change would be a timeless universe, he is not thinking of a universe in which *objects* remain static, i.e. such that they do not vary in their properties or relations across some putative temporal dimension. Rather, he is thinking of a universe in which *events* remain static, i.e. such that they do not vary in *their* properties or relations. On McTaggart's view, a universe in which events do not vary in their properties may well be one in which objects *do* vary across a putative temporal dimension. However, McTaggart would regard such a universe as timeless nonetheless because, on his view, this putative temporal dimension simply cannot be a *genuine* temporal dimension (since it features no changes in events).

What, for McTaggart, are events? They are, he says, 'the contents of a position in time' (or, equivalently, the contents of a 'moment') (McTaggart 1908: 458). In saying this, he means to remain agnostic about whether events are to be identified with moments. But he is clear that even if the two are not to be identified, they are nonetheless intimately bound together, for he says that the relation between an event and a moment is 'unvarying' (ibid. 467). By this he means that facts about the relation between any particular event and any particular moment are fixed, in the sense that they do not change over time – i.e. that if at any time t, an event e is the content of a moment m,

then at all times *t*, *e* is the content of *m*. So, premise 1 for McTaggart is the premise that necessarily, if time exists, some event must undergo a change that leaves the relation between it and its moment intact. We will consider a reason to doubt the truth of this premise in section 1.4 below, where we will also consider whether McTaggart can do without it.

3.2. Premise 2 of McTaggart's argument

According to McTaggart it is events, then, that must change if time is to exist. But what would it be for an event to change? It is in answering this question that McTaggart makes use of the distinction mentioned earlier between ordering moments in terms of an A-series and a B-series.

Moments are ordered in a B-series when they are ordered by the *earlier than* and *later than* relations. Each moment in such a series is either a certain fixed amount of time earlier than, or later than, each other moment in the series. Because events are the contents of moments, to order moments in this way is also to order events. And because events are tied to particular moments, it follows that the *earlier than* and *later than* relations between events are also fixed. And this entails that the B-properties that events have (i.e. the properties they have in virtue of standing in a B-series) are unchanging. For example, the death of Queen Anne (which occurred in 1714) has the B-property of *being 160 years earlier than the birth of Winston Churchill* (which occurred in 1874), and the B-property of *being 515 years later than the coronation of King John* (which occurred in 1199). But because the B-relations between the former event and the latter two events never alter, neither do the B-properties of the former. That is, because the event of Queen Anne's death always was, is and will be 160 years earlier than Churchill's birth and 515 years later than King John's coronation, so that event always had, has and will have the corresponding B-properties. So, McTaggart argues, events cannot vary with regard to their B-properties. And so, events cannot be said to change by gaining or losing B-properties.

Moments are ordered in an A-series when they are ordered in terms of whether they are past, present or future. Each moment in such a series is either a certain amount of time in the past, is present or is a certain amount of time in the future. Unlike the B-series, however, where a moment falls in an A-series is not unchanging. As we write, the moment in 1714 when Queen Anne died is approximately 300 years in the past, a certain moment in 2014 is present and the first moment of 2114 is around 100 years in the future. However, in 100 years' time, the first of these moments will be 400 years in the past, the second 100 years in the past and the third will be present. Again,

because events are tied to moments, to order moments in this way is also to order events. But this time the fact that events are tied to moments entails that the A-properties they possess *do* change. For example, as we write, the death of Queen Anne has the A-property of *being 300 years in the past*. Three hundred years ago it lacked this property, and instead had the property of *being present*. Five hundred years ago it lacked both of these properties, and instead it had the property of *being 200 years in the future*. So, McTaggart argues, events can vary with regard to their A-properties. And so, events can be said to change by gaining or losing A-properties.

McTaggart goes one step further than this. He argues not only that events can be said to change by gaining or losing A-properties, but that they can *only* be said to change by gaining or losing A-properties. This is because all properties of events other than their A-properties are fully determined by their B-properties and the fact that they are tied to moments. No event can cease to be an event, or cease to be the event that it is, because it 'can never get out of any time series in which it once is' (McTaggart 1908: 459). And no event can become another event, because this would mean it would have to become tied to another moment, which would make it a distinct event after all. So, he concludes, the only way in which an event can change is by undergoing a change from being future to being present, or from being present to being past (or, from being a certain amount of time in the future, to being a certain lesser amount of time in the future, and so on). And the only way in which events can undergo such changes is if they form an A-series. Thus, because time requires that events change, time requires that events form an A-series. This premise will be examined in section 1.6 below, where we will see it can be reasonably doubted.

3.3. Premise 3 of McTaggart's argument

McTaggart argues for this premise by first noting that every event must possess one or other of the following A-properties: the property of *being past*, the property of *being present* or the property of *being future*. He then notes that these properties are incompatible, in the sense that no event can possess more than one of them. That an event is present, for example, implies that it is not past or future. That this is so, he thinks, must be maintained if time is to exist, for if it is allowed that each event possess all three of these A-properties, then no event changes with regard to its A-properties after all, and so no event changes in any way, and so time does not exist. But, he says, each event *does* possess more than one of the A-properties, and, in fact, each possesses all three:

> If M is past, it has been present and future. If it is future, it will be present and past. If it is present, it has been future and will be past. Thus all the three incompatible [A-properties are attributable to] each event, which is obviously inconsistent with their being incompatible, and inconsistent with their producing change. (ibid. 468)

To illustrate take Queen Anne's death once more. This event is past, so we can attribute to it the A-property of *being past*. But it was (in 1714) present, so we can attribute to it the A-property of *being past*. And it was (before 1714) future, so we can attribute to it the A-property of *being future* too. So we can attribute all three incompatible A-properties to this event. A similar line of reasoning applies to all events, so no event changes with regard to its A-properties (for each event has all three). And so, McTaggart argues, a contradiction seems to lie at the heart of the A-series. In an A-series it seems that every event both cannot, but does, possess each A-property. And so it seems that events (and their moments) cannot form an A-series.

One might be puzzled by McTaggart's line of reasoning here, for there is an obvious rejoinder to this argument, which runs as follows:

> No event ever has all three A-properties simultaneously, but rather, each event has them successively. That is, each event either *is* present, *was* future, and *will be* past, or *is* past and *was* present and future, or *is* future and *will be* present and past, but that no event ever is, was, or will be past, present *and* future.

But McTaggart has a quick response to this rejoinder, which is most clearly articulated in *The Nature of Existence* (McTaggart 1927: 21–2). The difficulty, as he sees it, is to explain how it can ever truly be said of an event that it possesses one A-property, but not all of them. According to the rejoinder we can explain this by paying close attention to the tenses of the statements used to attribute A-properties to events. McTaggart's response can be given as follows:

> To say that an event *is* a certain way is to say that it is that way at the present moment, to say an event *was* a certain way is to say that it is that way at a past moment, and to say that an event *will be* a certain way is to say that it is that way at a future moment. So, for example, to say that an event is present, was future, and will be past, is to say that the event is present at the present moment, is future at some past moment, and is past at some future moment. But to say this is to assume that moments themselves can truly be said to have one of the A-properties, but not all of them (i.e. by saying, for example, that an event is future at some *past*

> moment). And this is a dialectically illegitimate assumption to make. One then owes an explanation of how a moment can be, e.g., past, but not also present and future. And one makes no headway by claiming that a moment can be past without being present and future by claiming that it *is* past, but *was* present and future, for this is just to say that it is past at the *present* moment, and is present and future at two distinct *past* moments, which obviously just reintroduces the same difficulty once more.

So, McTaggart believes, one cannot explain how events can have one A-property and not another without embroiling oneself in a vicious infinite regress. This is because every time one attempts to spell out how this can be using tensed statements, one ends up with another statement that needs an explanation of the same kind. So, McTaggart concludes that the contradiction in the A-series is a genuine one, and that events therefore cannot form an A-series. So, because events must form an A-series if they are to change, and events must change if time is to exist, McTaggart concludes that time does not exist. We will consider a response that can be given to McTaggart's argument for this premise in section 1.7 below.

3.4. Does McTaggart require premise 1?

Premise 1 seems to be the least well supported of McTaggart's premises. McTaggart introduces it as a view that would be 'universally admitted' and so perhaps thinks that it requires little defence. But, as we have said, the claim that time requires change can be taken to mean that it requires changes in objects (i.e. as in CP1 or CP2) or to require changes in events (i.e. as in CP3). The claim understood in the first way has come under question in the philosophical literature. Sydney Shoemaker, for example, argues against this claim in his 1969 paper 'Time without Change'. But while not universally accepted, this view has a good claim to be one that is, as Shoemaker himself thinks it is, 'a widely held view' (Shoemaker 1969: 363). By contrast the second view – that time requires changes in events – does not have the same status. This lies mainly in the fact that it is entirely unclear whether events are correctly thought of as things that *can* change. As both J. J. C. Smart and Arthur Prior have put it, while we would ordinarily say that *things* change, we would not say that *events* change. We would ordinarily say, rather, that events *happen* or *occur* (Smart, 1949: 485; Prior 1962: 2). C. D. Broad, in fact, goes even further, claiming that 'to talk of *events* changing seems almost unintelligible' (Broad 1923: 62). It is perhaps telling that, as observed, in the passages quoted above where McTaggart explicitly discusses premise 1, he himself

talks about *things* changing rather than events. Perhaps McTaggart is guilty of a slide from the more widely held CP1 to the more controversial CP3. If so, then his argument is on far less solid foundations than he himself thinks it is. But whatever the case may be in this regard, it can reasonably be said that McTaggart largely assumes what is a controversial premise, *viz.* that time requires that events change.

Some have argued that McTaggart's argument does not require the premise that it is events that change. Michael Dummett (1960: 499), for example, argues that premise 1 can be reformulated in terms of objects using the predicate 'is no more' to apply to objects that existed but do not now exist and the predicate 'is not yet' to apply to objects that do not yet exist but will exist (and, although Dummett doesn't mention it, presumably we also require the predicate 'is now' for objects that presently exist). If we call the properties picked out by these predicates 'existence-properties', Dummett's suggestion is that McTaggart's argument that the application of A-properties to events is contradictory can be reformulated as an argument that the application of existence-properties to objects is contradictory. So Dummett's suggestion is that McTaggart's argument can be reformulated in something like the following way:

(1) If time exists then objects must undergo genuine change.

(2) If objects undergo genuine change then they undergo change in their existence-properties.

(3) That objects undergo a change in their existence-properties is contradictory, and so they do not undergo any genuine change.

Therefore,

(4) Time does not exist.

The difficulty with this suggestion, however, is simply that it doesn't seem possible to spell out a convincing argument for the reformulated premise 3 without reintroducing A-properties. It is easy enough to reformulate McTaggart's initial reasons for thinking that the application of A-properties to events leads to contradiction in terms of existence-properties. The following parallels the quoted passage from McTaggart given above where he gives these reasons:

> If O is no more, it was the case that it is now, and was the case that it is not yet. If it is not yet, it will be the case that it is now, and will be the case that it will be no more. If it is now, it was the case that it is not yet, and will be the case that it is no more. Thus all the three incompatible

> existence properties are attributable to each object, which is obviously inconsistent with their being incompatible, and inconsistent with their producing change.

However, now consider the obvious rejoinder to the original argument, reformulated in terms of existence-properties applied to objects:

> No object ever has all three existence-properties simultaneously, but rather, each object has them successively. That is, each object either *is* such that it is now, *was* such that it is not yet, and *will be* such that it is no more, or *is* such that it is not yet, *will be* such that it is now, and *will be* such that it is no more, or *is* such that it is no more, and *was* such that it is now, and *was* such that it is not yet, but no object ever *is* such that it is now, is no more, *and* is not yet.

It was crucial to McTaggart's original argument that he had a response to the original rejoinder, and so it is equally crucial that a response is available to this reformulated rejoinder too. But how must McTaggart respond to this rejoinder? In fact, it seems he must respond in an exactly parallel way, as follows:

> To say that an object *is* such that it is a certain way, is to say that it is that way at the present moment, and to say that an object *will be* such that it is a certain way is to say that it is that way at a future moment, and to say that an object *was* such that it is a certain way is to say it is that way at a past moment. So, for example, to say that an object is such that it is now, was such that it is not yet, and will be such that it is no more, is to say that the object is now at the *present* moment, is not yet at some *past* moment, and is no more at some *future* moment …

We do not need to press the response further, as it is clear that it appeals to A-properties once more, applied to moments (i.e. it appeals to moments being *past*, *present* and *future* once more). What this shows is that for McTaggart's argument to have any plausibility, he will have to appeal to A-properties at some stage in the argument. It is true that in Dummett's reformulation we avoid applying A-properties directly to events, and only appeal to them as applying to moments. But if one balks at the suggestion that events are the sorts of things that can be said to change, one is likely to find the suggestion that moments can change to be equally suspect. So it is unclear that reformulating McTaggart's argument in terms of objects and existence-properties really achieves any advance over formulating it directly in terms of events and A-properties.

3.5. McTaggart's secondary argument for the unreality of time

McTaggart One does, then, seem to rely upon the premise that events can change. However, it is possible to discern a slightly different argument in McTaggart's work that does not seem (at least directly) to rely upon this premise. In order to see what this argument is, it is useful to consider a metaphor that McTaggart himself considers in footnotes to his 1908 and 1927 works (McTaggart 1908: 470 n.1; McTaggart 1927: 10 n.1). This metaphor can be presented, as McTaggart himself presents it, in two ways. It can be presented in terms of time itself flowing, or moving past us. Presented in this way moments of time move closer and closer towards us from the future, pass us in the present and then move further and further away from us into the past. It can also be presented in terms of our moving, or advancing, through time. Presented in this way we move closer and closer towards moments of future time, which become present as we reach them and then fade away into the past as we move further and further away from them. We will consider this metaphor more fully in the next chapter, where we will discuss whether there is any literal truth in it, and consider the opposition between those who believe that reality itself, as opposed to the language we use to represent it, is in some sense tensed, and those who believe that reality itself is tenseless. But here we focus on McTaggart's understanding of the metaphor, and the significance he thinks it has.

McTaggart takes the metaphor to capture something that he takes as being essential to our concept of time, *viz.* that in addition to having a certain order, moments in time also have a particular *direction*. He often puts this again in terms of events changing. He says, for example:

> [I]n dealing with the time series we have not to do merely with a change in an external contemplation of it, but with a change which belongs to the series itself. And this change has a direction of its own. The Great Charter came before the Reform Bill, and the Reform Bill did not come before the Great Charter. (McTaggart 1908: 463)

Here at least McTaggart need not appeal to events such as the signing of the Great Charter, and could quite easily put the point in terms of objects and their properties. For example, Winston Churchill went from being hirsute to being bald, and not the other way round. Turkey went from being a dynasty to being a republic, and not the other way round. The Earth went from being populated by dinosaurs to being populated by human beings, and not the other way round. And so on. Put in this way, McTaggart's point is that if time

is to exist, it must have an intrinsic structure that allows changes like this to occur in the particular privileged direction that we take them to occur. But, McTaggart argues, unless moments in time can be ordered in an A-series, time cannot have such an intrinsic structure. Then, once more, he takes his argument that the A-series is contradictory to show that time cannot have such an intrinsic structure, and to show therefore that time does not exist. In other words, we can find the following distinct argument for the unreality of time in McTaggart's work:

McTaggart Two

(1) If time is to exist, changes must occur in a particular direction.

(2) In order for changes to occur in a particular direction, moments must form an A-series.

(3) The A-series is contradictory, and so moments cannot form such a series.

Therefore,

(4) Time does not exist.

One might think that the direction of time can be captured by the B-series alone, with it being given by the relations of *earlier than* and *later than*. One might think, for example, that Churchill went from being hirsute to being bald, and not the other way round, because he was hirsute in 1894 and bald in 1960, and 1894 is earlier than (and so not later than) 1960. But McTaggart demurs. He argues that if moments in time are not ordered by an A-series, then strictly speaking they cannot be ordered by a B-series either. He thinks that unless moments are ordered by an A-series, one is simply not entitled to take the relations that moments stand in to each other in the B-series as being relations that determine a direction rather than a mere order (McTaggart 1908: 462). As such, he thinks that moments can only be related by the genuinely temporal relations of *earlier than* and *later than*, and so form a B-series, if moments also form an A-series. McTaggart puts this point by distinguishing another way of ordering moments that he calls 'the C-series'. The C-series is very much like the B-series except that the relations *earlier than* and *later than* do not govern its terms. It is, he thinks, what is left of the B-series if there is no A-series. It gives us an ordering of moments, but does not give us a temporal ordering:

> [I]t does not follow that, if we subtract the determinations of the A series from time, we shall have no series left at all. There is a series – a series of the permanent relations to one another of those realities which in time are

> events and it is the combination of this series with the A determinations which gives time. But this other series – let us call it the C series – is not temporal, for it involves no change, but only an order. (McTaggart 1908: 461–2)

One can see McTaggart's point here by considering a spatial analogy. Suppose we have a collection of arbitrary physical objects (poker chips, let us say) which we can call '*a*', '*b*', '*c*', '*d*', '*e*' and '*f*'. Now suppose we arrange these chips on a table in front of us from left to right. We might place *a* on the far left, followed by *b* immediately to its right, then *c*, *d*, *e* and finally, on the far right, *f*, which can be represented as follows:

a b c d e f

So placed, the chips are ordered in a particular way. But they have no intrinsic direction. There is no sense in which the left-to-right direction of the ordering is privileged over the right-to-left direction. This is seen particularly clearly by considering that if someone is viewing the chips from the other side of the table the ordering is preserved, but the left-to-right direction is reversed so that, for example, *a* is on the far right rather than the far left:

f e d c b a

In other words, although the ordering is absolute, the relations *left of* and *right of* are only distinguished from each other in terms of a point of view or perspective. *b* is between *a* and *c* absolutely. But *a* is only to the left of *b* if we are looking at the table from one side. Looking at it from the other side *b* is to the left of *a*. So the *left of* and *right of* relations do not determine an order independently of an observer, and so determine no intrinsic direction. McTaggart's point is that the ordering of moments in a C-series is analogous to this. We may take the order to run in a particular direction, but we may likewise take it to run in the opposite direction. There is, however, nothing in the relations between the moments in a C-series that determines which way we so take it, and so nothing in the relations that determines a privileged direction. So, according to McTaggart, by placing moments into a mere ordering we form a C-series, which is an ordering of moments that lacks an intrinsic direction. Such an ordering is not temporal for it does not account for the fact that changes occur in a particular direction along it. However, if we also place moments into an A-series, this does allow us to determine a particular privileged direction in the C-series, and to account for the direction in which changes occur along it. As such, an A-series together with a C-series determines a B-series, and gives content to the claim that the ordering of

moments within it is governed by the genuinely temporal relations of *earlier than* and *later than*.

How, then, does the A-series allow us to determine a privileged direction in the C-series, and so give rise to the B-series? On this point McTaggart appeals to the idea that moments change with regard to their A-properties:

> Therefore, besides the C series and the fact of change there must be given – in order to get time – the fact that the change is in one direction and not in the other. We can now see that the A series, together with the C series, is sufficient to give us time. For in order to get change, and change in a given direction, it is sufficient that one position in the C series should be Present, to the exclusion of all others, and that this characteristic of presentness should pass along the series in such a way that all positions on the one side of the Present have been present, and all positions on the other side of it will be present. (McTaggart 1908: 463)

Thus, McTaggart thinks that the direction of time must be given in terms of moments changing with respect to their A-properties, with the A-property of *being present* being instantiated by successive moments in the C-series.

3.6. Does time require the A-series?

In both of his arguments McTaggart moves from the impossibility of the A-series to the conclusion that time does not exist. But we might reasonably doubt this move. To see why consider that, in *The Nature of Experience*, McTaggart attempts to explain why the universe *appears* to conscious subjects like us to have an A-series structure, and so why it *appears* to us that time exists (even though it does not), in terms of its C-series structure. His view is that our belief that events possess A-properties (and so our belief that time exists) is an error, but one that is explicable given that events really are ordered in a C-series, i.e. he holds that it appears to have an A-series structure *in virtue* of having a C-series structure. Now, McTaggart's explanation of why this is so will not itself be of concern to us here, as it relies upon some of his broader metaphysical commitments which have not stood the test of time, and so are of little importance in contemporary philosophy of time. The possibility of such an explanation, however, is of importance, for it is this possibility that justifies doubting McTaggart's view that having a C-series structure is not in itself sufficient for the existence of time, which in turn justifies doubting his move from the impossibility of the A-series to the unreality of time. In short, the availability of such an explanation justifies one

in thinking that the impossibility of the A-series entails not that time does not exist, but rather that time is not as we naïvely think it is.

To see why consider what the universe would be like if it had only a C-series structure. It would consist of a series of three-dimensional events involving objects arranged along a fourth dimension. In such a universe objects may very well have different properties at different points along the fourth dimension. McTaggart himself would maintain that a C-series universe like this, without an accompanying A-series structure, would be one in which genuine changes do not occur, and one in which time does not have privileged direction, and so one in which time does not exist. But if it could be explained why such a universe would *appear* to conscious subjects like us to undergo A-series changes, and would *appear* to have a privileged temporal direction, one may reasonably doubt that McTaggart is right to maintain these conclusions, and instead hold that having a C-series structure across which objects vary in their properties is precisely what it *is* for a universe to contain genuine change, and for time to exist. And if one takes this view, one will reject the second premise of both *McTaggart One* and *McTaggart Two*.

To gain a deeper understanding of this point first consider a putative explanation of how the world appears to us to have an A-series structure in virtue of possessing a C-series structure:

> If the universe has a C-series structure this means that conscious subjects like us, or our lives, are spread out across a fourth-dimension which we can call (so as not to beg any questions) 'TIME' and take to be constituted by 'MOMENTS'. At any particular MOMENT of TIME, the experience of a conscious subject will be one in which the objects that exist at that MOMENT (and that are in close proximity to her) will appear to her. So, at any particular MOMENT, the experience of a subject will represent the things that appear to her as being present, although there is no genuine difference between her experience at one MOMENT of TIME and her experience at another MOMENT of TIME – both are equally real, but simply exist at different MOMENTS of TIME. Moreover, her experiences will be different at different MOMENTS of TIME (i.e. different experiences will occur at different points in the fourth-dimension). But these experiences will be linked together in various ways. In particular, her experiences will contain memories and other psychological traces that link them with experiences in one direction along the fourth-dimension, but not the other (i.e. in the direction that she, at any particular moment, can refer to as 'THE PAST'). Consider the experience of an opening door, for example. This will be made up, in our perceiving subject, from a series of experiences that occur at different MOMENTS. The first will be an experience of a closed door, and at close-by MOMENTS the experience will be of a door that is

> progressively wider and wider open. All of these experiences are equally as real as each other, but the later ones will contain psychological traces of the earlier ones, and thus give rise to the appearance, during the later experiences, that the door is going from being closed to being open, and not the other way round.

This explanation is meant to serve as an example, and so we do not claim that it is a fully convincing one (we shall return to the issue of accounting for our temporal experiences in more detail in Chapter 8). But suppose one were convinced by this explanation. Then what conclusion should one draw regarding time? Should one conclude, as McTaggart does, that it does not exist? Or should one instead conclude that time does exist, but that it is not as we naïvely think it is? (Equivalently, we can ask: is TIME time, but not as we would naïvely think it to be?)

Consider by way of analogy our perception of colour. When we view a coloured object it *looks* a certain way to us. Looking at red pillar boxes, for example, gives rise to a distinctive phenomenal experience in us – the experience of *redness*. Supposedly, it was once common to attribute to objects colours as they appear to us. But with the advent of modern science in the sixteenth century, this view has become increasingly hard to sustain. It seems that if what science tells us about the true nature of colour perception is right, then objects do not possess colours as they appear to us. It seems, for example, that nothing in the pillar box resembles our phenomenal experience of redness. To see why consider what science does tell us, in its bare bones. It tells us that our phenomenal experiences of colours arise due to the way our visual systems process the light that is reflected from coloured surfaces. Roughly put, red pillar boxes are made from a material that reflects light of a certain wavelength and absorbs light of other wavelengths, and our visual systems process light of the reflected wavelength in a way that gives rise to (somehow or other) the phenomenal experience of redness. Now ask: what does this tell us? Are we to conclude from this that objects are not really coloured? Some argue that the scientific facts really do entail this eliminativist conclusion, and declare: colours do not exist. But many in the philosophical literature do not draw this conclusion, and instead maintain that these facts show that for an object to possess certain light-reflectance properties is precisely what it *is* for an object to be coloured; to be red, for example, just is to be made from a material that, under normal conditions, reflects light of a wavelength of between 620 and 740 nanometres. So they declare: colours do exist (but science tells us they're not as we thought they were). (See Gow 2014 for an overview of the current state of the debate.)

The significance of the above is this: modern science has shown us that the world is not structured as we might naïvely think it is; objects do

not possess phenomenal colour properties (e.g. redness *as it appears to us*). Instead, it has shown us, the world is structured in terms of light and materials that reflect it, and we have an explanation of how the world, by being structured in this way, gives rise to experiences of colours in us. On the basis of this we could conclude, as some do, that colours do not exist. But it is not obvious that we should draw this conclusion. Instead it is plausible that we should take this explanation as revealing to us the true nature of colour. Our suggestion here is that McTaggart's argument regarding the existence of time can be taken in an analogous way. We can reasonably think that his arguments, if sound, show us that the world is not structured as we might naïvely think it is – events do not possess A-properties. Instead, it has only a C-series structure, and in virtue of possessing this structure it gives rise in us to experiences of change, and of temporal passage. On the basis of this we could conclude, as McTaggart does, that time does not exist. But it is not obvious that we should draw this conclusion. Instead it is plausible that we should take this explanation as revealing to us the true nature of change, and of time. If one takes this view, one will reject both the second premise of *McTaggart One* (i.e. that change requires that moments are ordered by an A-series) and the second premise of *McTaggart Two* (i.e. that change in a particular direction requires that moments are ordered by an A-series). And thus one will think that both of McTaggart's arguments are unsound, and so reject his conclusion that time does not exist.

3.7. Is the A-series contradictory?

That the A-series is contradictory is the third premise in both *McTaggart One* and *McTaggart Two*. It is the premise that has attracted the most criticism, and much has been written about it. Most consider his argument for the premise to be fallacious (although Dummett 1960 and Mellor 1981, 1998 are notable exceptions), but there is little consensus about precisely why it is fallacious. As we can't hope to cover everything that has been written about the premise in this section, we make a particular point of directing the interested reader to the further reading here, and focus on what we believe to be the most penetrating criticism of it, *viz*. J. E. J. Altham (2004).

Altham's short discussion of McTaggart's argument for premise 3 is buried in a paper that has as its main topic a seemingly unrelated debate within the philosophy of language. It is perhaps for this reason that it has so far received little attention in the philosophy of time literature. But, in our view, Altham's discussion of McTaggart's argument for premise 3 deserves to be much more widely known.

Altham begins by considering McTaggart's claim that every event has all three A-properties of being past, being present and being future. Altham notes that if McTaggart's argument is to have any plausibility, it is crucial that this initial claim gains our assent, but that before we give it, it is appropriate to ask for clarification of its meaning. He asks after such a clarification by asking what McTaggart means by 'has' when he says that every event 'has' all three of these properties. He then notes that McTaggart cannot mean that every event 'has at some time or other each' of the A-properties, as this would give rise to no contradiction at all. Nor, he notes further, can McTaggart mean 'has' to be taken as expressing a present tense claim, for then the claim would entail that every event is now past, present and future, which is false. Instead, Altham argues, McTaggart must mean 'has' to be understood *tenselessly* (i.e. in much the way that we would understand it in the sentence 'the number three has the property of being odd'), and gives the following sentence as an example of a claim that McTaggart would thus endorse:

(1) The Battle of Hastings is (tenselessly) past, and the Battle of Hastings is present, and the Battle of Hastings is future. (Altham 2004: 243)

However, Altham argues, even so understood one has no reason to think that (1) is true; even if we so understand the copula, we still have not been given any reason to think, in particular, that the second and third conjuncts in (1) are true. For example, if someone were to assert the sentence 'The Battle of Hastings is future' we would surely reject it as false, even if our interlocutor were to insist that we understand the 'is' within it tenselessly. Why would we so reject it? Altham's suggestion is that the temporal predicates 'past', 'present' and 'future', whenever they occur in a sentence, function just as their corresponding tenses do, and so that (1) is in fact equivalent to:

(2) The Battle of Hastings happened, is happening and will happen. (ibid. 244)

But (2) is clearly false, and so has no claim to our assent. And so, Altham thinks, we can prevent McTaggart's argument from getting started by rejecting his initial claim outright.

More needs to be said, however. As we have seen, after claiming that every event has all three A-properties of being past, being present and being future, McTaggart then considers a rejoinder according to which tenses are taken seriously. Taking the Battle of Hastings as our example once more, according to that rejoinder it is only the following that can be said about it:

(3) The Battle of Hastings *was* future, and the Battle of Hastings *was* present, and the Battle of Hastings *is* past.

McTaggart here gives us a different sentence from (1), and it is a sentence that is apparently innocuous. He then claims that (3) is equivalent to:

(4) The Battle of Hastings is future at some past moment, and the Battle of Hastings is present at some past moment, and the Battle of Hastings is past at the present moment.

And it was by considering the meaning of the terms 'past moment' and 'present moment' in (4) that was supposed to start us off upon a vicious regress. So even if we reject McTaggart's initial claim (1), if we admit that (3) expresses a truth and that it is equivalent to (4), it still seems that there is something in McTaggart's argument, for he can force upon us a vicious regress in explaining what the sentence is supposed to mean. But Altham's suggestion, if it is correct, prevents us from starting down this path in the first place. In (3) tensed copulas are mixed with temporal predicates. For example, it contains the phrase 'was future' which combines the tensed copula 'was' with the temporal predicate 'future'. But, according to Altham, temporal predicates such as 'future' can only be sensibly combined with the untensed copula 'is'. So, strictly speaking, (3) is not well-formed. Why can temporal predicates only be sensibly combined with the tenseless copula? Because, according to Altham's suggestion, temporal predicates cannot lose their indexicality, i.e. the function of a temporal predicate is to turn any sentence containing it into a corresponding tensed sentence, and so combining a temporal predicate with a tensed copula double-tenses the sentence, which makes no sense. To make this point clear consider again the third conjunct in (1):

(5) The Battle of Hastings is future.

Here the function of the temporal predicate 'future', according to Altham's suggestion, is to turn (5) into a future-tensed sentence equivalent to:

(6) The Battle of Hastings will happen.

But now consider:

(7) The Battle of Hastings was future.

If the function of the temporal predicate 'future' is to turn sentences that contain it into future-tense sentences, then (7) is equivalent to (6). But (7) seems not to be equivalent to (6), for (7) seems to express a truth, while (6) is false. But Altham's suggestion is that we should not therefore think that the temporal predicate is functioning in some other way in (7). Rather, we should think that (7), and other sentences that mix tensed copulas with temporal predicates, are not correct expressions of any sensible thought.

They should be thought of as being faulty in much the same way as the following sentence is:

(8) The Battle of Hastings was going to will happen.

This is not to say, however, that we cannot recover some kind of thought from (7). (7) can be viewed as *incorrectly* expressing the sensible thought that:

(9) It was the case that the Battle of Hastings was going to happen.

But if (9) is the correct way of expressing what (7) incorrectly expresses, then the correct expression of the rejoinder (3) is in fact the following:

(10) It was the case that the Battle of Hastings was going to happen, and it was the case that the Battle of Hastings was happening, and it is the case that the Battle of Hastings has happened.

But it is highly implausible that (10) is equivalent to (4), and so from (10) no vicious regress is forthcoming. So, if we adopt Altham's suggestion, not only can we reject McTaggart's initial claim (1) that every event has all three A-properties, we can also prevent McTaggart from forcing a regress upon us via (3).

3.8. Summary

In this chapter we have considered McTaggart's claim that time does not exist in some detail. We have identified two distinct arguments that he gives for the claim, and explained why he held each of their premises. We have also considered some arguments against each of their premises, and suggested that even if much of what McTaggart says is correct, this leads only to the conclusion that time is not as we think it is, and not that it does not exist. We will return to many of the issues raised in this chapter in later chapters of this book. In the next chapter, for example, we consider the debate between those who think that McTaggart was substantially right about how time must be if it is to exist (the A-theorists) and those who think he was wrong about this (the B-theorists).

Study Questions

1. What does it mean to order moments in time in an A-series? What does it mean to order them in a B-series?

2. McTaggart thinks that genuine change involves changes in events. Smart, Prior, Broad and Russell disagree, and think that it only involves changes in objects. Who is right?
3. Do you agree that it is essential to our concept of time that moments in time have a privileged direction?
4. If the universe has only a B-series structure, does this mean that time does not exist (as McTaggart thinks) or does it mean that time exists, but is not as we naïvely take it to be?
5. What is McTaggart's argument for the A-series being contradictory? Is it sound?

FURTHER READINGS

The most detailed discussion of McTaggart's philosophy as a whole is Broad (1933a, 1933b) (in two volumes). Chapter XXV in Vol. 2, 'Ostensible Temporality', contains his discussion of McTaggart's argument for the unreality of time. Other early discussions (pre-1960s) of McTaggart's argument can be found in Gotshalk (1930), Patterson (1941) and Oakeley (1946).

Other more recent discussions are in Dummett (1960), Gale (1966), Sanford (1968), King-Farlow (1974), Christensen (1974), Schlesinger (1983), Le Poidevin and Mellor (1987), Buller and Foster (1992), Thomson (2001), Dainton (2001), Dyke (2002), Corish (2005) and Tooley (2010).

Mellor (1981, 1998) and Fine (2005, 2006b) offer and defend sophisticated reconstructions of McTaggart's argument, and are particularly important.

4

The A-theory and the B-theory of time

This chapter considers the question of whether time is dynamic, or whether it flows, in any sense. The view that time is dynamic is called the A-theory, and we discuss three versions of this view. We consider the reasons we have for holding each version of the view, and consider a number of historical and contemporary objections to each. Sections 4.6 and 4.7 contain some difficult material, and readers may wish to skip these sections on a first reading.

Our experiences and the language we use to speak about the world both seem to represent time as being in some sense dynamic. McTaggart captures this with his A-series ordering of time. Of course, McTaggart thinks that the A-series is contradictory, and so believes that time does not exist. But many doubt that his argument is sound, or at least think that it does not rule out that the world is in some sense dynamic. And if the view can be made sense of, then we have good reason to accept that it's true, for then we have a simple explanation for why our experiences, and the language we use, represent time as being dynamic – simply: because it *is*. But can one make sense of this view? And are there other reasons for thinking it is true? These are the issues we address in this chapter.

Another way of approaching the issue of time's apparent dynamic nature is via the metaphor that we introduced in the last chapter, according to which time flows (or moves, or passes). Here is a particularly colourful description of the metaphor due to Donald Williams:

> Time flows or flies or marches, years roll, hours pass. More explicitly we may speak as if the perceiving mind were stationary while time flows by like a river, with the flotsam of events upon it; or as if presentness were a

> fixed pointer under which the tape of happenings slides; or as if the time sequence were a moving-picture film, unwinding from the dark reel of the future, projected briefly on the screen of the present, and rewound into the dark can of the past. Sometimes, again, we speak as if the time sequence were a stationary plain or ocean on which we voyage, or a variegated river gorge down which we drift; or, in Broad's analogy, as if it were a row of housefronts along which the spotlight of the present plays. "The essence of nowness," Santayana says, "runs like fire along the fuse of time." Augustine pictures the present passing into the past, where the modern pictures the present as invading the future, but these do not conflict, for Augustine means that the *events* which were present become past, while the modern means that *presentness* encroaches on what was previously the future. Sometimes the surge of presentness is conceived as a mere moving illumination by consciousness, sometimes as a sort of vivification and heightening, like an ocean wave heaving along beneath a stagnant expanse of floating seaweed, sometimes as no less than the boon of existence itself, reifying minute by minute a limbo of unthings. (Williams 1951: 461–2)

There is no denying that these metaphors seem apt to us – there does seem to be some truth in them. But is there *really* any truth in them? Do our experiences or the way in which we use language mislead us into thinking there's something in the metaphor when really there is not? Do our experiences of time's flow and the tenses of our language reflect some fundamental feature of reality, or is temporal passage nothing more than a myth, our experiences of it nothing more than a subjective illusion and the tenses of our language purely verbal?

The view that there is some literal truth in the metaphor of time's flow is known as 'the A-theory', and those who hold it are said to have a 'dynamic' view of time. The opposing view according to which there is no literal truth in the metaphor is known as 'the B-theory', and those who hold it are said to have a 'static' view of time. The A-theory comes in three broad forms: the Moving Spotlight View, the Pure Becoming View and the Serious Tenser View. In section 4.1 below we outline these three views. In sections 4.2 to 4.4 we consider the main reasons for and against holding the Moving Spotlight View. In section 4.5 we distinguish between two versions of the Pure Becoming View and ask whether they are immune from the objections to the Moving Spotlight View. In section 4.6 we turn to the Serious Tenser View, first describing and assessing an old version of the view, before considering a newer version of the view in 4.7.

4.1. The moving spotlight, pure becoming and serious tensers

In Chapter 5 we will discuss the opposition between those who have different *ontological* views (i.e. views about what exists) regarding the past, present and future. In particular, we will discuss the views known as 'presentism', 'eternalism' and the 'growing block view'. These views can be characterized roughly as follows:

Presentism: Only the present exists (the past and future are not real).
Eternalism: The past, present and future all exist (they are just as real as each other).
The growing block view: Only the past and the present exist (the future is not real).

We mention these views now because although we will discuss them more fully in Chapter 5, it is important to be aware that there is a particularly large overlap between them and the positions discussed in this chapter. The B-theory entails one of these ontological views, *viz.* eternalism, so all B-theorists are eternalists. And although the A-theory does not entail any of these ontological views, different versions of the A-theory are obtained by combining them with the dynamic view of time:

The moving spotlight view
This is a version of the A-theory that combines the dynamic view of time with eternalism. According to it, moments in time are ordered by a B-series and so stand in eternally fixed relations of *earlier than* and *later than* to each other, but there is also a single privileged moment, the present, such that all moments earlier than it are past moments, and all moments later than it are future moments. Moreover, on this view, as time flows, which moment is privileged changes, and so the present moves relative to the B-series moments, with successive B-series moments becoming present as it does so. The A-properties of *being past*, *being present* and *being future* are genuine properties, on this view.

The pure becoming view
Those who hold this A-theory view think that the metaphor of time's flow captures the fact that the universe as a whole is in a constant state of transience or flux. There are two versions of it. The first is the combination of the dynamic view of time with presentism. On this view there are no genuine A-properties of *being past* or *being future*; new states of affairs

constantly come into existence, replacing the previous states of affairs as being the only things that exist. The second version is the combination of the dynamic view of time with the growing block view. So although the A-property of *being past* is a genuine property, the A-property of *being future* is not; new states of affairs constantly come into existence, but they join the previously existing states of affairs, and so the totality of what exists grows.

The above two A-theory views are thoroughgoing metaphysical views – they each say something directly about how reality *is*. But in addition to these metaphysical views, there is also a further A-theory view:

The serious tenser view
This view focuses on the relationship between language and reality. Many of the sentences that we use to talk about reality are tensed, and contain terms known as temporal indexicals (e.g. 'now', 'yesterday' and 'next year'). We say things like 'It is hot, but it was cold', 'The gate used to be red, but now it is blue,' and 'I cannot wait until tomorrow'. Serious tensers, as their epithet suggests, take these features of our language seriously. They believe that tense is an ineliminable feature of language and that if tensed sentences are to be true, then reality itself must also, in some sense, be tensed. It is this fact that serious tensers take to be captured by the metaphor of time's flow. At least *prima facie*, serious tensers are not committed to any of the ontological views about time (but their view is consistent with each of them).

And in opposition to the A-theory views are the B-theorists:

The B-theorist view
As already mentioned, all B-theorists are eternalists, so although they disagree among themselves about certain key issues, there is less variability in their basic positions. All B-theorists are united in rejecting each of the A-theoretic views above. B-Theorists believe that the universe has a B-series structure in which all moments of time are equally real, and no moment is privileged as being the present (they think that the term 'the present' functions in the same way that indexical terms such as 'here' and 'I' do; they think, that is, that it serves simply to pick out the time at which it is uttered). They thus deny that *being past*, *being present* and *being future* are genuine properties, and believe that any sentences that seem to attribute such properties to things can be reduced to, or analysed in terms of, the B-theoretic relations of *being earlier than* and *being later than*. They maintain that there is no literal truth in the metaphor of time's flow,

and that our experience of time's flow can be explained away as being an illusion. And while not all B-theorists think that tense is an eliminable feature of language, they all maintain that reality itself need not be tensed in order for tensed sentences to be true.

In the sections that follow, we consider the three A-series views in more detail.

4.2. The moving spotlight view

The moving spotlight view is, more or less, the view that McTaggart believes must be true if time is to exist. Moments in time are ordered by both a B-series and an A-series, with successive B-theory moments becoming present as time flows. The primary consideration in favour of the view is that it explains our experience of time's flow in a very simple and natural way. Ask: why does it *seem* to us that time flows? The defender of the moving spotlight view can answer: because, in a way that is at least close to being literally true, it *does* flow. According to the moving spotlight view there is an objective difference between the present on the one hand and the past and the future on the other. What we experience as the flow of time is the 'movement' of the objective present along the B-series. Relatedly, the moving spotlight view gives substance to our ordinary belief that there is a real difference between the present on the one hand and the past and future on the other. And it also explains our ordinary belief, mentioned in Chapter 3, that time has a particular direction. Moving spotlight theorists, however, are not committed to the metaphor of time's flow being strictly and literally true. This is because they do not have to say that the present moment is an entity of some kind that literally moves along the moments in the B-series. Instead they can say that the present 'moves' along the B-series in virtue of successive B-series moments gaining, and then losing, the property of *being present*. (Consider by way of analogy a row of light-bulbs that light up in succession. Nothing in fact 'moves' along the row as the light-bulbs are illuminated. Rather, successive light-bulbs gain, and then lose, the property of *being illuminated*.) But that moving spotlight theorists do not have to appeal to the strict and literal truth of the metaphor of time's flow is no objection to their view, because as some have noted (e.g. Olson 2009a: 441), literal movement necessarily involves a change in *spatial* position, and moments of time cannot so change. Nevertheless, they can maintain that the present does move relative to the B-series in a way that involves a change in the *temporal* position of the present, i.e. in the sense that which moment

of the B-series is the present moment changes. They can thus cash out the metaphor of time's flow in terms of such changes, and so maintain that it makes perfect sense to say that time flows.

Despite the fact that the moving spotlight view explains our experience of time in a simple way, the view has not proved a popular one historically, chiefly due to the following two related objections that have been made against it:

(i) *The hypertime objection*
Changes are things that occur *in* time, and that *take* time to occur. So, if there are to be changes with regard to which B-series moment is the present moment, then there must be a second-order time series of 'hypertimes' relative to which these changes occur. But presumably there will be changes with regard to which second-order hypertime moments are present too, so there must also be a third-order time series of hyper-hypertimes relative to which these changes occur. But presumably there will also be changes with regard to which third-order hypertime moments are present, so there must be a fourth-order time series of hyper-hyper-hypertimes also … and so on, giving rise to an infinite hierarchy of time series. But that there is such an infinite hierarchy of time series is absurd. So the moving spotlight view is false.

(ii) *The rate objection*
If anything changes, it must make sense to ask how fast it changes. That is, there must be a specifiable *rate* of change. Consider, for example, literal movements once more. When we ask how fast something moves, we ask for a rate of change specified in terms of units of length (for some interval of length taken as a unit) and units of time (for some interval of time taken as a unit). For example, we can ask how fast a car is moving, and get the answer 30 mph. Here miles are taken as units of length, and hours as units of time, and the answer gives a rate of change that means that the car will travel 30 units of the former in one unit of the latter. Of course, if the moving spotlight view is true, the changes that take place as time flows are not spatial movements, and so when we ask how fast time flows we are not asking for a rate of change in terms of units of length and units of time. But then what are we asking for? It seems that we must be asking for a rate of change in terms of units of time and units of time – i.e. we must be asking how many units of time will pass during a unit of time. But this question admits of no sensible answer, so it makes no sense to ask

how fast the present changes, and so the moving spotlight view is false.

Both the hypertime objection and the rate objection are due originally to Broad (1938: 277–9), who was in fact a defender of an A-theory view, *viz.* the growing block version of the pure becoming view. But similar objections have been expressed by influential B-theorists. (See, for example, Smart 1949: 484 and Williams 1951: 463–4.)

4.3. Evaluating historical objections to the moving spotlight view

The Hypertime objection

The hypertime objection, even if sound, does not show that there is anything contradictory about the moving spotlight view. Rather, it shows that adopting the view lands one with a putatively unpalatable ontological commitment to hypertimes, hyper-hypertimes, and so on. But although few have countenanced taking on such a commitment (J. W. Dunne 1929, 1934, is an exception) it is not in fact clear that the commitment really is unpalatable when one compares it with other well-regarded metaphysical views. According to platonism about properties, for example, objects possess properties in virtue of standing in relation to platonic universals, *viz.* immutable and transcendent entities. For example, post boxes possess the property of being red in virtue of their standing in the instantiation relation to the platonic universal of *being red*. But platonic universals also possess properties (e.g. the property of *being a universal*), which seems to require the existence of second-order universals. And second-order universals also possess properties (e.g. the property of *being a second-order universal*), which seems to require the existence of third-order universals, and so on. So it is plausible that platonists are committed to there being an infinite hierarchy of platonic universals. But, platonists can maintain, this is not a problem for their view, but simply a fact about the metaphysical structure of reality. By accepting an infinite hierarchy of universals beyond first-order universals, platonists do commit themselves to there being a greater number of entities than they otherwise would, but many would think this to be unproblematic given that they do not commit themselves to there being a greater number of *kinds* of entities. (Whether it is problematic turns on whether quantitative parsimony, as opposed to qualitative parsimony, is a theoretical virtue. For discussion see Nolan 1997.) At any rate, unless more is said about why a commitment to an *infinite* hierarchy of time series is unpalatable, it seems to us that the moving spotlight theorist

can reply to the hypertime objection by simply accepting this as being a fact about the metaphysical structure of reality.

But more can be said. It is unclear whether the hypertime objection is sound. George Schlesinger, for example, has argued that one need not accept an *infinite* hierarchy of time series in order to make sense of the moving spotlight view, and that one can stop at second-order moments of time (i.e. at hypertimes). He argues, in effect, that just as first-order moments can be said to change with regard to their second-order temporal positions, so second-order moments can be said to change with regard to their first-order temporal positions, and so no third-order time series is required to account for changes in second-order moments (Schlesinger, 1980: 30–2). More recently, some have argued that moving spotlight theorists can explain how the objective present moves without admitting the existence of even second-order moments. They have argued that moving spotlight theorists can instead appeal to a device that presentists often appeal to, *viz.* 'primitive tense operators'. (See, e.g. Sider 2011: 246–7 and Skow 2009: 667–8.) We will consider this device more fully in Chapter 5.

The Rate objection

According to the rate objection, it doesn't make sense to ask how fast time flows. This objection can also be met by accepting the existence of hypertimes. Then the question of how fast time flows can be construed as asking for a rate of change in terms of units of first-order time and units of second-order time, i.e. as asking the question of how many units of first-order time will pass during a unit of second-order time. But recently some have argued that the objection can be countered even if one does not admit the existence of hypertimes. Ned Markosian (1993), for example, gives a number of ways in which one might respond. One response that is suggested by Markosian is that the objection begs the question against anyone who holds the moving spotlight view, for if the view is in fact true one can respond as follows:

> All talk of rates of change involves a comparison between two changes. When we say, for example, that a car is moving at a rate of 30mph, what this means is that the car will undergo a change in its spatial position of 30 miles as a moment of time undergoes a change in its temporal position of one hour. But there are no restrictions on what kinds of changes one can compare, and one can even compare changes in time with changes in time. So it is not meaningless to ask how fast time flows, but rather it admits only of a trivial answer, *viz*. that a moment in time undergoes a change in its temporal position of one unit as a moment of time undergoes a change in its temporal position of one unit – or, put more simply, time

> flows at a rate of one unit of time per one unit of time. (Markosian, 1993: 842–3)

Tim Maudlin argues similarly, claiming that it is trivially true that time flows at one unit of time per one unit of time because it is a necessary *a priori* truth:

> [I]f we ask how fast time flows, i.e. how fast time passes, we must mean to ask how the temporal state of things will have changed after a certain period of time has passed. In one hour's time, for example, how will my temporal position have changed? Clearly, I will be one hour further into the future, one hour closer to my death, and one hour further from my birth. So time does indeed pass at the rate of one hour per hour, or one second per second, or 3,600 seconds per hour …. (Maudlin 2007: 112)

One argument in response to the above claim that has surfaced a few times in the literature is the following:

(1) If time passes then time must pass at a rate of one unit per one unit, e.g. one second per second.

(2) There is no rate of one second per second (it is, rather, just a number).

Therefore,

(3) No literal movement is involved in the passage of time.

This argument is presented, for example, by Price (1997: 13), van Inwagen (2002: 59) and Olson (2009b: 8). Premise 2 of this argument is supported by the following reasoning: 'one second per second' means 'one second divided by one second', and one second divided by one second is one, which is simply a number and not a rate. However, that this line of reasoning has convinced anyone is puzzling. According to it, rates are like fractions, and so one can 'divide them through' to get a number. But even if some rates of change are fractions, those containing quantities (such as '*miles* per *hour*') are not and it makes no sense to 'divide them through' (consider the question: what is three *miles* divided by 24 *hours*?). So there is no reason to think that premise 2 is true. This (correct) response is given by Maudlin (2007: 193), Phillips (2009), Raven (2011b), Skow (2011) and Noonan (2015).

4.4. More recent objections to the moving spotlight view

So much, then, for the historical objections to the moving spotlight view. An objection of more recent vintage is the following:

(iii) *The Epistemic objection*
According to the moving spotlight view, all times exist, but only one is objectively the present moment. But at each moment of time at which thinking subjects like us exist, they believe, as we do, that the time they exist at is the objective present. But, the vast majority of thinking subjects are wrong in holding this belief, because only one time is objectively present. So we are probably wrong in believing that the time at which we currently exist is the objective present. For all we know, the objective present is temporally located in the year 3000, or the year 500 BC, and so for all we know we are located in the objective past, or the objective future. This is absurd, so the moving spotlight view is false.

In the literature the epistemic objection was first pressed by Craig Bourne (2002) and David Braddon-Mitchell (2004) against the growing block version of the pure becoming view. But it is equally applicable to the moving spotlight view, as Theodore Sider (2011: 261) has made clear. It is possible to sharpen the objection into an even more problematic form. To see this consider the following argument, given by Nicholas J. J. Smith, against those moving spotlight theorists who accept the existence of hypertimes. Smith asks us to consider a hypertime *t1* at which 1800 is present, and a later hypertime *t2* at which 1801 is present. He then asks us to consider what happens to someone located in 1800 as hypertime passes from *t1* to *t2*. His answer is 'Nothing':

> At hypertime t2 they are still there, in 1800, doing exactly what they were doing at t1. The now did not carry them along as it moved forward: it left them exactly when they were. Furthermore, apart from the fact that it is no longer the objective now, there is no difference whatsoever between the version of 1800 located at hypertime t2, and the version located at hypertime t1. (Smith, 2011: 246)

If we remember that the primary motivation for adopting the moving spotlight view is that it offers us a simple way to explain why it seems to us that time flows, it is possible to generalize Smith's objection as follows:

(iv) *The no explanation objection*
According to the moving spotlight view, all B-series moments exist, but only one is objectively the present moment. But at all times at which thinking subjects exist, it seems to them then, just as it seems to us now, that time flows. The moving spotlight view purports to explain why things seem this way to thinking subjects in terms of a 'moving' present. But consider Julius Caesar, who crossed the Rubicon in 49 BC. According to the moving spotlight view, 49 BC exists just as all other times exist, and Julius Caesar exists at that time and is crossing the Rubicon then. But it seems to Caesar in 49 BC that time is flowing just as much as it seems to us now in 2014 that time is flowing. But because there is only one moment that is objectively present, if 49 BC is that moment, then 2014 is not, and if 2014 is that moment, then 49 BC is not. So either it seems to Caesar that time flows in 49 BC even though he is not located at the objective present, or it seems to us that time flows in 2014 even though we are not located in the objective present. So being located at the objective present cannot be what explains why it seems to a thinking subject that time flows.

The no explanation objection is more powerful than the epistemic objection precisely because the former, unlike the latter, undercuts the primary motivation for accepting the moving spotlight view. Like the epistemic objection, it also applies equally to the growing block version of the pure becoming view. Whether it is fatal to either view is currently an open question. But, as we will see, there is one reply that can be given to the objection as it applies to the growing block version of the pure becoming view. And it is to pure becoming views that we now turn.

4.5. The pure becoming view

According to the pure becoming view, the universe as a whole is in a constant state of flux. As time passes, new states of affairs come into existence. On the presentist version, as new states of affairs come into existence, the old states of affairs go out of existence. On the growing block version, the old states of affairs continue to exist as the new come into existence. But on both versions, the moment that is objectively present is the most recent state of affairs to come into existence. Once more, the primary motivation for accepting the view is that it explains our experience of time's flow in a simple and natural manner. What we experience as the flow of time is the

continual coming into being of new states of affairs. We are located at the point of flux itself, and so undergo constant experiences of the coming into being of new states of affairs. For the presentist pure becoming theorist the moment of flux is the only moment of time there is. For the growing block pure becoming theorist the moment of flux is the leading edge of the growing block, the moment at which the new states of affairs come into existence to join the old. Both the presentist and growing block version of the view also explain, as the moving spotlight view was able to, our ordinary belief that there is a real difference between the present on the one hand, and the past and the future on the other. For the presentist version, the present is different from the past and the future simply because it exists while they do not. For growing block theorists, the present is different from the past and the future because it alone is the moment of flux itself. Pure becoming theorists also seem to have an advantage over B-theorists in being able to explain the direction of time in a simple manner – the direction of time is the order in which things come into being.

Growing block theorists also have an apparent advantage over both their presentist counterparts and B-theorists. Ordinarily we think that the past is fixed, but the future has at least a certain degree of openness: we think that all of what has been cannot now change, but that at least some things that are yet to come might not happen at all. On the growing block view this ordinary thought is easy to explain: the past exists but the future does not, and so the past *is* fixed and the future *is* open. This explanation is not available to either the presentist pure becoming view or the moving spotlight view. Whether or not this is a genuine advantage, however, is open to question, for it depends a great deal upon what it really means to say that the past is 'fixed' and the future 'open'. We return to this in detail in Chapter 6.

The pure becoming view, then, has many of the advantages of the moving spotlight view, particularly the advantage of being able to explain time's flow. However, pure becoming theorists do not think of their explanation of time's flow as being a mere alternative to the explanation given by the moving spotlight view. They believe it is superior. One reason for this is that moving spotlight theorists are committed to the view that time's flow involves changes in moments of time (or events) that are analogous to the changes that occur to objects. Just as an object can gain and then lose, say, the property of being red, moments of time can gain and then lose the property of being objectively present. But pure becoming theorists think that this is a confusion. Broad was the first to explicitly defend the pure becoming view, and he spells out the putative confusion in the following way:

> [B]ecoming is of so peculiar a character that it is misleading to call it a change. When we say that a thing changes in quality, or that an event

> changes in pastness, we are talking of entities that exist both before and after the moment at which the change takes place. But when an event becomes, it comes into existence; and it was not anything at all until it had become. (Broad 1923: 68)

There is a sense in which temporal passage involves a change on the pure becoming view, however. The change is one that involves reality *as a whole*; the entire extent of what *is* changes as time passes. Broad himself thinks that this is a 'simple and fundamental notion', and judging by the comments he makes shortly after raising the hypertime and rate objections to the moving spotlight view, he apparently thinks that saying this is in itself sufficient to show that the pure becoming view is immune to these objections (Broad 1938: 280–1). But it is not clear that Broad is right on this score. If the moving spotlight theorist needs to invoke hypertimes to explain how B-series moments can change, why does the pure becoming theorist not need to invoke them to explain how reality as a whole can change? And if it makes sense to ask for the rate at which B-series moments change, why does it not make sense to ask for the rate at which reality as a whole changes? Given that the defender of the moving spotlight view has responses available to the hypertime and rate objections, this is perhaps a moot point, as there seems to be no obvious reason why the pure becoming theorist could not adopt the same responses. But this does illustrate that, if one finds those responses unconvincing, one cannot easily avoid the objections in question by adopting a pure becoming view.

As we mentioned, the growing block version of the pure becoming view is also susceptible to the epistemic objection and the no explanation objection. Given that the past exists on the growing block view, and contains thinking beings who believe that the moment they exist at is present, how do we know that we are not in their situation? And if those past beings experience the flow of time even though they are not located at the point of flux, how can being at the point of flux explain our experience of time's flow? Peter Forrest (2004) has offered a growing block response to the epistemic objection. His idea is that it is only those who exist at the edge of the growing block who are conscious beings. Consciousness itself, he argues, arises from the 'causal frisson' that occurs at the point of flux. So, although the past exists and contains beings who are like us in some respects (they are physical entities just as we are), they are not like us in all respects, as, in particular, they are not conscious. This is not to say that they weren't once conscious, of course. They were conscious when the time they are at was the point of flux, but the time they are at is not now the point of flux, and so they are not now conscious. How, then, do we know that we *are* at the point of flux, i.e. in the objective present? Simply because we are conscious, and we know

that we are conscious (it is a fact which, presumably, we can know by introspection; Forrest 2004: 359). Although Forrest gives this as a response to the epistemic objection, if sound it also serves as a response to the no explanation objection. The reason why past people, like Caesar, do not experience time's flow at the moments at which they exist is for the simple reason that they have no experiences at all at those moments. They once did have experiences, including the experience of time's flow, i.e. when the moment they exist at was the point of flux, but they do not do so now. It is only those like us who are located at the point of flux who have experiences, and so only those like us who experience time's flow.

Forrest's response to the epistemic and no explanation objections, known as 'the Dead Past Hypothesis', certainly overcomes those objections, but accepting it brings its own problems. As Christopher Heathwood has argued, if the hypothesis is true, it makes it difficult for the growing block theorist to explain how sentences attributing consciousness to past beings can be true. A general principle that many metaphysicians subscribe to is the principle that if a sentence is true it must be grounded by some aspect of reality – i.e. sentences are made true by how things *are*. (This is often known as the 'Truthmaker Principle'.) According to the Dead Past Hypothesis Caesar exists in 49 BC, but is not conscious. This is how things *are*, so they can explain why Caesar is not conscious in 49 BC. But even if it is not true that Caesar *is* conscious in 49 BC, it is certainly true that Caesar *was* conscious in 49 BC. This is, for sure, a truth that is expressed in the past tense, but it is a truth nonetheless. The problem for the Dead Past Hypothesis is that nothing about how things *are* can explain why this is true. This is an ontological objection to the Dead Past Hypothesis, and we say no more about it here, for as we will see in Chapter 5, a similar objection also dogs presentism, and many reject presentism precisely because of the trouble it has accounting for past-tensed truths. The salient point to note here is that many adopt the growing block view because it enables them to account for past-tensed truths more easily than presentism. But if Heathwood is right, then adopting the Dead Past Hypothesis leaves growing block theorists no better off than presentists, and so undercuts this reason for holding the view (Heathwood 2005: 250–1).

At least *prima facie*, presentist versions of the pure becoming view are immune to the epistemic and no explanation objections. On the presentist version of the view, it seems, we can easily know that we are currently in the objective present simply because no other times than it exist. And, it seems, it is easy to explain why we experience time as flowing whereas past individuals do not. Past individuals do not exist, so do not experience anything at all, and so *a fortiori* do not experience time as flowing. This is the view taken by, for example, Bourne (2006b: 24), Braddon-Mitchell (2004: 199), Heathwood (2005: 50) and Sider (2011: 261–2). However, Ross Cameron has

recently argued that presentism is susceptible to the epistemic objection. He argues that appealing to the fact that presentism entails that we are now in the objective present doesn't help to solve the epistemic problem of how we know that we are in the objective present, but merely pushes the question back to how we know that presentism itself is true, which is a question that he thinks is just as difficult to answer as the original question:

> Presentism entails that we are present. If presentism is true then we cannot wrongly think that we are present. But this does not secure our knowledge that we are present, unless we can come to *know* that presentism is true. And, so far, this looks like no easier an epistemic problem than the one we started with: knowing that *everything* is present is, if anything, harder than knowing that *you* are. (Cameron 2015: 45)

Nonetheless, Cameron thinks that there is a solution to the epistemic objection that is available to pure becoming theorists and moving spotlight theorists alike. He argues that each can adopt an account of knowledge according to which we do not have to have any subjective evidence that the moment we exist at is objectively present in order to know that it is so. So long as the present moment *is* objectively present, and we are hooked up to it in the right way, then we know it is present, on this view (Cameron 2015: 49–50). The account of knowledge appealed to by Cameron is known as 'externalism', and so his response depends upon whether externalism is a viable theory of knowledge. Many think that it is, but others disagree. To fully assess externalism here would take us too far afield, but for further discussion and references see Pappas (2014).

The moving spotlight view, and the two versions of the pure becoming view, are metaphysical through and through. Each involves a substantial ontological claim, and combines it with a direct metaphysical claim about how reality is that makes time dynamic. The moving spotlight view combines the ontological claim that past, present and future moments exist (eternalism) with what we might call the *direct* metaphysical claim that one moment is distinguished from all others by the possession of a special property, the property of being present, which is had successively by different moments of time. The first version of the pure becoming view combines the ontological claim that only the present exists (presentism) with the *direct* metaphysical claim that new moments of time are constantly coming into being, and as they do, the old ones go out of existence. And the second version of the pure becoming view combines the ontological claim that the past and present exist but the future does not (the growing block view) with the *direct* metaphysical claim that the sum total of what exists is constantly increasing, with new moments of time constantly coming into existence to join the moments that already

exist. We here emphasize the *directness* of the metaphysical claims involved in each of these views because there is a substantial literature in which the issues involved in these claims are treated as having counterparts of at least equal importance that are more semantic in nature. These are issues related to the truth and meaning of tensed sentences in our language, and involve questions such as: What do tensed sentences mean? How does the world have to be if tensed sentences are true? Most agree that questions such as these are important and that they have metaphysical consequences (although see Heil 2003 and Dyke 2008 for denials of this claim). And some even take them to be the primary battleground between the A-theory and the B-theory. It is to that battleground we now turn.

4.6. The serious tenser view 1: The old B-theory of time

The literature on the serious tenser view is voluminous, and much of what has been written involves the use of technical apparatus from the philosophy of language. Here we content ourselves with describing the development of the debate in broad outline.

Grammatically tensed sentences are ubiquitous in natural language. In English tense is expressed in a variety of ways, often via the use of a copula, as in:

(i) Smith *is* happy. (Present tense.)

(ii) Smith *was* happy. (Past tense.)

(iii) Smith *will be* happy. (Future tense.)

And often via an alteration in the verb form, as in:

(iv) Smith *runs*. (Present tense.)

(v) Smith *ran*. (Past tense.)

(vi) Smith *will run*. (Future tense.)

But tense is also expressed using a wide variety of other devices (including adverbs such as 'now' and 'yesterday', adjectives such as 'past' and 'present', prepositional phrases such as 'at present' and 'in two days' time') (see Craig 2000a: 4–5). But however tense is expressed, as D. H. Mellor has noted, the important point is that tensed sentences express 'how near or far from the present, past or future, something is' (Mellor 1981: 4). Thus (i) and (iv) express how things *are* (i.e. in the present) and so are present tensed, (ii)

and (v) express how things *were* (i.e. in the past) and so are past tensed and (iii) and (vi) express how things *will be* (i.e. in the future) and so are future tensed. Taken at face value such sentences seem to express A-facts, i.e. facts precisely about how things are in the present, were in the past or will be in the future. So, taken at face value, if these sentences are to be true then it seems that reality must itself be tensed in some sense. This is the serious tenser view:

> The serious tenser view: In order for tensed sentences to be true reality itself must be tensed in some way.

So although many of the claims serious tensers make are semantic claims about the relationship between language and the world, the view has metaphysical consequences. What are those consequences? At least *prima facie*, it seems that if the serious tenser view is true, and so there are tensed facts, then there must be a privileged temporal position, *viz.* the present, according to which they obtain. Consider the tensed sentence 'Churchill was Prime Minister', for example. According to serious tensers this expresses the tensed fact *that Churchill was Prime Minister*. This fact obtains now but did not obtain two-hundred years ago. So the present must in some way be privileged over the past with regard to the obtaining of this fact. And if this is true, then it seems that at least one of the metaphysical A-theory views described above must also be true. And in fact many do combine the serious tenser view with some metaphysical version of the A-theory. Prior (2003: chapter 1) for example, combines the serious tenser view with presentism, Tooley (1997) combines it with the growing block view and Cameron (2015) combines it with the moving spotlight view. However, recently Kit Fine (2006b) has argued forcefully that one can be a serious tenser *without* holding that there is a privileged temporal position according to which tensed facts obtain. Instead, Fine argues, one can maintain that reality is 'non-Absolute' such that contrary tensed facts (e.g. the fact that I am presently sitting and the fact that I am presently standing) obtain relative to different times, or one can maintain that reality is 'fragmented' such that contrary tensed facts can obtain together (Fine 2006b: 401–2). The details of Fine's argument will not matter here. The important point is that if he is right then the serious tenser view does not entail any of the previous metaphysical A-theory views. Nonetheless, because B-theorists deny that reality is non-Absolute and fragmented, what is clear is that if the serious tenser view is true, then the B-theory must be false. Consequently, B-theorists defend the view that the meaning and truth of tensed sentences can be explained in tenseless terms.

The earliest attempt to explain the meaning and truth of tensed sentences without admitting A-facts involved an attempt to offer a wholesale translation

of tensed sentences into tenseless sentences, i.e. a way of producing, for every tensed sentence, a tenseless sentence that is synonymous with it. There were two proposals for how this was to be done, but both are now generally considered to fail for the simple reason that the proposed translations are not, in fact, synonymous with the original tensed sentences. This abandoned view is known as 'the old B-theory of time'. It has been replaced by 'the new B-theory of time'. Those who defend the new B-theory admit that there are tenseless sentences that cannot be translated into tenseless ones, but maintain that this is not of particular importance. Early defenders of the new B-theory claimed that what is important is that tenseless truth-conditions can be given for every tensed sentence. This claim has faced heavy criticism, and more recent defenders of the new B-theory instead claim that what is important is that, for every tensed sentence, there is a tenseless fact that makes it true.

Defenders of the old B-theory endorsed the following argument:

(1) If a sentence S1 is synonymous with another S2, and S2 does not require the existence of A-facts in order to be true, neither does S1.

(2) Tenseless sentences do not require the existence of A-facts in order to be true.

(3) For every tensed sentence there is a tenseless sentence that is synonymous with it.

Therefore,

(4) Tensed sentences do not require the existence of A-facts in order to be true.

The key claim of the old B-theory is given by premise 3, and old B-theorists attempted to show that it is true by giving a way to translate tensed sentences into tenseless ones. There were in fact two distinct proposals about how to do this: the 'date-sentence' proposal, and the 'token reflexive' proposal. The first was developed in slightly different ways by Bertrand Russell (1940) and Gottlob Frege (1956), among others. And the second was developed in slightly different ways by Hans Reichenbach (1947) and J. J. C. Smart (1963), among others. Here we focus on problems facing the date-sentence proposal (although similar problems face the token reflexive proposal too).

Take as examples the sentences from the first group above:

(i) Smith is happy. (Present tense.)

(ii) Smith was happy. (Past tense.)

(iii) Smith will be happy. (Future tense.)

Clearly token utterances of these sentences can differ in truth value. If Smith will be happy on 1 January 2020, but sad on 2 January 2020, then a token utterance of (i) made on 1 January 2020 will be true, and a token utterance made on 2 January 2020 will be false. Those who proposed the date-sentence analysis of tensed sentences took considerations of this sort to indicate that distinct tokens of the same tensed sentence type have different meanings, and thus to show that what was needed if their proposal was to succeed was a translation of tensed sentence tokens rather than tensed sentence types. Let us suppose that tokens of each of these sentences are uttered by Jones on 1 January 2014 at 3 p.m. According to the date-sentence proposal in uttering these sentences Jones expresses what the following sentences express:

(DSi) Smith is happy at 3 p.m. on 1 January 2014.

(DSii) Smith is happy at some time earlier than 3 p.m. on 1 January 2014.

(DSiii) Smith is happy at some time later than 3 p.m. on 1 January 2014.

In these sentences the 'is' is not to be understood as expressing the present tense. It must, rather, be understood in a tenseless manner (i.e. in much the way that we would understand it in the sentence 'the number three is odd'). According to the date-sentence analysis, then, if Jones had uttered (DSi), (DSii) and (DSiii) instead of (i), (ii) and (iii), he would have expressed exactly the same thing as he did in fact express. Of course, if Jones utters tokens of sentences (i), (ii) and (iii) at a different time and date, say 4 p.m. on 2 January 2014, then he does not express what (DSi), (DSii) and (DSiii) express. But, according to the date-sentence analysis, instead he expresses what a different set of tenseless sentences express ('Smith is happy at 4 p.m. on 2 January 2014', etc.). By offering translations such as these the defenders of the date-sentence proposal took themselves to have shown that all tokens of tensed sentences can be translated into sentences that do not involve tense, but only the B-relations of *earlier than* and *later than* along with a reference to a particular time and date. But they were wrong. To see why consider (i) and (DSi) once more:

(i) Smith is happy.

(DSi) Smith is happy at 3 p.m. on 1 January 2014.

According to the date-sentence analysis, at 3 p.m. on 1 January 2014, Jones could have used either of these two sentences to express precisely the same thing. But suppose that you hear Jones's utterance of (i) at that time and date, and come to know that what Jones expresses using (i) is true as

a consequence. Now ask: would you thereby be in a position to know that what (DSi) expresses is true? The answer is 'no'. This is for the simple reason that you might not know what the time and date is when Jones utters (i). It follows from this that (i) and (DSi) cannot express the same thing, i.e. that they are not synonymous. One might say in this case that (DSi), in expressing what time and date Smith is happy at, expresses *more* than (i) does. Now consider that you are planning on visiting Smith, but you know he is no fun to visit when he is not happy. As a rational decision maker, then, you will only make a decision to visit Smith at a time when you know he is happy. Now suppose further that at 3 p.m. on 1 January 2014 Jones utters (DSi) instead of (i), and one comes to know what it expresses as a consequence. Now ask, on the basis of knowing (DSi), would you be in a position to make the decision to visit Smith? The answer is 'no', for once more, you might not know what the time and date is when Jones utters (DSi). However, were Jones to utter (i) instead of (DSi), one *would* then be in a position to make the decision to visit Smith. So one might say in this case that, in giving you information that allows you to make a rational decision about visiting Smith, (i) expresses *more* than (DSi). So it is clear that (i) and (DSi) do not mean the same thing. Although it is not immediately obvious why, arguments of a similar ilk apply to all attempts that have been made to offer translations of tensed sentences into tenseless ones. (For references see the end of the chapter.) So the old B-theory is generally considered to have been refuted.

4.7. The serious tenser view 2: The new B-theory of time

Defenders of the new B-theory reject the claim that tokens of tensed sentences can be translated into tenseless ones. But they argue that despite this, true tensed sentences do not require the existence of tensed facts. As with the old B-theory, a variety of different versions of the new B-theory have been developed (by e.g. Smart 1980, Beer 1988 and Oaklander 1991, among others). Here we focus on the version developed by Mellor in his 1981 book *Real Time*. He describes his position as follows:

> Past, present and future tense statements – e.g. a clock saying (in effect) 'It is now two o'clock' by chiming twice – are objectively true quite independently of consciousness or of anything else subjective. Physical facts alone suffice to make them true or false. What makes a clock's chiming two true, if it is, is its chiming two at two o'clock; and there is nothing subjective or psychological about that … But nor is there anything tensed about it.

> Like other specimens or "tokens" of present tense sentences, the chime is true if and only if it occurs at the same time as it asserts to be present, in this case two o'clock, whether that is now the present time or not. Similarly for tokens of future tense sentences, which are true if and only if suitably earlier than their subject matter: e.g. 'The train will arrive in ten minutes' is true just in case it is said ten minutes before the train arrives. Similarly for past tense tokens, true if and only if suitably later than their subject matter: 'Today is the Queen's fiftieth birthday' is true if said fifty years after her birth and false otherwise. So far as time goes, in short, the truth of a tensed statement depends only on how much earlier or later it is made than whatever it is about. Whether its subject matter is also past, present or future is irrelevant to its truth; so such statements can quite well be objectively true or false even though nothing in reality is past, present or future at all. (Mellor 1981: 5)

The view Mellor defends here is that tenseless truth-conditions can be given for all tokens of tensed sentences. Because one gives the truth-conditions of a token sentence by specifying the circumstances that obtain if and only if the token sentence is true, Mellor thus endorses the following argument in *Real Time*:

(1) If a token t of a sentence S is true if and only if certain circumstances obtain that can be specified in tenseless terms, then t does not require the existence of tensed facts in order to be true.

(2) All tokens of tensed sentences are true if and only if circumstances obtain that can be specified in tenseless terms.

Therefore,

(3) No token of a tensed sentence requires the existence of tensed facts in order to be true.

However, despite their improvement on the old B-theory, early versions of the new B-theory like Mellor's have come under considerable fire, and a battery of arguments have been presented against them. Many of these objections focus on the technical issues from the philosophy of language mentioned earlier (to give just one example, on whether or not temporal indexicals such as 'now' and 'yesterday' express what are known as 'Fregean senses' – see Dyke 2003 for discussion). Others have exploited the fact that early new B-theorists seem to mean different things by the term 'truth-conditions', and the fact that many, including Mellor in *Real Time*, are not always clear about what they mean by the notion. (Above we glossed this notion in terms of specifying the circumstances that obtain if and only if a sentence is true, but precisely what this gloss

amounts to is itself unclear.) Indeed, L. Nathan Oaklander, himself an ardent defender of the new B-theory, claims to find four distinct uses of the notion in the literature (Oaklander 2003: 273). And according to William Lane Craig, no matter precisely how the term 'truth conditions' is used, the notion must remain a semantic one, and so cannot serve the B-theory's purpose anyway:

> The giving of truth conditions is a semantic exercise; specifying grounds for a statement's truth concerns ontology. One can lay out semantic conditions which will permit one to determine for any sentence whether that sentence is true or false without saying anything at all about the ontological facts which make the sentence true. (Craig 1996: 22)

Under pressure from objections such as these, new B-theorists have now largely abandoned the term 'truth-conditions' altogether, and now state their view in ontological terms. Led by Mellor (1998) (in an updated version of *Real Time* called '*Real Time II*'), they now make the ontological claim that all tenseless sentences are *made true* by B-facts (this is the notion of Truthmaking again that we will consider further in the next chapter), and endorse the following argument:

(1) If a token t of a sentence S is made true by B-facts, then t does not require the existence of tensed facts in order to be true.

(2) All tokens of tensed sentences are made true by B-facts.

Therefore,

(3) No token of a tensed sentence requires the existence of tensed facts in order to be true.

So, for example, they claim that if a token of (i) ('Smith was happy') is truly uttered at a time *t*, it is made true by the B-fact that Smith is happy at some time before *t*. In making this move, however, the new B-theorists have not answered all of the objections made against their view, and whether the *new* new B-theory view is successful is still very much up for grabs. Readers are encouraged to consult the further reading in order to follow up on developments in the literature.

4.8. Summary

In this chapter we have outlined three A-theory views according to which time is, in some sense, dynamic. We have looked at the reasons we have

for holding each view, and considered a number of historical and contemporary objections to each. We noted at the start of the chapter (in section 1.1) that A-theory and B-theory views have an ontological component. We said that moving spotlight theorists and B-theorists believe that the past, present and future all exist, presentist pure becoming theorists believe that only the present exists and growing block pure becoming theorists believe that the past and the present exist, but the future does not. In the next chapter we consider these ontological views themselves in more detail.

Study Questions

1. What is the difference between the moving spotlight view and the pure becoming view? Which is *prima facie* more plausible?
2. We describe the moving spotlight view and the pure becoming view as being 'metaphysical through and through'. What does this mean? In what way does the serious tenser view differ?
3. What are the hypertime, rate, epistemic and no explanation objections? Do any of them (and if so which) give us reason to reject any of the A-theoretic views we discuss?
4. What is the difference between the old and new B-theory of time? Is the new B-theory an improvement over the old?

FURTHER READINGS

The literature on the A-theory/B-theory debate has many strands to it. To follow up on specific strands the reader should follow the references given in the text above. Williams (1951) and Smart (1963) are two classic defences of the B-theory worth emphasizing, and many of the papers in Prior (1968/2003) are classic defences of the A-theory (see, in particular, Chapters 1, 8, 9 and 14). Craig (2000a, 2000b) gives a spirited defence of the A-theory, but also offers an excellent overview of many of the issues covered in this chapter. Zimmerman (2008) also defends the A-theory while giving a good general overview of the debate. The most important defence of the B-theory is Mellor (1981, 1998). Two useful collections on the serious tenser view and the new B-theory of time are Oaklander and Smith (1994) and Jokic and Smith (2003). Finally, one objection to the B-theory that we have not discussed but cannot go without mention is Prior's 'Thank Goodness That's Over' objection. This hugely influential objection is found in Prior (1959). For responses that also include an overview of the ensuing literature see Dyke and Maclaurin (2002) and Beer (2008).

5

Presentism vs. eternalism

This chapter examines the debate between presentists, who believe that only the present exists, and eternalists, who believe that all times are equally real. We start with an attempt to understand these views in more detail, before distinguishing between a number of presentist views. We then consider a range of objections to presentism, and end with a discussion of eternalism and one further view, the growing block view. Sections 5.2 and 5.3 contain some difficult material, and readers may wish to skip over some of the more technical aspects of these sections on a first reading.

Does the past exist? Does the future? Or is the present the only time there is? These questions are *ontological* questions, and have generated a great deal of discussion in the contemporary literature. The two main answers that have been given were introduced in the previous chapter:

Presentism: Only presently existing things exist (past and future things are not real).

Eternalism: Past, present and future things all exist (they are just as real as each other).

In this chapter we begin with an attempt to understand these views more precisely (having a clear view of this is crucial for engaging with the current literature), before focusing on the main metaphysical arguments that have been given against presentism, paying special attention to one called 'the Truthmaker objection'. There is also another major objection to presentism, the argument from special relativity, that we postpone treatment of until Chapter 10 where we specifically consider the implications that modern

physics has on the metaphysics of time. There are also arguments against eternalism, but these tend to have a wider applicability, and so are dealt with elsewhere in this book (we indicate where in section 5.7 below). And there is also another ontological view about time that we introduced in the previous chapter, i.e.:

> The growing block view: Only past and present things exist (past and present things are just as real as each other, but future things are not real).

However, despite having some notable defenders (e.g. Broad 1923; Tooley 1997; Button 2006), the growing block view is not currently a popular view, and attracts far less discussion than either eternalism or presentism. The main reason for this is that the growing block view, ontologically speaking, is a half-way house between presentism and eternalism. Growing block theorists agree with eternalists but disagree with presentists about whether the past exists, and they disagree with eternalists but agree with presentists about whether the future exists. This means that growing block theorists inherit many of the problems of both views, as well as facing problems of their own. (For more on this see section 5.7 below.)

We begin in section 5.1 with a general worry about the debate between presentists and eternalists. This is the worry that, in fact, presentists and eternalists are not in genuine disagreement with each other and that the debate between them is in fact a 'merely verbal' dispute. Considering this debate will enable us to frame presentism and eternalism more precisely. Equipped with this clearer understanding, in section 5.2 we consider how presentists and eternalists understand tensed sentences, and frame one particular version of presentism – 'primitivist presentism'. In section 5.3 we briefly draw some parallels, that many believe to be instructive, between presentism and eternalism on the one hand, and views in the philosophy of modality on the other, which allows us to frame a different version of presentism – 'ersatzer presentism'. We then turn to the major metaphysical objections to presentism. In section 5.4 we consider the biggest metaphysical objection of all – the Truthmaker objection, *viz.* that presentists cannot say what makes past- and future-tensed sentences true. In section 5.5 we examine some presentist responses to this objection. In section 5.6 we consider some further objections to presentism. We then briefly return to eternalism and the growing block views in section 5.7.

5.1. Is the presentism/eternalism debate merely verbal?

In order to get a feel for this issue, consider the following sentence:

S1: Dinosaurs exist.

Presentists deny S1, while eternalists endorse it. It has been suggested, however, that in so doing presentists and eternalists must understand S1 to mean different things. Furthermore, the suggestion continues, what presentists deny on their understanding is actually something that eternalists would also deny, and what eternalists endorse on their understanding is something that presentists would also endorse. If this is right, then presentists and eternalists do not in fact disagree about anything substantive. The suggestion concerns the meaning of the term 'exists' and its cognates. 'Exists' can be understood in either a tensed or a tenseless way. Understood in the tensed way 'exists' means something like 'exists now'. But understood tenselessly, 'exists' is equivalent to the disjunction 'exists now, or have existed, or will exist'. So S1 is ambiguous between the following:

S1*: Dinosaurs exist now.
S1**: Dinosaurs exist now, or have existed, or will exist.

So, the suggestion is that presentists, in denying S1, understand it as expressing what S1* expresses, while eternalists, in endorsing S1, understand it as expressing what S1** expresses. So presentists and eternalists understand S1 to mean two different things. Moreover, if the suggestion is correct, as eternalists would deny S1* just as presentists do, what presentists deny in denying S1 is something that eternalists would also deny. And as presentists would endorse S1** just as eternalists do, what eternalists endorse in endorsing S1 is something that presentists would also endorse. So, there is not really any substantive disagreement between presentists and eternalists. It is a merely verbal one regarding how we should understand the term 'exists'. (For expressions of this sceptical worry see, e.g. Crisp 2004, Meyer 2005 and Noonan 2013.)

The sceptic who denies that the debate between presentists and eternalists is substantive thus puts forward a view according to which 'exists' can *only* be understood in two ways, *viz.* either as 'exists now' or as 'exists now, or have existed, or will exist'. If the sceptic is right, then even the statements of presentism and eternalism given above are problematic. Consider the statement of presentism once more:

Presentism: Only presently existing things exist.

Substituting in the sceptic's two suggested meanings of the term 'exists' gives us the following:

Presentism*: Only presently existing things exist now.
Presentism**: Only presently existing things exist now, or have existed, or will exist.

But Presentism* is trivially true, and Presentism** is obviously false. Now consider the statement of eternalism once more:

Eternalism: Past, present and future things all exist.

Substituting in the sceptic's two suggested meanings of the term 'exists' once more gives us the following:

Eternalism*: Past, present and future things all exist now.
Eternalism**: Past, present and future things all exist now, or have existed, or will exist.

But Eternalism* is obviously false, and Eternalism** is trivially true.

According to the sceptic, Presentism* and Presentism** are the only two possible versions of presentism, and Eternalism* and Eternalism** the only two possible versions of eternalism. So, if the sceptic is right, presentism is trivially true and eternalism obviously false (if 'exists' is taken to mean 'exists now') or presentism is obviously false and eternalism trivially true (if we take 'exists' to mean 'exists now, or have existed, or will exist'), and there is no way to frame either of the views in a way that both makes them non-trivial and gives them a chance of being true.

The standard response to the sceptic is to deny that 'exists' can only be understood in the two suggested ways. And the usual way of developing this response is to maintain that there is available to us a way to speak about absolutely every object that there is – i.e. no matter where, when or perhaps even how it exists. In the parlance of modern metaphysics (which takes its cue from the language of first-order predicate logic) we can *quantify unrestrictedly* over everything that there is, and so we can take 'exists' to express such a quantification. 'Exists', taken in this way, is said to mean 'exists *simpliciter*'. (See, e.g. Oaklander 2002: 75, Brogaard 2012: 159, Callender 2011a: 80, Wuthrich 2012: 442.)

To gain a better understanding of this notion consider looking in the fridge and saying 'There are no tomatoes'. By saying this one would not mean to

be taken as saying that there are no tomatoes anywhere, i.e. that tomatoes do not exist anywhere in the world. One would mean to be taken as saying that, *in the fridge*, tomatoes do not exist. Perhaps one's sentence is really an ellipsis for 'There are no tomatoes in the fridge', but many would consider sentences like this to be better understood as involving *restricted* quantification. Understood in this way, one is making a straightforward existence claim, but in so doing one is simply restricting one's attention to what's in the fridge. If we use the subscript '$_{\text{fridge}}$' to indicate the way in which the quantifier is restricted in the claim about tomatoes given above, we can express the restricted quantificational claim as follows:

- It is not the case that there exists$_{\text{fridge}}$ tomatoes

Now consider S1 again:

S1: Dinosaurs exist.

It is fairly obvious that most of us would not normally admit that this sentence is true, but eternalists endorse it. Are they therefore committed to believing something most of us would normally deny? Eternalists claim not, and explain this by saying that when we normally make claims such as this we are using the present tense, and in so doing we are using restricted quantification – we are, that is, restricting our attention to the present time, i.e. to what exists now. Similarly, eternalists say, past- and future-tensed uses of the term 'exist', such as that in 'Dinosaurs existed', and in 'Dinosaurs will exist', involve restricted quantification where we restrict our attention to those things that exist in the past and the future respectively. But, eternalists also maintain, we can also use 'exists' without any restrictions at all. When we do so, past, present and future things are all included within the scope of our quantifiers. So we can understand S1 as saying:

S1***: Dinosaurs exist *simpliciter.*

S1*** means that, quantifying absolutely unrestrictedly over everything that there is, dinosaurs exist. And this, eternalists claim, is true. Crucially, presentists can agree with eternalists about the possibility of absolutely unrestricted quantification, but claim that when we do quantify absolutely unrestrictedly, because there are no past and future things, we only quantify over presently existing things. That is, presentists can agree that S1 is to be understood as expressing S1***, but deny that it is true *when understood in this very way*. If this is right then the debate is restored to being a substantive one, and both presentism and eternalism can be

stated in terms that both makes them non-trivial and gives them a chance of being true, i.e. as:

Presentism***: The only things that exist *simpliciter* are present things.
Eternalism****: Past, present and future things all exist *simpliciter.*

Some have developed the claim that we can quantify absolutely unrestrictedly further (e.g. Sider 2006). Others have mounted direct arguments against this claim (e.g. Meyer 2005). But we will pursue this issue no further here, and assume from hereon that the debate between presentists and eternalists is a substantive one, and understand the two views as they are given by Presentism*** and Eternalism***. (In order to remind the reader, throughout this chapter and in later chapters when relevant we will use the subscript '$_{\text{simpliciter}}$' whenever we express an existence claim that is to be taken to be one made using absolutely unrestricted quantification.)

One question that arises from consideration of the above is the question of how presentists understand tensed sentences. Consider the past-tensed version of S1:

S2: Dinosaurs existed.

We have seen that eternalists understand this sentence to be a sentence in which we quantify restrictedly over past things. If we use subscripts again (e.g. '$_{\text{past}}$') to indicate the way in which the quantifier is restricted, we can express how eternalists understand S2 as follows:

S2*: There exist$_{\text{past}}$ dinosaurs.

This entails:

S3: There exist$_{\text{simpliciter}}$ dinosaurs.

Presentists deny S3, so because S2* entails S3, they cannot understand S2 to mean S2*. They cannot, that is, take S2 to quantify over past things, as they believe that there are no past things. So how do presentists understand S2? In fact, there are two broad ways in which presentists have understood S2. The first involves understanding it in terms of primitive tense operators (these were mentioned in section 4.3). Such presentists are known as *primitivist* or *non-reductive* presentists. The second involves understanding it in a similar way to eternalists, but with the quantifiers ranging over abstract entities rather than genuine past entities. Such presentists are known as *reductive* or *ersatzer* presentists. We take these two versions of presentism in turn.

5.2. Primitivist/non-reductive presentism

Although some historical figures seem to hold presentist views (e.g. Augustine, discussed in Chapter 1), Arthur Prior was the first to develop presentism in detail (see e.g. Prior 1967 and many of the papers in Prior 1968/2003). His basic position is that all talk of time, and all tensed talk, can be understood as involving primitive tense operators. But what are primitive tense operators? An operator is a term that attaches to a sentence to make a new sentence. To say that an operator is 'primitive' is to say that it is conceptually basic and so cannot be defined in more basic terms. There are many operators (e.g. 'It is not the case that' is a simple operator which we can attach to sentences such as 'Snow is white' to form new sentences such as 'It is not the case that snow is white'), but the ones of immediate interest here are the temporal operators 'It was the case that' and 'It will be the case that'. These attach to sentences to form new tensed sentences. And it is these operators (sometimes along with a variety of other similar ones) that primitivist presentists such as Prior appeal to in analysing tensed sentences such as S2. According to primitivists S2 is not a simple quantificational sentence at all, but rather a sentence containing the past-tense operator 'It was the case that' with a quantificational sentence within its scope (or, as it is sometimes put, 'embedded within it'). If we use capitals ('WAS') to express past-tense operators, we can express how primitivists understand S2 as follows:

S2**: WAS: there exist$_{\text{simpliciter}}$ dinosaurs

Similarly whereas eternalists think that future-tensed sentences such as 'There will be people living on Mars' are to be understood as quantifying over things that exist in the future, primitivist presentists think that such sentences are to be understood as containing a future-tensed operator with a quantifier embedded within its scope (i.e. as 'WILL: there exist$_{\text{simpliciter}}$ people living on Mars'). Crucially, presentists of this ilk claim that sentences that occur within the scope of a tense operator are not existentially committing. So, for example, because the claim that there exists$_{\text{simpliciter}}$ dinosaurs is within the scope of the past-tense operator 'WAS' in S2**, primitivist presentists deny that S2** entails S3, and in this way they believe that they can avoid a commitment to the existence$_{\text{simpliciter}}$ of dinosaurs. Although it *was* the case that dinosaurs exist$_{\text{simpliciter}}$, they claim, it is not *now* the case that dinosaurs exist$_{\text{simpliciter}}$.

One important point to note about primitivist presentism is this: it seems that primitivist presentists, despite maintaining that only the present exists, still need to find some way to talk about non-present *times*. (See Meyer

2009a, 2009b.) Of course, no presentist can say that non-present times are, or contain, genuine entities. But they do need to avail themselves of *talk* about non-present times and entities, even if such talk is really, at bottom, talk about the present time and what exists at it. The reason for this is that primitivist presentists, like everyone else, must be able to express obvious truths about the past in sentential form, and explain their meaning in a systematic way by giving their truth-conditions. And it is here where talk about times is needed. We do not go into the full details of why this is so here, but in order to grasp the basic idea note that S2, even for the eternalist, does not seem to require an explicit commitment to the existence of *times* themselves (i.e. as entities in their own right) – all it requires is that there is some realm of being called 'the past' in which dinosaurs exist. But compare S2 with:

S4: Caesar once crossed the Rubicon.

Intuitively, while S2 says simply that dinosaurs exist in 'the past' (i.e. taken as a realm of being), S4 says that *at some specific but unspecified past time* Caesar crossed the Rubicon. In other words, the truth-conditions of this sentence seem to require not only that there be objects that exist in 'the past', but also that there exist *times* at which past objects exist and events occur. Eternalists can deal with sentences like S4 easily enough. They can take times to be basic entities that exist in the past and at which things exist and have properties at, or they can construct them out of past things themselves. (Taking the first option is to adopt a substantivalist position, and taking the second a relationist position – these views are discussed in Chapter 2.) Consider also the following sentences:

S5: Caesar crossed the Rubicon in 49 BC.
S6: Caesar crossed the Rubicon five years before he was assassinated.
S7: In 49 BC, Caesar bathed six times.

These sentences too seem either to express direct truths about times themselves (and relations between them), or it seems that their truth-conditions must be given in terms of times (and relations between them). It seems that S7, for example, is true iff there are six *times* in 49 BC at which Caesar bathed. Either way, eternalists can deal with these quite simply, just as they can deal with S4, by an appeal to genuine times. But primitive presentists cannot. So what can they do? Many primitive presentists, recognizing this problem, either introduce further primitive tense operators (e.g. *metrical* tense operators such as 'it was the case 35 years ago that'), or introduce times as *abstractions*. This latter option involves defining times (as abstract entities)

in terms of the past- and future-tense operators. One specific suggestion on this score comes from Arthur Prior himself, who defines times in terms of maximally consistent sets of propositions (a proposition is, roughly, what a sentence expresses) that themselves contain past- and future-tense operators. A maximally consistent set of propositions can be thought of as a full specification of how the world could be (in this case, at a particular time). So, for example, a particular time in 49 BC is thought to be the set of propositions that express everything that *was* true at that time, including tensed truths about what *was* and *will be* the case from the perspective of that time. In this way, Prior has the resources to talk about times, and is able to make use of them in giving the truth-conditions of tensed sentences, without giving up on the idea that all talk about tense and time is ultimately cashed out in terms of primitive tense operators. Times, on this view, are simply abstractions that are defined in terms of primitive tense operators.

There have been various objections to attempts like Prior's to construct times in terms of primitive tense operators. According to one important set of objections the attempt to do so fails because there remain sentences expressing truths about the past and future that cannot be adequately expressed or explained using this method (again, see Meyer 2009a, 2011). According to another more recent objection, the Truthmaker objection, even if primitivist presentists are able to express and give the truth-conditions for all the required tensed sentences, their account still fails because they are not able to explain in a plausible way what *makes* tensed sentences true. The idea is one that should be familiar from section 4.7. As we saw there, giving the truth-conditions for tensed sentences is a semantic exercise, while specifying what *makes* a sentence true concerns ontology. And according to the Truthmaker objection primitivist presentists cannot appeal to abstract times, constructed in terms of primitive tense operators, to explain what *makes* tensed sentences true. We will return to the Truthmaker objection below. We note it here because at least some presentists have taken it to be decisive against primitivist presentism, and so see the objection as motivating a move to ersatzer presentism, which, they believe, can successfully respond to the truthmaking worry.

5.3. Ersatzer/reductive presentism

In order to introduce ersatzer presentism, it is instructive to consider the parallels that hold between time and modality (i.e. the study of possibility, necessity and related notions). Consider the following sentence:

S8: Unicorns might have existed.

This, we may suppose, is true. But how are we to understand this sentence? Some philosophers, known as 'possibilists' (or 'modal realists'), believe that there are other universes that are just as real as this one, and that contain objects that are just as real as the objects within our universe. These universes are known as 'concrete possible worlds'. Concrete possible worlds are not the possible worlds that some quantum physicists believe in, because unlike the latter they are realms of being that are entirely separate from our own and from each other – they are not related to our universe or to each other by any spatiotemporal relations. One can think of them as 'ways our world (i.e. universe) could have been'. Possibilists believe that if we quantify unrestrictedly then we quantify over not only what is in our physical universe (which they call 'the actual world' and take to be just one among the concrete possible worlds), but also what is in all of the other concrete possible worlds too. They thus advocate understanding S8 as a quantificational sentence in which we quantify over concrete possible worlds. Using the subscript '$_{\text{possible-world}}$' to indicate this, we can express this as:

S8*: There exist$_{\text{possible-world}}$ unicorns.

And because things in other concrete possible worlds are just as real as things in the actual world, they take S8* to entail:

S9: There exist$_{\text{simpliciter}}$ unicorns

This view, then, is entirely parallel to eternalism. The eternalist believes that all times are equally real, and the possibilist believes that all possible worlds are equally real.

Despite generating a huge amount of discussion, possibilism is a minority view. Most philosophers baulk at admitting the existence of concrete possible worlds other than our own, and hold the view that only the actual world exists. They are thus known as 'actualists', and some actualists are also primitivists who appeal to primitive modal operators in the same way that primitivist presentists appeal to primitive temporal operators. According to this view S8 is not to be understood in terms of possible worlds at all. Rather, it is to be understood much as primitivist presentists understand tensed sentences, i.e. as containing the primitive modal operator 'It is possible that' with a quantified sentence embedded within it. The standard way of expressing the possibility operator 'It is possible that' is using the diamond '◊', and so we can express this as:

S8**: ◊ Unicorns exist$_{\text{simpliciter}}$

Crucially, primitivist actualists claim that sentences that occur within the scope of a modal operator are not existentially committing (i.e. just as primitive presentists claim that sentences that occur within the scope of temporal operators are not existentially committing). So, for example, because the claim that there exists$_{\text{simpliciter}}$ unicorns is within the scope of the possibility operator '◊' in S8**, primitivist actualists deny that S8** entails S9, and in this way primitivist actualists believe that they can avoid a commitment to the existence$_{\text{simpliciter}}$ of unicorns. Although unicorns *possibly* exist$_{\text{simpliciter}}$, they claim, it is not *actually* the case that the unicorns exist$_{\text{simpliciter}}$. There is thus a close parallel not only between eternalism and possibilism, but also between primitivist presentism and primitive actualism. And indeed, it is often thought that if they are to give the truth-conditions of modal sentences primitive actualists must themselves find some way to *talk* about possible worlds (i.e. just as primitive actualists must find a way to talk about times if they are to give the truth-conditions of tensed sentences). And some primitivist actualists have attempted to construct possible worlds using primitive modal operators, with possible worlds being identified with maximally consistent sets of propositions that themselves contain modal operators. So the parallel runs deep. (Cresswell 2012 gives a book-length treatment of these parallels.)

Now, in the literature on modality there is also another well entrenched view, *ersatzer actualism* (or 'ersatz modal realism'), according to which modal operators are not quantifiers that range over concrete possible worlds as the possibilist believes, but neither are they primitive operators as the primitivist actualist believes. Instead, ersatzer actualists believe, modal operators should themselves be constructed in terms of possible worlds, not concrete possible worlds, but *abstract* possible worlds. There have been various suggestions for how to understand what such abstract possible worlds are, but according to one influential attempt we are to understand them as maximally consistent sets of propositions which do *not* themselves contain modal operators. (The most famous attempt of this kind is Stalnaker 1976.) The idea is that sentences that say something *p* is possible express the fact that *p* is contained within a set of propositions that together give a full description of how the world could have been. S8, then, is to be understood as a genuine quantificational sentence that says something like:

S8***: There exists$_{\text{simpliciter}}$ some possible world (*viz.* a maximally consistent set of non-modal propositions) that contains the proposition *that unicorns exist*.

One key feature of this kind of view is that although all possible worlds are just as real as each other (as all are genuinely existing, albeit abstract, entities), and each one of them represents a way in which the actual world

(i.e. the concrete world that we live in) could have been, only one among them is distinguished as being the *actualized* world. This is the one and only possible world that represents things as they actually are. In other words, one maximally consistent set of propositions is not only a full description of how the actual world could be, but is in fact a full description of how the actual world *is*, and so contains only propositions that expresses how things *really are*.

Why is this view of modality important? Because it has long been recognized that it is possible to adopt an 'ersatz' view of times (see, e.g. Chisholm 1979 and Zalta 1987), and in the recent literature some have suggested that this option should be adopted by presentists (see Bourne 2006a, 2006b; Crisp 2007). In order to give the truth-conditions for tensed sentences, remember, some primitive presentists attempt to construct times out of sets of propositions that themselves contain temporal operators. This means that they cannot understand temporal operators in terms of (or reduce them to) those sets of propositions. But if instead the presentist constructs times out of sets of propositions that do *not* themselves contain temporal operators, then this option is available to them. And this is an option that ersatzer presentists take. The idea is that for each past/future time, there is a set of propositions that gives a full description of how the world was/will be at that time, and ersatzer presentists take those sets of propositions to *be* those times. So on this view a sentence that says something *p* used to be the case expresses the fact that *p* is contained within a particular set of propositions that *is* some past time.

The above gives the basic idea, but skirts over a few important details. There are, in fact, a couple of complications for ersatzer presentists that do not arise for ersatzer actualists. According to ersatzer actualists *every* set of propositions that give a full description of how the world could be *is* a possible world. But ersatzer presentists cannot say that *every* set of propositions that gives a full description of how the world could be *is* a time. This is for the simple reason that there are sets of propositions that describe the world as being a way that it never was, nor ever will be. One such set, for example, contains the proposition that there are unicorns. Ersatzer presentists must, then, specify which sets of propositions represent how the world was and how the world will be. Moreover, because the past and future history of the world has a certain temporal structure (certain events happen earlier than others), they must also specify an ordering among those sets of propositions that places them into an order that matches that temporal structure. To this end, ersatzer presentists add a primitive relation (which we can call 'the E-relation') that orders just those sets of propositions that describe how the world was and will be as eternalists think the *earlier than* relation orders genuine times. Finally, they hold that there is one and only one set of propositions among those that are ordered by the E-relation that represents how

the actual world (presently) *is*. This is a set of propositions that is privileged in the same way that the set of propositions that represents how the actual world is on the ersatzer actualist view. (See Bourne 2006a: 13; Crisp 2007: 104.) We can thus express the way that ersatzer presentists analyse simple past-tensed sentences like S2 ('Dinosaurs existed') as follows:

> S2***: There exists$_{\text{simpliciter}}$ a time *tx* and a time *ty* (*viz.* maximally consistent sets of non-temporal propositions) such that *tx* represents how the world is (presently), *ty* contains the proposition that dinosaurs exist and *ty* is E-related to [*viz.* 'earlier-than'] *tx*.

Simple future-tensed sentences (e.g. 'There will be people living on Mars') get analysed similarly, but with the set of propositions representing the way the world is (presently) standing in the E-relation to the set containing the target proposition (e.g. the proposition that people live on Mars). More complicated tensed sentences like S5–S7 above have a more complicated analysis, but there is a more-or-less uniform translation from any eternalist analysis to an ersatzer presentist analysis, so any sentence that eternalists can analyse can be analysed by ersatzer presentists.

Before we turn to the Truthmaker objection, it is worth noting that although ersatzer presentists and eternalists understand sentences like S2 as being quantificational sentences, unlike eternalists, ersatzer presentists do not think that S2 entails that dinosaurs exist$_{\text{simpliciter}}$. According to eternalists, times contain (or are constituted by) concrete objects such as dinosaurs. But the same is not true for ersatzer presentists. Times, for them, are sets of propositions, and do not contain any concrete objects at all. So although ersatzer presentists are committed to the existence of times, they are not committed to the existence of any past or future objects.

5.4. The Truthmaker objection

The Truthmaker objection is the most discussed objection to presentism, and can be put in the form of a simple question: what *makes* tensed sentences true? As has been mentioned, this objection has been levelled against primitivist presentism, and proponents of ersatzer presentism believe that their view is immune to it. Before we see why they think this, let us first see how the objection runs against primitivist presentists.

According to primitivist presentists, past-tensed sentences are sentences that express how the world *was*, and future-tensed sentences express how the world *will be*. And accepting that such sentences are true, such

presentists say, does not commit us to the existence of any past or future things. Many contemporary philosophers think that this position is untenable because it is incompatible with the following basic metaphysical principle:

> Truthmaker: What is true is made true by what exists$_{\text{simpliciter}}$.

Truthmaker has been cashed out in a variety of slightly different ways, but however it is to be correctly cashed out, most take it to express a basic metaphysical truth. As Simon Keller has put it:

> For many of us, it is hard to imagine that Truthmaker could be incorrect, regardless of how many headaches it causes. Sometimes it is difficult to explain how certain propositions that we normally regard as true could be made true by what we normally take to constitute the entirety of what exists. When metaphysicians notice such difficulties, however, they do not tend to reject Truthmaker. They are more likely to try to explain how the things that we normally take to exist really are enough to explain why the propositions are true, or to suggest that there are more existing things than we would otherwise have thought, or to argue that the apparent truths are not true after all. (Keller 2004: 87)

The idea lying behind Truthmaker is that for a sentence to be true, there must be some ontological ground for its truth (the Truthmaker objection is thus sometimes called 'the grounding objection'). In other words, for any sentence, there must be something or some things in reality that *make* the sentence true. In yet other words, truth must somehow be grounded in reality, or in what there *is*, i.e. in what exists$_{\text{simpliciter}}$. Consider a simple existential sentence, for example:

> S10: There are human beings.

S10 is true. Truthmaker tells us that there must be something or some things that exist that make it true. Intuitively, of course, it is the existence of human beings that makes S10 true. But if one were to deny the existence of human beings (for some reason or other), Truthmaker dictates that one must specify an alternative existent thing that can plausibly serve to make S10 true. According to Truthmaker, one cannot simply claim that S10 is a brute fact, or a free-floating truth, that has no ground in what exists$_{\text{simpliciter}}$. As Theodore Sider conceives of it, for example, '[t]he point of the truthmaker principle … is to rule out dubious ontologies' (Sider 2001: 40), i.e. ontologies that allow there to be truths that are not grounded in what exists$_{\text{simpliciter}}$.

We do have to be a little careful in how we understand Truthmaker, however, for consider a simple negative existential truth:

S11: There are no unicorns.

It seems that S11 is not made true by the *existence* of anything. It seems that it is made true, rather, by the *non-existence* of things of a certain type, *viz.* unicorns. One way of modifying Truthmaker in order to deal with this is to understand it as follows:

Truthmaker*: If any truth were a falsehood, then something would have to exist$_{\text{simpliciter}}$ that does not exist$_{\text{simpliciter}}$, or something that does not exist$_{\text{simpliciter}}$ would have to exist$_{\text{simpliciter}}$.

So, for example, S10 is true because human beings exist$_{\text{simpliciter}}$, but if it were false then it would have to be that human beings do not exist$_{\text{simpliciter}}$. And S11 is true because unicorns do not exist$_{\text{simpliciter}}$, but if it were false then it would have to be that unicorns exist$_{\text{simpliciter}}$. Moreover, if we consider sentences that are not simple positive or negative existential truths, it is plausible that further modifications to Truthmaker are needed. However, we do not consider how to correctly formulate Truthmaker further here. For our purposes, we can stick with Truthmaker itself. An intuitive understanding of the principle will allow us to frame the relevant issues. (See the introduction to Beebee and Dodd 2005 for details about how to correctly frame the principle.)

To sum up, the problem that Truthmaker poses for primitivist presentists is simply this: if asked what things exist$_{\text{simpliciter}}$ that make (past- and future-) tensed sentences true, it seems that they can say little in reply. Consider S2 once more:

S2: Dinosaurs existed.

Unlike eternalists, primitivist presentists cannot say it is the existence$_{\text{simpliciter}}$ of dinosaurs that makes this sentence true. Instead, it seems, they are forced to either say that it is a primitive fact that S2 is true, or find some presently existing things that can serve as the truthmakers for S2. However, at least *prima facie*, there are no such things. In its most general form, then, the Truthmaker objection to primitivist presentism runs as follows:

(1) What is true is made true by what exists$_{\text{simpliciter}}$.

(2) There are past- and future-tensed truths.

(3) Past- and future-tensed truths are not made true by what exists$_{\text{present}}$.

(4) Presentism is the view that there is nothing that $\text{exists}_{\text{simpliciter}}$ but does not $\text{exist}_{\text{present}}$.

Therefore,

(5) Presentism is false.

Sometimes the argument is expressed in terms of *facts*. Facts (in at least one relevant sense) are supposed to be the real-world correlates of true sentences. Crucially, facts are supposed to be structured entities that have real-world objects among their constituents. Consider a sentence that is not a simple existential truth:

S12: Barack Obama is the president of the USA.

Suppose we ask: what makes S12 true? Some think we must answer: the *fact* that Barack Obama is the president of the USA. And this fact, it is thought, is a structured entity that has among its constituents the real-life individual Barack Obama (i.e. the man himself). Now consider:

S13: George Washington was the president of the USA.

And ask: what makes S13 true? Eternalists can reply as before by saying that it is a fact that has among its constituents the real-life individual George Washington (i.e. the man himself). This fact, despite being constituted by an individual that exists at some past time, is not in any essential way different in kind from the fact that Barack Obama is the president of the USA. But what can primitive presentists say? They *can* say that what makes S13 true is some presently existing past-tensed fact, but they *cannot* say that such a fact has George Washington (the man himself) as a constituent (because, according to primitive presentists, George Washington does not $\text{exist}_{\text{simpliciter}}$). So instead, it seems, they must either say that it is a primitive unstructured fact (i.e. one with no constituents at all) or appeal to some other thing as a constituent in place of George Washington himself. But both of these options are *prima facie* untenable. Craig Bourne, considering the sentence 'Socrates taught Plato', puts the point in the following way:

> [T]he essential question is: what *makes* such truths true? What are the constituents of the facts that make them true? … *how* is it possible for the proposition that Socrates taught Plato to be true? Which particulars can be invoked as the constituents of such a fact? Not Socrates or Plato – they don't exist [i.e. $\text{exist}_{\text{simpliciter}}$]. Nor can we invoke a present past-Socrates – what a mysterious object that would be! The alternative is to invoke the

> primitive present fact that Socrates taught Plato. But without being able to say how this fact is structured (for its constituents are certainly not Socrates or Plato), this move is far from satisfactory … And it is no good complaining that [Socrates and Plato] did exist, because we want to know what does exist to make the proposition true now. (Bourne 2006b: 3–4)

How might primitivist presentists respond to the Truthmaker objection? Focusing on its general form, premise 2 is simply the statement that there are some truths expressible using past- and future-tensed sentences, which seems undeniable (although Markosian 2005 offers a response to the Truthmaker argument by denying that at least some past 'truths' really are truths – we discuss this response more fully in section 6.5). Premise 4 is merely a statement of primitive presentism, and so cannot be rejected. So primitivist presentists must either reject premise 1, and so deny Truthmaker, or else reject premise 3 and argue that past- and future-tensed sentences are in fact, despite what one might think, made true by presently existing things. Some have taken the first option and rejected Truthmaker. Among those who do so, some reject the idea that Truthmaker needs replacing with any other principle (see e.g. Merricks 2007: xvii). Others have argued that although Truthmaker is false, there is some other closely related principle that is true but that is also consistent with primitivist presentism. For example, Andre Gallois (2004: 649) has suggested adopting a disjunctive version of Truthmaker, i.e. something like:

> *Disjunctive Truthmaker*: What is true is made true by what exists$_{\text{simpliciter}}$, or by what used to exist$_{\text{simpliciter}}$, or by what will exist$_{\text{simpliciter}}$.

But responses like these have received much criticism and have seemed misguided to most. (See Caplan and Sanson 2011 for an overview.) To reject Truthmaker, most think, just *is* to reject the idea that truth is grounded in reality, and so to admit that there can be ungrounded or free-floating truths. One's metaphysical view may be superior in some respects if one rejects Truthmaker (e.g. by admitting the existence of fewer entities than someone who accepts it), but as Truthmaker is considered to be a basic metaphysical principle, most think that the cost of rejecting it cannot be outweighed by gains elsewhere. As such, the consensus seems to be that the most promising response to the Truthmaker objection is to take the second option and reject premise 2 by arguing that, in fact, tensed sentences *are* made true by things that presently exist. This is the response that most have pursued in the literature.

5.5. Presentist responses to the Truthmaker objection

As Caplan and Sanson have put it, in order to ground truths about the past (and future) in the present, primitivist presentists need to 'equip the present with a perfect record of the past [and future]' (2011: 200). The simplest of all attempts is one that simply posits presently existing primitive unstructured tensed facts that make truths about the past and future true. Some (e.g. Craig 2003: 400) have in fact pursued this approach, but it is not a popular approach for the reasons given by Bourne in the passage quoted above. It is thought that primitivist presentists need to do more than simply assert the existence of mysterious unstructured facts – they need to give their facts some structure. And it is just this that many presentists have attempted to do.

John Bigelow (1996) takes his inspiration from the Roman philosopher Lucretius who he takes to have held the view that the world is a constantly existing entity which retains a trace of all past events that took place on it (Bigelow 1996: 45). He suggests a modification of this view, as follows:

> One of the things that exists is the whole world, the totality of things that exist. The world can have properties and accidents, just as its parts may have. It is a present property of the world, that it is a world in which Helen was abducted and the Trojans were conquered. (Bigelow 1996: 46)

Bigelow thus suggests that what makes past-tensed sentences such as 'dinosaurs existed' and 'George Washington was the president of the USA' true is that the world itself instantiates the properties of *having once contained dinosaurs* and *having been such that George Washington was the president of the USA* respectively. Facts are also given some structure, on this view. The fact *that dinosaurs existed*, for example, is not an unstructured entity, but an entity that consists of an individual (the world) and a property that is instantiated by that individual (the property of *having once contained dinosaurs*). Simon Keller (2004) suggests two further views, in addition to Bigelow's Lucretian presentism, that primitivist presentists could adopt to ground past-tensed truths in the present.

The first of Keller's suggestions builds upon the view known as 'haecceitism', according to which every individual possesses, as an essential property, the property of being the individual that it is (Keller calls such a property of individuals '*thisness*'). So, for example, Barack Obama has the property *being Barack Obama*, and George Washington (when he existed) possessed the property *being George Washington*. Now, if one believes that properties are entities in their own right, it is plausible that they can exist uninstantiated (i.e.

they can exist even if nothing has them). Consider the property of *being a megagon* (i.e. a regular one-million sided shape), for example. This property, we may suppose, is not instantiated by any object. But one may still hold that the property of *being a megagon* itself exists, perhaps as some kind of abstract entity. Keller's suggestion is that by maintaining that each individual's thisness exists even at times when the individual itself does not, primitivist presentists can say that past-tensed truths about those individuals are made true by their thisnesses. On this view, the facts that make past-tensed sentences true can easily be given a more 'fine-grained' structure than on Bigelow's. Keller, for example, explains that the fact that makes the sentence 'Anne Boleyn was executed' can be said to have a number of thisnesses as constituents:

> Among the haecceities that presently exist, the presentist can say, are the thisnesses of Anne Boleyn, of the sword with which Anne was executed, and of the swordsman who was specially brought over from France. These properties themselves, says the presentist, instantiate a relation that somehow mirrors the relation that the [eternalist] claims to be instantiated by Anne, the sword, and the swordsman. (Keller 2004: 97)

Keller's second suggestion involves the primitivist presentist first supposing that all true present-tensed sentences are made true by the fact that certain arrangements of atomic particles obtain at the present time. For example, we might suppose that the true present-tensed sentence 'the cat is on the mat' is made true by the fact that there are atomic particles arranged cat-wise that are located on top of certain other particles arranged mat-wise. Then, if the presentist supposes that these atomic particles have always existed, and always will exist, the presentist can further suppose that these particles have past-tensed properties that encode within them their entire history, including facts about where they were located at past times, and so how they were arranged relative to other atomic particles at those times. So, on this view, past-tensed propositions are made true by the present fact that a certain set of atomic particles were arranged in certain ways at past times, which is encoded in the past-tensed properties that the individual particles from that set presently possess. Thus, for example, the true past-tensed sentence 'the cat was on the mat yesterday' is made true by the fact that a certain set of atomic particles individually possess properties that entail that they were arranged cat-wise yesterday and were on top of a certain other set of particles which individually possess properties that entail they were arranged mat-wise yesterday (Keller 2004: 100).

The above three options for the presentist are by no means exhaustive. But they make clear that the presentist can find ways to deny premise 2

of the Truthmaker objection. Each involves appealing to presently existing properties of some kind that, in virtue of being instantiated by present objects, or by being related to each other in some way, determine all past truths. The appeals strike many eternalists as being ontologically extravagant. The entities countenanced by presentists are often thought to be, in some sense or other, 'dubious'. But it is worth noting that, from the presentist's perspective, the entities that eternalists appeal to in grounding past truths – i.e. past and future objects and *their* properties – are equally dubious. So it is unclear whether presentists are really in a worse position, ontologically speaking, than eternalists. We leave it to the reader to judge whether or not this is so. (However, see Sider (2001: 41, 2003: 185) for an influential attempt to explain why the presentist's entities are dubious in a way that the eternalist's are not. For discussion and replies to Sider see Kierland and Monton 2007, Crisp 2007 and Cameron 2011.)

We finish this section by briefly considering how ersatzer presentists can deal with the Truthmaker objection. As mentioned, ersatzer presentists think that their view is immune to it. The reason why this is so is because, as we have seen, unlike primitivist presentists they take past-tensed sentences to express genuine quantifications over past times, but construe those times as being abstract sets of propositions that are related to the present time (i.e. the actualized set of propositions that describes how the world is now) by the E-relation. And it is this very fact that enables them to give an easy reply to the Truthmaker objection. In other words, their view, unlike that of the primitivist presentist, has a reply to the Truthmaker objection built into it from the start. They do not need to countenance extra entities, or alter their account in any way, to deal with it. To see this, note that according to the ersatzer presentist past-tensed sentences express propositions that are true iff a certain present-tense proposition is included in one of those sets of propositions that are past times. For example, the sentence 'George Washington was the president of the USA' is true iff the *present*-tense proposition *that George Washington is the president of the USA* is included in a set of propositions that is E-related to the actualized set of propositions. So, the ersatzer presentist can say, it is this fact – i.e. the present fact that the proposition *that George Washington is the president of the USA* is contained within a past time (conceived of as a set of propositions) – that grounds the truth of the sentence 'George Washington was the president of the USA'. A similar story can be told for all other past- (and future-)tensed sentences, and so, if this account is correct, the Truthmaker objection poses no problem for ersatzer presentists. Whether this account is correct, however, remains to be seen. (For criticism of ersatzer presentism see, e.g. Merricks 2007: 125 and Oaklander 2010.)

5.6. Other problems for presentism

Presentism faces a variety of other problems. As mentioned, one problem that is often considered to be decisive, the argument from special relativity, will be considered in Chapter 10. Other problems relate to issues to do with time's flow that we have already considered in previous chapters. Presentists seem to be committed to a pure becoming view, and so are open to at least some of the arguments against that view (e.g. the hypertime objection considered in Chapter 4). In Chapter 7 we will also see that there are concerns over whether presentism is compatible with certain views to do with persistence over time (specifically, 'perdurantism', according to which objects persist by having distinct temporal parts at distinct times). And in Chapter 9 we will see that some have worries that presentists, unlike eternalists, cannot make sense of the possibility of time travel. In addition, there are two further problems that are distinct from, although closely related to, the Truthmaker objection:

The singular proposition objection
According to a venerable view, certain sentences, including past-tensed sentences, express what are known as 'singular propositions' (see, e.g. Plantinga 1974, 1983; Kaplan 1977/89; Kripke 1980). These are propositions that are *directly* about some object. An example is 'Socrates was wise'. According to one way of spelling this view out, this sentence expresses a proposition that has Socrates (i.e. the flesh and blood man himself) as a constituent. But according to presentists, Socrates does not exist, and so the proposition cannot have the flesh and blood man himself as a constituent. And so, presentism is false.

The cross-temporal relations objection
Things at different times can be related to each other in various ways. For example, one of the authors of this book (B. C.) admires David Hume. However, B. C. exists in the twenty-first century, and Hume existed in the eighteenth century, so the two-place relation of admiration that holds between B. C. and Hume is a cross-temporal relation. But it is plausibly an *a priori* truth that in order for any two-place relation to hold, whether it is cross-temporal or not, both of its relata must exist (see Bigelow 1996: 39). So, not only must B. C. exist, but Hume must exist too. But, according to presentists, Hume does not exist. So, presentism is false.

With regard to the first of these objections, presentists may simply deny that there are singular propositions, but many believe that presentists can meet

both of these objections in much the same way as they meet the Truthmaker objection, i.e. by positing substitute entities to serve as the direct object of the relevant propositions and as non-present relata. On the haecceitist view, for example, presentists can say that the singular proposition has not Socrates himself as a constituent, but Socrates's presently existing thisness, and they can say that the relation of admiration holds not between B. C. and Hume, but rather between B. C. and Hume's presently existing thisness. (For further discussion of these points, see e.g. Adams 1986; Bigelow 1996; Zimmerman 1998a; Crisp 2003, 2007; Markosian 2004a; De Clercq 2006; McKinnon and Bigelow 2012.)

We mention just one more objection to presentism that has received less attention but will be relevant in Chapter 8:

> *The thick and thin objection*
> According to presentism, only the present exists. But does the present have any temporal breadth? If it does not, then the present moment is 'thin' – it is a durationless instant (this, recall, seemed to be Augustine's view – see Chapter 1). If it does, then the present moment is 'thick' – it has some duration, even if that duration is very small. But on the one hand, if the present is thin, then presentists will have trouble accounting for two things. First, they will have trouble accounting for the apparent duration that our experiences of the present have. Second, as Bertrand Russell (1945: 210) argues, certain events *take time* to occur (for example, the act of *believing something*, it seems, cannot take place in an instant). So presentists cannot account for such events. On the other hand, if the present is thick, then presentists must admit that reality has at least some temporal span (albeit, perhaps, a small one). But if they admit this then they can have no objection *in principle* to eternalism, according to which reality has a large temporal span. Eternalism would then only differ from presentism in degree, and not in kind, which undermines the presentist's rejection of eternalism. So, whether the present is thick or thin, presentism is in trouble.

A few have dealt with this objection, and have argued that presentists can take the view that the present moment has a limited duration (e.g. Hestevold 2008). We say no more about it here, however, because we take this issue up again in section 8.7.

5.7. Eternalism and the growing block view

We finish this chapter with a few words about eternalism and the growing block view. First, eternalism. It is fair to say that, historically, the most influential objection to eternalism is that by treating time as being analogous to space, it radically misconceives its nature. In so doing, it has been held, eternalists fail to take tense seriously and leave themselves unable to account for its dynamic nature. (Craig 2000b, Chapter 7, presents this view forcefully and in depth.) This claim may seem strange since, as we have seen in the previous chapter, eternalism *can* be combined with the view that time is dynamic – the result is the moving spotlight view. However, the moving spotlight view has typically been thought to be the weakest of the A-theory views, and has proven deeply unpopular in recent years. With new work defending the moving spotlight view now appearing (e.g. Cameron 2015) though, perhaps its popularity will grow. Other objections to eternalism highlight its incompatibility with some supposedly 'common-sense' views. Eternalists, for example, must deny that dinosaurs do not exist (a common-sense view which is supposed to persist even once one insists that 'exists' is to be understood as 'exists$_{\text{simpliciter}}$'). These are not, however, the only worries one might have regarding eternalism and we address some additional worries in other chapters. One such objection is that eternalists cannot explain our experience of time's flow (see Chapter 4, but also see section 8.6). Another objection to eternalism is that it seems to fit most naturally with a view of persistence, *viz.* perdurantism, which many think is implausible. We consider this issue in Chapter 7.

As mentioned at the beginning of this chapter, the growing block view is a half-way house between presentism and eternalism. The growing blocker agrees with the eternalist about the ontological status of past times and with the presentist concerning the ontological status of future times. As such, the growing block theorist appears to be vulnerable to objections from both sides. The growing block view is also open to some of the objections discussed above. On the one hand they share the eternalist's commitment to denying the common-sense view that past objects such as dinosaurs do not exist and the (A-theoretic) eternalist's difficulties in responding to the no explanation objection (see section 4.4). On the other hand they share the presentist's difficulties in accounting for what makes it true, if indeed anything does, that the sun *will* rise tomorrow and in dealing with some of the worries concerning special relativity. It looks, then, as if the proponent of the growing block view will need to say a great deal to motivate their view in order to overcome such a formidable range of objections. One area where the growing block view does seem to have a *prima facie* advantage over both

eternalism and presentism is in accounting for the common-sense view that the past is fixed, while the future is in some sense open. Here the growing block view seems to have a simple explanation available that is not available to either presentism or eternalism, i.e. that the past is fixed because past times exist, the future open because future times do not exist (although see section 6.4 for more on whether this really is an advantage for the growing block view). And a number of other arguments have also been offered for the view. Tooley (1997), for example, argues that the growing block view is best able to account for various cross-temporal relations (and, in particular, causal relations), Robson (2014) that the growing block view can provide attractive responses to some enduring philosophical puzzles concerning death and Briggs and Forbes (2012) that the growing block view can provide an extremely attractive semantics for truths about other times.

5.8. Summary

In this chapter we considered the ontological debate regarding the existence of the past, present and future. We first gave a way of understanding presentism and eternalism using the notion of existence$_{\text{simpliciter}}$. We then outlined two versions of presentism, primitivist presentism and ersatzer presentism, and explained how eternalists and proponents of the two versions of presentism understand past- and future-tensed sentences. We then turned to the most discussed objection to presentism, the Truthmaker objection, and outlined how presentists can respond to it. This was followed by a brief discussion of some further objections that presentists face, and we finished with an overview of the objections to both eternalism and the growing block view. In the next chapter we turn to the contention that the future differs from both the present and the past in being, in some sense, open.

Study Questions

1. Why is the debate between presentists and eternalists sometimes claimed to be a 'purely verbal' one? Does defining the two views in terms of 'existence$_{\text{simpliciter}}$' show that this claim is false?
2. Explain the difference between primitivist presentism and ersatzer presentism.
3. Outline the Truthmaker objection to presentism and explain what responses the presentist has available. Which of these responses is the most plausible?

4. Presentism, eternalism and the growing block view are all *ontological* views regarding which times exist. Which of these views do you think is the most plausible?

FURTHER READINGS

To follow up on specific issues we again encourage readers to consult the references given in the text above. Miller (2013) gives a good general overview of all three ontological views of time. Crisp (2003) provides one that focuses on presentism, while Rea (2003) focuses on eternalism (although he calls it 'four dimensionalism'). Bourne (2006a) is probably the most important modern defence of presentism, and Sider (2001) probably remains the most important defence of eternalism (Sider argues for eternalism as part of a broader defence of 'perdurantism' which we discuss in Chapter 7). For a defence of the growing block view see Tooley (1997). Keller (2004) and Caplan and Sanson (2011) provide an overview of the Truthmaker objection to presentism, but also mention other important objections in the process.

6

The open future

This chapter examines the ongoing debates concerning in what respects, if any, the future is open. In particular, we focus on the claim that the truth values of certain claims about the future are, in some sense, 'unfixed'. Sections 6.4 and 6.5 contain some rather advanced material which those new to these topics may wish to omit on their first reading.

We expect that many of you will agree with Corine Besson and Anandi Hattiangadi (2014: 252) when they assert that it 'is highly intuitive that the future is open while the past is closed; that the future is unsettled, whereas the past is settled'. As we will see, though, it is not a straightforward matter to determine either what precisely this intuition amounts to or whether it is one which we should ultimately endorse. In this chapter we will focus on the debate over so called 'future contingents', that is, statements concerning the future which are (or at least appear to be) neither necessary truths nor necessary falsehoods. Most of us are happy to accept that it is now settled that in the future two plus two will still equal four and settled that the future will not contain any married bachelors. By contrast, many people find something unnerving in the thought that it is presently settled whether they will go to work tomorrow morning or whether human beings will colonize Mars by the year 2115.

In section 6.1 we survey a number of possible interpretations of the intuitive claim that the future is open whereas the past is closed. We also highlight a particular kind of openness, *alethic openness*, which will serve as the focus for our discussion in this chapter. In section 6.2 we examine the most prominent reasons for accepting the claim that the future is open in this sense: that a closed future would imply that there aren't any genuinely

contingent claims concerning the future and that a closed future would entail that human beings lack free will. In section 6.3 we consider whether there are any good reasons for denying that the future is genuinely open in this sense. In particular, we consider the worry that accommodating the open future intuition would require unacceptable revisions to classical logic. In section 6.4 we ask whether the debate concerning the open future can tell us anything interesting about the metaphysics of time. Section 6.5 examines some arguments for the claim that the past might also be open in various respects.

6.1. What kind of openness?

What does it mean to say that the future is open? It is important to consider this issue carefully since, as Rachel Briggs and Graeme A. Forbes (2012: 257) point out, our standard picture of the world is one where differences 'between past and future abound. The past, many of us think, is fixed and determinate; the future is open and indeterminate. The arrows of time and causation point from past to future, not from future to past' and so forth. In this section we will discuss some of the manifold differences which philosophers have been concerned with when they claim that the future is open whereas the past is closed.

We will begin – as many discussions of this topic have – by considering the sea-battle discussed in Book 9 of Aristotle's *De Interpretatione*, a battle which has since become one of the most famous events in the history of philosophy (a feat made all the more impressive by the fact that no-one is even sure whether it will take place). Aristotle describes the case as follows.

> A sea-fight must either take place to-morrow or not, but it is not necessary that it should take place tomorrow, neither is it necessary that it should not take place, yet it is necessary that it either should or should not take place tomorrow […] One may indeed be more likely to be true than the other, but it cannot be either actually true or actually false. (Aristotle 2006: 33)

This case has served as the focal point for discussion concerning the open future for most of the history of Western philosophy and still holds a prominent place in much of the contemporary debate. As we've already mentioned in Chapter 1 there are numerous different interpretations of Aristotle's writings on this and other issues. Our focus in this chapter will not, however, be on these interpretive issues and so we will give scant attention to the various competing interpretations of Aristotle within the philosophical

literature (though see further readings for a history of these debates). Instead we will focus on the different senses of 'openness' which have proven most relevant to the contemporary debate.

The most common account of the kind of openness involved in the claim that the future is open is *alethic openness*. What does it mean for the future to be alethically open? Ned Markosian (1995: 96) offers the following account:

> To say, with regard to some time, t, that the future is *open* at t is to say that there are some propositions about the future relative to t that are, at t, neither true nor false. To say that the future is *closed* at t is to deny this, i.e., to say that every proposition about the future relative to t is, at t, either true or else false.

So the claim that there will be a sea-battle tomorrow is alethically open at the present time iff (i) it is not presently true that there will be a sea-battle tomorrow and (ii) it is not presently false that there will be a sea-battle tomorrow. And, of course, the alethic openness of the future is not confined to potential sea-battles. Those who think that the future is alethically open will typically claim that a wide range of future contingents are presently neither true nor false. As we write these words it isn't presently either true or false that we will finish writing this chapter; as you read them it isn't presently true or false that you will finish reading it and (unless you are reading these words very far in our future) it isn't presently true or false for either you or us that human beings will colonize Mars by 2115.

For most of the rest of this chapter we will be evaluating the claim that the future is open in this sense (though see e.g. Besson and Hattiangadi 2014 and Barnes and Cameron 2009 for some worries about taking the open future debate to be equivalent to the debate concerning alethic openness). As such when we talk about the 'open future' below we will, unless otherwise indicated, mean the *alethically* open future. Before doing so, though, we will consider some other ways in which we could cash out the intuition that the future is somehow open. Doing so is important because it is all too easy – even for trained philosophers – to offer arguments which conflate the different senses in which the future might be open, and someone who wants to establish that the future is (or isn't) alethically open had best make sure that their arguments do not rest on such an equivocation.

There are many things that the authors of this book don't know. We don't know the national bird of Paraguay (or even whether Paraguay has a national bird), we don't know what you're thinking right now, we don't know whether the total number of stars in the universe is odd or even. These issues are *epistemically open* for the authors of this chapter. A particular proposition is epistemically open for someone at a time iff they don't know at that time

whether that proposition is true or false. A proposition is epistemically closed for someone at a time iff they either know that proposition to be true at that time or else know it to be false at that time. So the proposition that the total number of stars in the universe is even is epistemically open not only for the authors of this chapter but for the human race in general. By contrast the proposition that Paraguay has a national bird is epistemically open for the authors of this chapter but not for Paraguayan bird-enthusiasts. The propositions which are, at present, epistemically open for all human beings include a number of claims concerning the future. It is, for example, epistemically open in this sense whether human beings will ever colonize Mars and what next week's winning lottery numbers will be.

There are a number of interesting questions we could ask concerning epistemic openness. Why is it that propositions concerning our own immediate futures tend to be epistemically open to us whereas those concerning our own immediate past do not? Are there any contingent propositions concerning the future which aren't epistemically open? And so forth. The debates concerning alethic openness we will consider in this chapter may well help us to answer some of these questions but it is clear that debates concerning whether the future is open aren't primarily concerned with the question of whether the future is *epistemically* open since it is undeniable that many claims concerning the future are open in this sense.

A more controversial species of non-alethic openness is *modal openness*. A proposition is modally open at a time iff it is possible at that time for the proposition to be true and possible at that time for the proposition to be false. A proposition is modally closed at a time iff it is either necessary at that time that the proposition is true or necessary at that time that the proposition is false. It is clear, then, that the claim that there are married bachelors and the claim that two plus two equals four are both modally closed at all times but it is much less clear whether there are some claims that are modally open at some times and modally open at others. In particular, it is a controversial matter whether any propositions concerning the future – such as those regarding sea-battles tomorrow – are modally open at present.

Some philosophers have claimed, for reasons we will outline below, that no propositions about the future are open in this sense whereas others have argued not only that some propositions concerning the future are modally open but that our intuition that the future is open can be accounted for by the claim that it is modally open rather than alethically open. Doesn't modal openness entail alethic openness though? After all, if it is presently true that you will stay in bed tomorrow then surely this means that it is impossible for you to do otherwise (as this would result in the contradictory result that you both do and don't stay in bed tomorrow). We will return to this question – and the relationship between alethic and modal openness more generally – in the next section.

The final interpretation of the openness intuition we'll consider is the claim that the future is *causally* open. It is a common – though by no means uncontroversial (for reasons we discuss in section 5) – view that we are unable to do anything now which causally influences the past. In contrast to this it is typically taken for granted that many of the actions we perform now will cause various future events to occur. We can say, then, that a particular time is causally open at present if the actions we perform now are able to have some causal influence on what happens at that time.

6.2. In defence of the open future

Having considered a range of interpretations of the claim that the future is open in the last section we will now go on to assess one specific interpretation, the claim that the future is *alethically* open, in detail. While the view that the future is, in some sense, open has a great deal of intuitive support, it is not clear to what extent these intuitions favour the view that it is open in a specifically alethic sense. It would be useful, then, for a believer in the alethically open future to be able to produce some compelling argument in favour of their view. In this section we consider two such arguments. One common motivation for the view that the future is open, in this sense, is the claim that openness of this kind is required to account for the fact that there are any future contingents at all. Consider an individual, Eva, trying to decide whether she should pursue a career as an engineer or as an emu farmer (a choice we have, doubtless, all faced at some point in our lives). Assume further that, as a matter of fact, Eva will become an emu farmer. Now consider the following argument:

Necessity Argument

(1) It is presently true that Eva will become an emu farmer.

(2) If it's presently true that Eva will become an emu farmer then it is impossible for her not to become an emu farmer.

(3) If it is impossible for Eva not to become an emu farmer then it's necessary that she will become an emu farmer.

Therefore,

(4) It is necessary that Eva will become an emu farmer.

And what holds with respect to Eva's becoming an emu farmer holds with respect to any truth concerning the future. As such, it looks as if an alethically

closed future will be one in which there are no future contingents at all since any true claim about the future will be necessarily true and (for parallel reasons) any false claim concerning the future will be necessarily false. The thought, then, is that the future being alethically closed entails that it is also *modally* closed.

The conclusion that the future is modally closed is not without its defenders. Spinoza (1677/2001: 31), for example, famously claimed that there are no contingent facts since 'things could be produced by God in no other manner and in no other order than that in which they have been produced'. However, most find the view that everything that will happen will happen of necessity to be unpalatable (often for reasons concerning the existence of human freedom which we will discuss below). Given this, it looks as if such individuals will be committed to accepting the claim that the future is alethically open. Fortunately for the defender of the view that the future is modally open while alethically closed, though, appearances are deceiving and the *Necessity Argument* is fallacious.

To see why this is so, consider David Lewis's (1976b: 151) response to the fatalist's claim that – for reasons paralleling those we have offered in the Eva case above – there are no future contingents and that everything that *will* happen *must* happen:

> I am not going to vote Republican next fall. The fatalist argues that, strange to say, I not only won't but can't; for my voting Republican is not compossible with the fact that it was true already in the year 1548 that I was not going to vote Republican 428 years later. My rejoinder is that this is a fact, sure enough; however, it is an irrelevant fact about the future masquerading as a relevant fact about the past, and so should be left out of account in saying what, in any ordinary sense, I can do.

Why is this fact irrelevant? Because typically when we claim that we can perform some action at a time what we mean to say is that it is compossible with certain facts concerning the history of the world up to that point that we perform the action in question. And, in this sense, it certainly seems possible that Lewis could vote Republican (and that Eva could become an engineer). There is no relevant fact about the world up until the point where Lewis ultimately makes his decision which is incompatible with his voting Republican – the world *could* have been exactly as it actually was up until that point but have then diverged – and so this action *was* possible for Lewis even though it turned out to be non-actual (for more on this view see Lewis 1981). Of course, there is *some* fact, the fact about how Lewis will vote in the future, which is incompatible with his voting Republican. However, this is a fact about Lewis's future, rather than his past or present, and as such is

irrelevant to determining whether he could have voted Republican given our ordinary understanding of such claims. We will have much more to say about Lewis's claims here (along with the other arguments in Lewis 1976*b*) in Chapter 9. For now, though, we will turn to our second argument in favour of the view that the future is open.

While the *Necessity Argument* fails, it does help to highlight some features which are crucial to understanding what is without doubt the most famous argument for the future's being open: the argument from human freedom. Recall the case of Eva deliberating between her two career paths and consider the following argument:

Freedom Argument

(1) It is presently true that Eva will become an emu farmer.

(2) If it is presently true that Eva will become an emu farmer then she is not free to choose not to become an emu farmer.

(3) If Eva is not free to choose not to become an emu farmer then her choice of career is not a free choice.

Therefore,

(4) Eva's choice of career is not a free choice.

And, once again, what applies to Eva's decision applies to any other apparently free choice which human beings might face if the future is alethically closed. What should we make of this argument? One obvious response is to merely accept the conclusion and admit that Eva and, by extension, the rest of us lack free will with respect to the various decisions we make. Yet, while this option is not without its sympathizers – such as Galen Strawson (1986) and Derk Pereboom (2001) – the majority of philosophers are keen to resist the conclusion that human beings do not possess free will. There is, however, no clear consensus among opponents of the *Freedom Argument* as to exactly why the argument fails.

One common response is to reject premise 2 by arguing that freedom doesn't require that the future is alethically open but merely that it is modally open. We might think, for example, that all that is required for Eva's choice to be free is that she *could* perform either action in the ordinary sense which we outlined above. Others deny that even this much is required for human freedom. Some philosophers have argued that we should reject premise 3 and that it is not required for a choice to be free that we are able to choose otherwise. Some take David Hume (1748/2004: 61) to be arguing for such a view when he claims that freedom is 'a power of acting or of not acting, according to the determination of the will'. On this view an action is free iff

it results from our acting on our own desires. Many others have, however, found this conception of freedom problematically impoverished. Peter van Inwagen (2004: 66), for example, points out that this condition would be met by the lower classes – the 'Deltas' and 'Epsilons' – from Aldous Huxley's science fiction novel *Brave New World*. These individuals do what they desire to do but their desires are 'imposed on them by prenatal and postnatal conditioning' put in place by their social betters. 'Each of them is always doing exactly what he wants' but what 'he wants is to do as he is told by those appointed over him' (ibid.). It looks, then, as if the Deltas and Epsilons would be paradigms of free agents on this interpretation of Hume's view but, van Inwagen claims, this clearly clashes with our intuitions concerning what it is to have (or to lack) free will. The Deltas and Epsilons are not free agents at all, let alone paradigms of free agency.

The responses we have considered here are far from being the only possible rejoinders to the *Freedom Argument*. The philosophical literature concerning the nature of free will is vast and almost all of the major figures in Western philosophy (as well as many philosophers in other traditions) have had something to say concerning the freedom of the will. As such, we cannot hope to provide a comprehensive discussion of the available options here (though see further readings for some useful starting points). We will, however, mention one final method of responding to the *Freedom Argument* which is, perhaps, the most obvious. This final option is merely to deny the earlier assumption we made that premise 1 is true. Not, of course, because it is presently false that Eva will become an emu farmer, since this would lead us into essentially the same predicament, but rather because the proposition that Eva will become an emu farmer is presently neither true nor false. That is to say that the future is alethically open with respect to Eva's future career. This response seems like an obvious means by which to circumvent the worries concerning human freedom we have considered in this section but, as we will see shortly, it has some issues of its own.

6.3. Against the open future

So, why might someone deny that the future is alethically open? There are a number of possible motivations for this claim. One such argument, offered by Besson and Hattiangadi (2014: 259), points out that it is perfectly acceptable to assert various contingent claims concerning the future (including some statements relating to the, apparently, free actions of human beings). There would, for example, be nothing *prima facie* problematic in someone's asserting that 'I will go to the shops in an hour's time'. It is, however, generally taken to be

a necessary condition of an assertion's being acceptable that it is true. Given this, it looks as if we are committed to the claim that the future is alethically closed at least with respect to claims of this kind. Of course this does not apply to all assertions regarding future contingents. It would not, for instance, be acceptable to assert either that 'human beings will have colonized Mars by 2115' or that 'it is not the case that human beings will have colonized Mars by 2115'. However, this can – as Besson and Hattiangadi (ibid.: 260) point out – easily be accounted for by an appeal to epistemic openness since neither of these claims seems to be (at present) knowable and it is typically taken to be problematic not only to assert what isn't true but also to assert what you do not *know*.

There is much that can be said with respect to this argument and the numerous other arguments which have been offered for the claim that the future is alethically closed (see further readings for details). In this section, though, we will focus primarily on the worry that upholding alethic openness requires that we reject some aspect of the standard logical system – *classical logic* – which the vast majority of philosophers employ in their reasoning. While the possibility of abandoning classical logic has, as we will see, proven attractive to a number of philosophers, most find such a move to be anathema, believing that 'Classical logic and semantics are vastly superior to the alternatives in simplicity, power, past success, and integration with theories in other domains' (Williamson 1992: 162).

The most obvious worry in this vein is that alethic openness is in conflict with the principle of classical logic known as *bivalence*: the principle according to which every proposition is either true or false. This principle is seen by many as both a piece of straightforward common sense and as a key component of much of our reasoning (in philosophy and elsewhere). Even those, such as Ned Markosian, who themselves reject bivalence accept that 'for many people, the principle of bivalence enjoys the status of a long-standing, pre-philosophical intuition' (1995: 97) and that the principle should not be abandoned without good reason (we consider Markosian's argument for rejecting the claim in section 6.5). If, though, the future is alethically open and it is presently neither true nor false that there will be a sea-battle tomorrow then it looks as if we must reject bivalence. It appears, therefore, that the defender of the alethically open future is left with two options. They can either argue that rejecting the principle of bivalence is not so problematic after all or else argue that, appearances notwithstanding, the claim that the future is alethically open is (when appropriately finessed) compatible with bivalence.

The standard methods for rejecting bivalence with respect to future contingents are either to claim that some claims about the future presently have no truth value or to introduce an additional truth value (or truth values) which can

be applied to such propositions. We will focus here on the second of these options.

In order to see how such an option might develop A. N. Prior (1953: 317–18) asks us to consider some system of logic in which the 'truth-values of which the propositions of the system are considered to be capable are truth, symbolised by "1", falsehood, symbolised by "0", and a third, symbolised by "½"'. The addition of this third truth value, often known as 'indeterminate', certainly seems to accommodate our intuition that the future is alethically open while the past is not. While claims about the past and present will receive one of the standard truth values of 1 or 0 (that is, they will either be true or false), many propositions regarding the future – those which are presently alethically open – will receive the additional truth value of ½. Such propositions, then, will be neither true nor false at present but will possess the third truth value of indeterminate. Further, the introduction of this third truth value need not merely be an *ad hoc* response to worries concerning the open future since there are a number of other areas where positing a third truth value might prove useful.

We have suggested above that philosophers typically accept that all propositions concerning the past and present are either true or false but this is not quite true. Leaving aside worries about the open past which we will address later in this chapter, a number of philosophers have proposed that certain claims about the present are neither *determinately* true nor false, the most common example of this being claims involving 'vague predicates' which Rosanna Keefe (2008: 315) describes as follows:

> Vague predicates, such as 'tall', 'bald', 'heap', 'rich', 'baby', typically have borderline cases, apparently lack sharp boundaries and are susceptible to sorites paradoxes. Consider, for example, the question whether my young child is still a baby (rather than, for example, a toddler). There is not an instant at which it suddenly becomes false to say that she is a baby, and there are stages at which she is a borderline case of a baby – neither clearly a baby nor clearly not one. A sorites paradox can be formulated when we formulate the compelling premise 'if a child is a baby at some instant, then it is still a baby one second later'. For we can use this to argue from the true premise that a three-day old child is a baby to the false conclusion that it is still a baby at 5 years old.

It is a vexed matter how we are to handle borderline cases containing such predicates. One possible solution (not Keefe's own) though, is to introduce a third truth value to handle such cases. We can say, then, that it is neither true nor false but indeterminate that borderline cases of tallness are tall, of redness are red and so forth.

There are, however, some costs to claiming that future contingents have this third truth value of indeterminate. The view is certainly one that many people find counterintuitive in some respects – Prior (1953: 317) notes that many philosophers, himself included, 'have a strong initial repugnance to the whole conception of a three[truth]-valued logic' – but some worries for the view run deeper that that. One such concern is that introducing a third truth value would require quite sweeping changes in the kinds of logical system which philosophers typically employ. Consider, for example, inclusive disjunction. In classical logic an inclusive disjunction of the form 'P or Q' is true if P is true, if Q is true or if both P and Q are true, whereas it is false if both P and Q are false. It is not immediately clear, though, what we should say about the truth value of the disjunction in a system where both P and Q are indeterminate. This worry is by no means a decisive one and many of those who have proposed three valued logics have gone to great lengths to account for how various logical operators – disjunction, conjunction, negation etc. – should be accommodated within their systems. A second concern regarding accounts of this kind relates back to Besson and Hattiangadi's assertion argument above. If we accept that some future claim – for example, the claim that you will go to the shops in an hour's time – has the truth value of indeterminate then it follows that this claim is not true and, as such, it seems that it should never, *contra* our ordinary intuitions concerning such cases, be acceptable for you to assert this claim. Finally, there is a worry that the introduction of a third truth value doesn't really get to the core of the issue. Ross Cameron (2015: 227), for example, claims that the third truth value account of indeterminacy 'doesn't seem to capture the phenomenon: adding a third truth-value does not help us capture the thought that some propositions are unsettled between the initial two truth-values'. What we need according to Cameron and others (such as Wright 2003 and Barnes 2010) is not an account according to which it is settled that indeterminate claims – concerning contingent future events or otherwise – have some third truth value but rather one where it is unsettled which of the two classical truth values of truth and falsity they possess. Those interested in pursuing such options are encouraged to consult the further readings. For now, though, we turn to the second option for those who wish to defend the alethically open future: trying to preserve classical logic by retaining bivalence.

This strategy may initially seem like a complete non-starter. To say that the future is alethically open commits us to the claim that some propositions about the future are neither true nor false whereas bivalence is the claim that all propositions have one of these two truth values. What clearer example of a contradiction could there be? Some philosophers do not think that things are quite that simple though. One common strategy in this respect is to distinguish between the claim that the disjunction ('P is

true or P is false') is true and the claim that one of its disjuncts (either 'P is true' or 'P is false') is. According to this view while it is not presently true that there will be a sea-battle tomorrow and not presently false that there will be a sea-battle tomorrow, it *is* presently either true or false that there will be a sea-battle tomorrow. Why is this? Well consider that even though (we will assume) nothing presently makes it true that there will be a sea-battle tomorrow and nothing presently makes it true that there will not be a sea-battle tomorrow, the fact that there either will or won't be a battle is determined by the laws of classical logic alone. This approach has recurred a number of times in the history of the open future debate (indeed some, such as Willard Van Orman Quine 1953: 65, take it to be part of Aristotle's own response to the worries he raises concerning potential sea-battles). It is not, however, a convincing one. As mentioned above, a disjunction of this kind is taken to be true in classical logic iff either of its disjuncts are true, and a rejection of this classical view of disjunction has struck a number of philosophers as absurd. Quine (ibid.), for example, is famously uncompromising in urging us to eschew the 'desperate extremity of entertaining Aristotle's fantasy that "It is true that p or q" is an insufficient condition for "It is true that p or it is true that q"'. Even if we do not find the rejection of the classical conception of disjunction to be a 'desperate extremity', though, it is certainly a strange move to make within the current debate. Remember that the standard motivation for retaining bivalence is the desire to preserve classical logic but the proposed manoeuvre only saves bivalence at the cost of rejecting another element of the classical picture.

We have seen, then, that there are some serious worries regarding the claim that the future is alethically open. One response for those convinced that the arguments against the alethically open future are cogent is to reject the view that the future is open in any theoretically interesting sense, but this is not the only option available to them. A number of philosophers – such as Elizabeth Barnes and Ross Cameron (2009, 2011) – have recently defended ingenious new accounts of the openness of the future. Such accounts aim to retain the rules of classical logic while allowing that the future is not merely epistemically, modally or causally open. Those interested in the details of such accounts – and the arguments for and against them – are encouraged to consult the further readings at the end of this chapter.

6.4. The ontology of the open future

So far in this chapter we have been looking at debates concerning the truth values of certain contingent claims regarding the future. Earlier, in Chapter

5, we looked at debates concerning the ontological status of the future (as well as the past). We also briefly suggested that there might be some reason to think that some views concerning the ontology of time are better able to account for the intuition that the future is open than others. In this section we will ask whether there really are such connections between these two debates.

As we already mentioned in section 4.5, the apparent conflict between the open future and eternalism is not difficult to see. If it is presently true that various future times exist then surely it is either presently true that those times contain sea-battles, human colonies on Mars etc. or presently false that they contain such items. It seems, then, that anyone who adopts an eternalist view of the ontology of time is also committed to the view that the future is alethically closed. This conflict may, however, be merely apparent. Barnes and Cameron (2009: 305) have recently outlined a peculiar form of eternalism that seems able to account for the future's being alethically open, arguing that

> [t]he existence or otherwise of the future is simply not the issue. What matters to the open future is solely that it is presently unsettled what entities will exist. One way to argue for this unsettledness is to deny that there are any future entities (whilst also providing some argument that nothing *else* could settle what entities will exist other than the future ontology itself); but our point is simply that this is not necessary. It is perfectly consistent to claim that there are future entities, but that it is as yet unsettled *which* future entities there are: that's exactly analogous to claiming that it's perfectly settled that there is a colour that this borderline colour patch has, but that it's unsettled which colour it has.

While Barnes and Cameron's own focus is, as mentioned above, on a new kind of non-alethic openness, we take it that the lessons they adduce can usefully be applied with respect to alethic openness as well. Someone who holds a 'three truth value' account of the open future might, for example, claim that while it is presently true that the future exists it is presently indeterminate what the future is like. So, claims like 'future objects exist' will be given a truth value of 1 whereas claims like 'there will be a sea-battle tomorrow' will be given a truth value of ½ since it is presently indeterminate whether the future is such as to include such a battle (just as statements about the colours of borderline colour patches will often be given a truth value of ½ even though it is uncontroversially true that the colour patches themselves exist).

It is an overstatement, then, to claim that no version of eternalism is compatible with the claim that the future is open. Certainly, though, we should be happy to accept that the standard versions of eternalism we addressed in Chapter 5 are incompatible with the future's being alethically

open. In particular, the view that the future is alethically open is incompatible with the B-theoretic version of eternalism which provides the main locus for discussion in the literature. Barnes and Cameron's view requires some statements such as 'there will be human colonies on Mars by 2115' to move from being indeterminate to being true (or false) as time passes. Such an account will, however, be anathema to the B-theorist since it presupposes an A-theoretic notion of temporal passage (for more on this notion see Chapter 4).

At first glance, the presentist doesn't appear to be straightforwardly committed to any particular view as to the openness of the future. There may, however, be some reason to think that the presentist will have trouble accounting for the future's being alethically open. Consider the following line of reasoning:

> The presentist is committed to regarding the past and future as being on an ontological par (since neither of them exists) and, as such, they should regard them as alethic equals. So the presentist should either adopt an open past/open future view or else a closed past/closed future view since any other combination would risk a charge of arbitrariness. Given, though, that the past is clearly not alethically closed, the presentist should reject the open future view.

There is a lot to say about this argument. It is, for example, not as clear as it might seem that the past is alethically closed (as we discuss in the next section). The presentist may also object that their adopting a closed past and open future view is not as arbitrary as it may seem.

In order to adjudicate this issue we would need to return to the debate concerning truthmakers for presentism which we examined in Chapter 5. The presentist cannot appeal to the past or future themselves to serve as truthmakers for their claims about the past or future but, as we have seen, the range of alternative options available to them is extensive. What the presentist needs – if they are to account for the intuition that the future is open and the past closed – is for there to be some truthmaker which is available for past truths but not for future truths. Whether the presentist is ultimately able to offer a convincing account of this kind is a difficult matter to resolve and one which has received surprisingly little attention in the literature on presentism (the debate between Craig 2001 and Diekemper 2005 being one notable exception). We will consider one possible response the presentist could offer in the next section. For now, though, we will turn to consider the relationship between the growing block view and the open future.

In many respects the growing block view appears ideally placed – as Joseph Diekemper (2005) argues at length – to accommodate the intuition

that the future is open and the past closed (so much so that even professional philosophers occasionally make the mistake of conflating the two views). The growing blocker can account for the alethic disparity between the past and future by appealing to their *ontic* asymmetry (Tooley 1997: 135–46 offers an influential account in this vein). Statements about the past are made true by past events, whereas statements about the future have no future events to serve as their truthmakers. So far so good for the growing blocker who endorses the views that the future is alethically open. One might object, though, that our intuition is only that *some* future contingents are alethically open, not that *all* future contingents are. Briggs and Forbes (2011: 258), for example, point out that it certainly appears to be presently true 'that there will be a lunar eclipse on January 21, 2019. (Astronomers know that there will be a lunar eclipse on January 21, 2019, and what is known is surely true.)' How should the growing block theorist account for this? It looks as if they must either deny that any future contingents are presently true or else allow that some claims about other times are not made true by the times themselves. Yet, neither of these options seems particularly attractive. The first requires the growing blocker to reject some intuitively obvious claims concerning the future whereas the latter requires them to sacrifice one of the key *prima facie* advantages their view has over the presentist's.

We have focused above on the relationship between the open future and the 'big three' rival positions concerning the ontology of time but it is worth noting that considerations concerning the open future have sometimes been used to motivate the acceptance of more exotic accounts of the nature of time. Storrs McCall (1994: 3), for example, proposes a model of time in which the universe has 'the shape of a tree, with a single four-dimensional trunk for the past and a densely branching set of four-dimensional manifolds for the future'. On McCall's model there presently exist a great many possible futures (represented by the branches of this tree) which gradually disappear as time progresses and more and more of reality becomes part of the closed past (the tree's trunk). The tree '"grows" or ages by losing branches' (ibid.). We will not, however, discuss either the plausibility of such exotic accounts or their ability to account for the open future intuition here (though those interested in pursuing such matters are encouraged to consult the further readings).

6.5. The open past?

We mentioned at the opening of this chapter that our standard view of the world appears to be one in which the past is closed and the future open. As we have seen, though, there is controversy both as to what sense of

openness is relevant here and as to whether the future really is open in this sense. In this section we will investigate a different issue: the openness of the past.

As with the claim that the future is open, the claim that the past is open admits of a number of different readings. It is certainly clear that the past is, in some respects, epistemically open for us. There are, after all, various things concerning the past – how many stars there were in the universe five minutes ago, what Julius Caesar's last thought before being assassinated was etc. – which no present human being knows. Whether the past is causally closed is rather more controversial. One way in which it might be possible for us to causally influence the past is by going there via the means of time travel (something we will discuss at length in Chapter 9) but some (such as Dummett 1954) have argued that it is possible to causally influence the past in ways which do not involve time travel. As with the debate over the open future, though, we will not have much to say about these kinds of openness but will, instead, focus primarily on alethic openness.

Why, then, might someone be inclined to doubt the apparently obvious claim that the past is alethically closed? One motivation concerns the various cases we mentioned above – concerning vagueness and the like – which some philosophers are inclined to address by postulating an additional truth value of indeterminate. If it is presently indeterminate whether a particular colour patch is red then it is, presumably, also indeterminate whether it was red a second ago. We will, however, ignore such general considerations in what follows and focus on cases of openness which result specifically from concerns relating to the philosophy of time.

One motivation of this kind ties alethic openness very closely to epistemic openness. Anti-realists concerning the past might, for example, maintain that a proposition about the past is true iff we possess sufficient evidence of its truth (and false iff we possess sufficient evidence of its falsity) or that a proposition about the past is true iff it is in some sense possible for us to verify that proposition (and false if it is possible to falsify it). There seem, though, to be some propositions about the past – think, again, about propositions concerning Caesar's dying thoughts – which will be neither true nor false according to such accounts. As such, those who accept such anti-realist views about past truth will likely be committed to the claim that the past is alethically open (see Dummett 2004 for an in depth discussion and critical evaluation of such views). A second motivation, and one which will form our main focus in this section, arises from the Truthmaker problem for presentism which we discussed in Chapter 5.

Markosian (1995) proposes that a very attractive solution to the Truthmaker problem for presentists is to maintain that claims about the past and future are made true by facts concerning (i) the present state

of the universe and (ii) the laws of nature. Consider some proposition, P, regarding the immediate future. P will be true at present if the present state of the universe plus the laws of nature entail that P, false if the present state of the universe plus the laws of nature entail that not P, and neither true nor false if neither of these is the case. This proposal has a number of advantages. It seems, for example, to account for the intuition that it is not presently true that there will be human colonies on Mars in 2115 as well as the intuition that it is presently true that there will be a lunar eclipse in January 2019 (assuming we accept the plausible claim that the latter but not the former is guaranteed by the present state of the universe plus the laws of nature). Further, as Markosian (ibid.: 97) himself stresses, it provides us with a useful response to the worries concerning free will etc. which we discussed in section 6.2. As we have seen, one of the most prominent arguments for the claim that the future is alethically open is that human beings have free will and that this can only be accounted for by postulating an open future. Whatever else can be said in favour of this argument, though, it only looks to be persuasive when aimed at those already open to the idea that human beings genuinely possess free will. By contrast, if aimed at those who deny (or at least question) human freedom it would be a 'question-begging defense, since the very claim that we *are* free is at stake' (ibid.). By contrast, Markosian's view does not beg the question here since the claims he makes, concerning the laws of nature and truthmakers for presentism, do not presuppose any particular answer to the question of whether human beings are free.

If we are willing to go this far, though, then it looks like we should also be willing to go further since – as Markosian (ibid.: 100) points out – many of the relevant laws of nature are *time-symmetrical*. That is to say that

> If a particular sequence of world states, WS_1, WS_2, …, WS_n, is allowed by that law, then the sequence WS'_n, …, WS'_2, WS'_1 (where WS'_i is the reverse-state of WS_i, for any number, i) is also allowed by the law. That is, if a given sequence of world states is allowed by the law, then so is the sequence that is, roughly speaking, the first sequence in reverse.

Put simply this means (roughly) that in many cases where the present state of the universe plus the laws of nature allow for multiple possible futures these will also allow for multiple possible pasts. If we accept this, though, then it looks as if the presentist who accepts the open future view is also committed to accepting that the past is open (at least, that is, if they accept Markosian's 'laws of nature' account of truthmakers for future truths along with the claim that the presentist should employ truthmakers of the same kind for both past and future truths).

What, then, should we make of this argument? Markosian himself admits (ibid.: 103) that the considerations he adduces do not demonstrate that the past is open but, rather, that there

> are two morals that one might reasonably draw from these considerations. On the one hand, one might draw the moral that it was a mistake to defend the claim that the future is sometimes open by appealing to indeterminism in the laws of nature together with some appropriate version of the correspondence theory of truth. The difficulty with drawing this moral, however, is that there appears to be no other, non-question-begging of the claim that the future is sometimes open. On the other hand, one might draw from these considerations the moral that the future is sometimes open, and the past is too.

So, the main motivation Markosian offers for accepting the first moral is that accepting the second leaves us with no (non-question begging) argument in favour of the claim that the future is open. There are, however, a number of ways in which we might reasonably avoid concluding that the past is alethically open. First, we could simply reject the claim that the future is alethically open. Second, we could try to offer some other argument for the future's being open which doesn't beg the question against those who deny the existence of free will. As we hope our discussions above (along with many of the further readings we list below) illustrate, both of these options have their share of defenders.

6.6. Summary

In this chapter we have considered how best to explicate the notion that the future is, in some sense, open. We focused primarily on the claim that the future is alethically open and saw that there are a number of *prima facie* very plausible arguments in favour of this claim but that it also encounters some worrisome objections: objections that have led some to abandon the view that the future is open in the way we pre-theoretically take it to be, and others to try to retain our pre-theoretic intuitions about the open future but to explain these in ways that do not involve an appeal to specifically *alethic* openness. We also saw that it is not as straightforward as it may initially seem to determine which views concerning the ontology of time are best able to account for the intuition that the future is alethically open. Finally, we looked at the possibility that – contrary to our standard way of viewing the world – the past may also be open. In the next chapter we turn to ask how ordinary

objects persist through time and what consequences, if any, this has for the debates we have addressed thus far.

Study Questions

1. What are the different ways of interpreting the intuition that the future is open? Which of these most closely matches your own view of what we mean when we say the future is open while the past is closed?
2. Does human freedom require that the future is alethically open?
3. Does the open future view require us to abandon bivalence? If so, is this a problem for the open future view?
4. In what sense(s) should we accept the claim that the past is open?

FURTHER READINGS

Some useful general overviews of issues concerning the open future include Øhrstrøm and Hasle (2011) and Torre (2011). As we mentioned in this chapter the correct interpretation of Aristotle's famous sea-battle problem – and his own response to it – has been the subject of much dispute. Some influential discussions of these issues include Ockham (1969), Anscombe (1956), Strang (1960), Hintikka (1964) and Williams (manuscript). For discussions of how best to formulate the intuition that the future is open see Mayo (1962), Barnes and Cameron (2009, 2011) and Briggs and Forbes (2012). As we mentioned, the literature concerning free will is vast but some particularly useful discussions include van Inwagen (1983), Dennett (1984) and Steward (2012). Frankfurt (1969) presents an influential argument for the claim that free will doesn't require the ability to do otherwise. For explicit discussions of the relationship between free will, fatalism and the open future see Diekemper (2004), Rea (2006), Finch and Rea (2008) and Bourne (2011). These issues also have important analogues within debates in the philosophy of religion concerning freedom and God's foreknowledge. For more on these debates see Craig (1988) and Zagzebski (1991). Probably the most influential modern account of the 'third truth value' approach to the open future was presented by the Polish philosopher and logician Jan Łukasiewicz (1952). For other discussions of the logic of future contingents given the alethically open future see Forbes (1996), MacFarlane (2003) and García-Carpintero (2013). For some additional discussion of the consequences of claiming that the future is alethically open see Pruss (2010), Rhoda (2010), Raven (2011a) and Rosenkranz (2012). Todd (2016) defends the view that all future contingents are false and Beall (2012) considers the view that there might be an overabundance of truth values for future contingents. For further discussions of the relationship between the open future and the ontology of time (and metaphysics more generally) see Miller

(2006a), Kodaj (2014) and the essays in Correia and Lacona (2013). For further discussion of the claim that the past might be open in various respects see Dummett, (1964), Gorovitz (1964), Price (1984), Goddu (2011), Hazlett (2011) and Makosian (2013).

7

Perdurance and endurance

This chapter centres on the question of how ordinary objects (like chairs, trees and human beings) persist through time. We give particular attention to the debate between the endurantist and the perdurantist. The discussion in section 7.4 focuses on some complex issues at the intersection of persistence and temporal ontology. Readers who find this material difficult at first are encouraged to consult the relevant further readings (and, in particular, Zimmerman 1996).

Bertrand Russell once famously quipped that it is common practice among philosophers to begin their arguments with 'something so simple as not to seem worth stating, and to end with something so paradoxical that no one will believe it' (Russell 1918: 321). The debate between the endurantist and the perdurantist may strike you as a perfect example of this. The simple fact we begin with is that various things persist across time. The authors of this book were born at some point in the past and will (we hope) continue to exist for quite some time into the future. The Colossus of Rhodes was completed in 280 BC and destroyed by an earthquake 54 years later. Mayflies hatch, live their famously short lifespans and then die. So far, so obvious. Why, then, do philosophers have such difficulty accounting for this commonplace fact?

In this chapter we look at the most prominent philosophical attempts to account for the fact that ordinary objects persist through time, examining the various problems and paradoxes they encounter. In section 7.1 we present the endurantist view, according to which, objects persist through time by virtue of being wholly present at every time at which they exist. Many philosophers regard the endurantist's view as by far the most intuitive account of how objects persist through time, but, as we will see, it also encounters a powerful objection in the form of the so called 'problem of temporary

intrinsics'. In section 7.2 we outline the most prominent rival to the endurantist view: perdurantism. According to the perdurantist, objects persist through time by having what philosophers call a 'temporal part' located at each time at which they exist. We will also consider some worries facing the perdurantist account. In section 7.3 we consider a new contender on the scene, stage theory, and consider whether there are any reasons to prefer it to rival accounts. Finally, in section 7.4, we ask whether accepting an account of how objects persist through time commits one to a particular ontology of time.

7.1. Endurantism

The endurantist maintains that ordinary objects – such as people, pigeons, pies and pyramids – persist through time by virtue of being wholly present at each of the times at which they exist. They maintain that ordinary persisting objects

> have three spatial dimensions and move through time. Persistence in three dimensions means that an object is at one time, then the next time, then the next time, and so on; things are wholly present at each time at which they exist. An object that is here now is entirely here now. (Hales and Johnson 2003: 524)

As presented, the endurantist view may initially strike you as little more than a restatement of the common-sense claim we are trying to account for: that ordinary objects persist through time. The Eiffel Tower, the *whole* Eiffel tower, stands in Paris right now. Just as the whole tower *was* there yesterday and when it was completed in 1889. Just as the same tower *will* (very likely) still be there tomorrow and in a decade's time. The very same three-dimensional object has persisted through time and change. And what holds for the Eiffel Tower holds for you, for us and for most of the objects we encounter in our daily lives. Things for the endurantist are not, however, as uncomplicated as they may initially appear.

First, there is a debate concerning how exactly the endurantist's key notion of 'being wholly present' is to be understood. This apparently straightforward notion has proven surprisingly difficult to analyse and a number of competing accounts have been offered. We will not, however, enter into this debate here – though those interested in pursuing it are encouraged to consult the further readings – and will merely assume that a persisting object is wholly present at a time if it is present at that time and its being so isn't a matter of its having a temporal part at that time (we will explore what it means to have temporal parts in section 7.2).

A second difficulty for endurantist accounts runs deeper. It seems that, however it is ultimately explicated, the claim that ordinary objects persist through time by being wholly present at different times quickly leads us into paradox. To begin to see the problem, take one example of a persisting object: the actor Mickey Rooney. Now consider Rooney as he was in 1927 when he landed his first film role (Young-Rooney) and Rooney as he was filming his final feature in 2014 (Old-Rooney). Old-Rooney and Young-Rooney have a lot in common; they are both human beings, both male, both called 'Mickey Rooney' and so forth. Yet, there also seem to be a number of important properties which the two do not share. Old-Rooney has been married eight times whereas Young-Rooney has never married, Young-Rooney has a full head of hair whereas Old-Rooney is bald, Old-Rooney is 93 years old whereas Young-Rooney is only 6 and so on. Such differences in properties are key to the following argument (where *p* is some property, such as being bald, which Old-Rooney has but which Young-Rooney lacks):

Different Properties Argument

(1) If Young-Rooney is numerically identical to Old-Rooney then they must have all the same properties.

(2) Old-Rooney has property *p*.

(3) Young-Rooney does not have property *p*.

Therefore,

(4) Young-Rooney and Old-Rooney are not numerically identical.

If this argument is sound then it seems that Young-Rooney and Old-Rooney cannot be the same person after all (since they are not numerically identical). It cannot be then that – as the endurantist maintains – a single person (Mickey Rooney) has persisted through time and change by being wholly present at different times. Is the *Different Properties Argument* sound though?

Perhaps not. We may, for example, ask why the endurantist cannot merely reject premise 1. The primary motivation for accepting this premise comes from an influential and intuitive principle known as 'the indiscernibility of identicals' or 'Leibniz's Law' (see Chapter 2 for discussion of Leibniz and his views). Leibniz's Law maintains that if *a* and *b* are numerically identical then they must have all the same properties. This means that if *a* and *b* differ in the properties they possess then they can't be numerically identical: if Mark's car is red and the car Mary is driving is blue then Mary isn't driving Mark's car; if Esther is six foot tall and the murderer is five foot nine then Esther isn't the murderer; and so on. If, however, Old-Rooney *really* is the same person as Young-Rooney then surely they must be numerically identical and as such

have all the same properties. But, since this is not the case, it looks as if the two Rooneys can't be the same person after all. Leibniz's Law is certainly a very attractive principle – especially when restricted to what we will later term 'intrinsic properties' – but it is not uncontroversial (as discussed in the further readings). Even if we reject Leibniz's Law, though, a deeper problem lurks.

A further worry for the endurantist is that it is not only possible for Young-Rooney and Old-Rooney to have different properties but also for them to have *incompatible* properties. For example, to adapt a famous case from David Lewis (1986: 203), Young-Rooney may be sitting while Old-Rooney is standing. It is not possible, though, for any individual to be both sitting and standing (since these are incompatible properties) so Young-Rooney and Old-Rooney cannot, common sense notwithstanding, be the same person. It seems, then, that we can offer a strengthened version of the earlier argument which is no longer reliant on the truth of Leibniz's Law:

Incompatible Properties Argument

(1) If Young-Rooney is numerically identical to Old-Rooney then they can't have incompatible properties.

(2) Old-Rooney has property *p*.

(3) Young-Rooney has property *q*.

(4) *p* and *q* are incompatible properties.

Therefore,

(5) Young-Rooney and Old-Rooney are not numerically identical.

This argument is an instance of the most prominent objection against endurantism: the problem of temporary intrinsics. Sally Haslanger (1989: 119), herself an endurantist, describes the worry for her own view as follows:

> The problem of temporary intrinsics is this: ordinary objects persist through changes in their intrinsic properties, i.e. those properties which an object has in virtue of the way it is, independently of anything else. To use Lewis's example, 'when I sit I'm bent, when I stand, I'm straight'. But an object cannot have incompatible properties. So how is intrinsic change possible?

Temporary intrinsics are the intrinsic properties which people (and other persisting objects) have at one time but lack at another. They include most of the ordinary properties – standing, sitting, being bald, being 93, being hot or cold etc. – which are the subject of our everyday thought and talk.

If endurantists really are unable to offer a satisfactory account of such properties then this looks to be a fatal blow for their view.

The most common endurantist response to this argument is to reject premise 4 and to deny that Old-Rooney and Young-Rooney genuinely possess incompatible properties. This response may initially seem very strange, for haven't we already seen that Old-Rooney and Young-Rooney possess numerous incompatible properties? The former is bald, the latter hirsute; the former is 93, the latter 6; and so forth. According to some endurantists, though, matters are not as simple as they appear. E. J. Lowe (1988: 73), for example, suggests the following three ways of explaining what it is for some object (*a*) to have some property (*F*) which allows us to escape the problem of temporary intrinsics. We could interpret the claim that '*a* is *F*'

> either as (i) '*a* is *F*-at-*t*' (so that what is really being ascribed to *a* is, say, a shape-at-a-time – a kind of *relational* property), or as (ii) '*a* is-at-*t F*' (so that the ascription of a shape to *a* is *temporally qualified*, i.e., the property-exemplification relation between *a* and a shape is relativized to a time), or finally as (iii) '*a*-at-*t* is *F*' (so that a shape is ascribed to a *temporal part* of *a* […]).

The third solution involves rejecting endurantism altogether – in favour of a perdurantist account – and we will investigate this option further in section 7.2. For now, though, let's look in a little more detail at the first two options.

The first solution is to claim that Old-Rooney does not, strictly speaking, have properties such as being bald, standing or being 93 but, rather, has properties such as being bald-relative-to–2014, standing-relative-to–2014 and being 93-relative-to-2014, whereas Young-Rooney has properties such as sitting-relative-to-1927. Appealing to these 'time-relativized' or 'time-indexed' properties allows the endurantist to avoid any contradiction. It may well be impossible for the same person to be both sitting and standing but there is no such contradiction entailed by the claim that a person is sitting-relative-to-1927 and standing-relative-to–2014. The second option, the so called 'adverbialist' account, provides Lowe's own preferred solution. The adverbialist retains familiar properties – such as standing, sitting etc. – rather than their time-relativized cousins and, instead, modifies the ways in which objects *have* these properties. So objects still have properties like sitting or standing but rather than having them *simpliciter*, have them, e.g. 1927ly or 2014ly. Again, the endurantist is able to avoid contradiction here.

The time-relative property view and the adverbialist view both allow the endurantist to avoid the apparent contradiction resulting from the problem of temporary intrinsics. Yet, these positions encounter worries of their own. The most common charge made against these accounts is that they don't actually account for the common-sense belief that we have different intrinsic

properties at different times but, rather, end up rejecting it. Lewis (1988: 65) claims that on these accounts 'nothing just has a shape *simpliciter*' and that the 'temporary "intrinsic properties" of things, so understood, do not deserve the name'. The time-relativizer rejects the claim that objects have *intrinsic* properties at a time in favour of the claim that these objects bear a particular kind of relation to a time. Whereas the adverbialist rejects the claim that objects straightforwardly *have* properties such as squareness in favour of the claim that they e.g. have them *t1*ly. Surely it would be better, though, if we were able to discover a solution to the problem of temporary intrinsics which allowed us to preserve the intuition that objects have intrinsic properties such as squareness in a straightforward way.

One proposed solution in this vein involves an attempt to sidestep the problem entirely by questioning the picture of time which underlies it. A standard presentist response to the problem of temporary intrinsics is to claim that while it is true – and true in a straightforward way which requires no appeal to adverbialism of time-relativized properties – that a person is presently standing and true that she *was* sitting, this does not entail that there is any object which has both of these incompatible properties. As we saw in Chapter 5, the presentist maintains that the tensed fact that *x was* sitting no more entails that some sitting object exists than does the modal fact that it is *possible* for *x* to be sitting. As such, if we accept a presentist ontology of time, the problem of temporary intrinsics seems to dissipate altogether. How attractive this response to the problem of temporary intrinsics is will, of course, ultimately depend on whether presentism itself is a plausible account of the ontology of time (an issue we address in detail in Chapter 5).

7.2. Perdurantism

We have seen, then, that the *prima facie* appealing account of persistence which the endurantist offers quickly runs into the worrisome problem of temporary intrinsics. In this section we consider the most prominent alternative to endurantism: perdurantism. According to the perdurantist, objects do not persist through time by being wholly present at different times, but rather by having different 'temporal parts' which occupy these different times. An object undergoes a change in its intrinsic properties if one of these temporal parts possesses a particular intrinsic property and another temporal part lacks this property.

In order to understand the perdurantist position it is, of course, crucial to understand the pivotal notion of a temporal part. Sider (2008: 242) offers the following account:

> Temporal parts theory is the claim that time is like space in one particular respect, namely, with respect to *parts*. First think about parts in space. A spatially extended object such as a person has *spatial parts*: her head, arms, etc. Likewise, according to temporal parts theory, a temporally extended object has *temporal parts*. Following the analogy, since spatial parts are smaller than the whole object in spatial dimensions, temporal parts are smaller than the whole object in the temporal dimension. They are shorter-lived.

Young-Rooney and Old-Rooney are not persons in their own right, but rather *parts* of a person. The notion that people have parts is not, in itself, a particularly strange or unfamiliar one. Rooney's right foot was a part of him and so was his left foot. The two and a half million rivets which make up the Eiffel Tower are parts of the tower and so on. These ordinary parts are sometimes referred to by philosophers as 'spatial parts'. The perdurantist adds to this familiar picture another kind of part: temporal parts. The object standing in Paris right now is not the whole of the Eiffel tower but rather a *temporal* part of the tower. The object sitting in your chair right now is not a person but rather a temporal part of a person.

So what are these temporal parts part of? Or, to put it another way, what are persons – and other ordinary objects – on the perdurantist view? According to the perdurantist, persons are identical to four-dimensional objects composed of these temporal parts (such objects are often referred to as 'space-time worms'). Not just any worm will do though. While the perdurantist will typically accept (for reasons discussed in e.g. Sider (2001: 120–32) and Varzi (2011: 208)) that any collection of temporal parts composes *some* object, not every collection of temporal parts will compose the kind of ordinary persisting object we are concerned with in this chapter. It is not, for example, the case that every arbitrary collection of person parts (either temporal or spatial) will compose some person. Young-Rooney and Old-Rooney are (temporal) parts of the same person, just as your present temporal part and your temporal part from the moment you were born are parts of the same person. There is, however, no *person* who has both Young-Rooney and your present temporal part as parts. It seems, then, that there must be something which makes two, or more, temporal parts part of the same person. What though? This is a controversial issue among perdurantists, but David Lewis offers a particularly influential account of what links a single person's disparate temporal parts. Lewis argues (1976: 17) that what matters most in determining whether some future temporal part is part of the same person

> *is mental continuity and connectedness*. […] My present experiences, thoughts, beliefs, desires, and traits of character should have appropriate

> future successors. My total present mental state should be but one momentary stage in a continuing succession of mental states. These successive states should be interconnected in two ways. First, by bonds of similarity. Change should be gradual rather than sudden, and (at least in some respects) there should not be too much change overall. Second, by bonds of lawful causal dependence […] each succeeding mental state causally depends for its character on the states immediately before it.

According to Lewis, then, the different temporal parts of a person are linked by relations between the mental states of these person parts and, in particular, relations of similarity and causal dependence. As already mentioned, though, this view is controversial and other perdurantists might be more inclined to give quite different accounts of what links a person's temporal parts. However we account for these links though, the perdurantist picture of the world – populated as it is by extended space-time worms made up of temporal as well as spatial parts – may initially strike you (as it has many others) as being rather outlandish. We should ask, then, why so many philosophers have been inclined to adopt perdurantism.

A first motivation for accepting perdurantism is the apparent ease with which it can deal with worries concerning temporary intrinsics. Young-Rooney and Old-Rooney are distinct objects and, as such, accepting the claim that one has some property which the other lacks doesn't create even a *prima facie* conflict with Leibniz's Law. Similarly, since they are distinct objects, there isn't even an apparent contradiction involved in asserting that one is sitting while the other is standing. Of course, these two objects are part of some larger object (Mickey Rooney himself) but the problem of temporary intrinsics doesn't arise for this larger object either. Rooney has one temporal part (Young-Rooney) which is sitting and another (Old-Rooney) which is standing. Just as, to return to an example of McTaggart's from Chapter 3, a poker may be hot at one end (one spatial part) and cool at the other (a distinct spatial part). It is no more paradoxical, the perdurantist maintains, for an object's temporal parts to vary in the properties they instantiate – or for them to instantiate incompatible properties – than for its spatial parts to do so. It looks, then, as if the perdurantist can easily dispose of the problem of temporary intrinsics which so vexed the endurantist.

This is not the only motivation for accepting the perdurance view though. Consider the following case from Derek Parfit (1984: 254–5):

> *My Division*. My body is fatally injured, as are the brains of my two brothers. My brain is divided, and each half is successfully transplanted into the body of one of my brothers. Each of the resulting people believes that he is me, seems to remember living my life, has my character, and is

in every other way psychologically continuous with me. And he has a body that is very like mine.

Cases like this, where it appears as if one individual splits into two (fission cases), have generated a great deal of discussion in the literature on persistence. The method of fission – brain bisection, mishap during *Star Trek*-style teleportation or simply dividing like an amoeba – varies depending on the writer, but the basic thrust of these cases is the same. To understand some of the worries such cases generate, consider an individual (Elizabeth) who will shortly fission into what appear to be two resulting individuals (Eliza and Beth). What are endurantists to make of the relationship between Elizabeth and the resulting person(s)? It looks as if they have four possible options: (i) neither of the resulting individuals is Elizabeth; (ii) both of the resulting individuals are Elizabeth; (iii) only Eliza is Elizabeth; (iv) only Beth is Elizabeth.

The first answer is problematic. Consider the relationship which normally holds between individuals and their past and future selves. Whatever the relationship is which we normally think constitutes this 'personal identity' over time – psychological continuity, bodily continuity etc. – we can consistently describe our fission case in such a way that it still holds between Elizabeth and both of her post-fission duplicates (see further readings for much more on this argument and on the problem of personal identity in general). Given this, it may seem reasonable to conclude that both of the resulting individuals are Elizabeth, but this solution soon runs into objections. Imagine that post-fission Eliza and Beth's lives diverge quite dramatically. Eliza becomes an engineer while Beth becomes an emu farmer, Eliza marries while Beth remains single, Eliza turns to a life of crime while Beth remains a law abiding citizen and so forth. It would clearly be difficult to maintain in this case that Eliza and Beth are one and the same person (consider, for example, that someone who accepted this would have great difficulty explaining why it is impermissible to punish Beth for Eliza's crimes). If, though, Eliza is not identical to Beth then they cannot both be identical to Elizabeth. This is a simple consequence of the logical law known as the *transitivity of identity*. To say that identity is transitive means that if *a* is identical to *b* and *b* is identical to *c* then *a* must also be identical to *c*.

This leaves us with a choice between (iii) and (iv). To make this choice we would need to identify a principled reason to favour one individual over the other as the *real* Elizabeth. On what possible basis could we make such a decision though? The worry – as Derek Parfit (1971: 5) puts it with respect to his own fission case – is that at the point immediately after fission each of the resulting individuals is 'exactly similar' and so 'how can I survive as only one of the two people? What can make me one of them rather than the other?' And, of course, what holds here also holds with respect to the relationship between Elizabeth, Eliza and Beth.

It seems, then, that all four of the options we have considered lead to problematic consequences. The perdurantist is, however, able to sidestep this debate entirely. On the perdurantist account, neither Elizabeth (as she existed pre-fission) nor Eliza and Beth (as they exist post-fission) are persons in their own right. Rather, they are temporal parts of two distinct persons. The first person (let's call her E-Eliza) is composed of all of Elizabeth's temporal parts until the moment of fission and all of Eliza's temporal parts after the fission. The second (let's call her E-Beth) is composed of all Elizabeth's temporal parts until the moment of fission and all of Beth's temporal parts after the fission. These two individuals are unusual in a number of ways, most obviously in that they share many temporal parts, but – the perdurantist maintains – there is no paradox here. Distinct individuals can share temporal parts in much the same way that distinct objects can share spatial parts. To claim that E-Eliza and E-Beth share temporal parts is no more metaphysically problematic than to claim that two roads share a section or that conjoined twins share a liver.

So far so good for perdurantism. Unfortunately for the perdurantist, though, their view also encounters some notable objections. Many worries concerning the perdurance view revolve around merely highlighting how counterintuitive the view is and how much it conflicts with our ordinary pre-theoretical picture of the world. More developed arguments have, however, been proffered. One such argument appeals, once again, to the possibility of fission. We saw above that fission cases provide an important motivation for accepting the perdurantist view, but they also create some significant concerns for the perdurantist. Lewis (1986: 218) – perhaps the most prominent defender of a perdurantist ontology – asks what the perdurantist must say concerning a pre-fission individual:

> [W]hat do we say when a [temporal part] shared between two (or more) people is present? Strictly speaking, two people are present there by way of that one [temporal part], but […] It seems for all the world that there is only one. We will have to say something quite counter-intuitive, but we get a choice of evils.

Consider the time (*t*) just prior to the fission case we discussed above and Elizabeth's temporal part at that time (E-at-*t*). On the perdurantist view, E-at-*t* is part of two distinct individuals meaning that there are, in fact, two people (E-Eliza and E-Beth) located where Elizabeth is at *t* by virtue of having a temporal part (E-at-*t*) at *t*. Surely this is the wrong result, though; doesn't common sense tell us that only *one* person enters the fission process?

It looks as if we have the three options here (Lewis's 'choice of evils'). First, we could flatly assert that (appearances notwithstanding) there are in fact two people present at *t*. Secondly, we might maintain that while it is

permissible for most ordinary purposes to assert that there is only one person present at *t,* this claim is, strictly speaking, false. Finally, we could claim that there is only one person present at *t* because there is only a single temporal part of a person (E-at-*t*) present at *t*. Which of these options should the perdurantist adopt? As we will see in the next section, there are a number of philosophers who find the third option to be no evil at all. These philosophers maintain that we ought to identify persons with temporal parts of worms rather than with the perduring worms themselves. For now, though, we will focus on evaluating the first two options, both of which require us to deny (either straightforwardly or with some qualification) the intuitive claim that only one person enters the fission process.

Lewis concedes that adopting either of these options will be a cost for the perdurantist, but he does not think that it will prove a particularly high one. He reminds us (ibid.: 219) that 'we're talking about something that doesn't really ever happen to people except in science fiction stories and philosophy examples, so is it really so very bad that peculiar cases have to be described in peculiar ways?'. How problematic it is for the perdurantist to have to claim that two people are present prior to fission remains a point of some contention, with some, such as Michael Rea (1998: 255–7), claiming it may well be more of a problem than Lewis would have us believe. Further, it is not obvious – as Lewis (1993: 24) later concedes – that this worry can be confined only to science fiction tales and philosophical thought experiments.

We have seen, then, that both perdurantist and endurantist views encounter some worrisome objections. In the next section we will go on to examine a new contender on the scene – the stage theory – and ask whether it can help to resolve some of the issues that rival theories encounter.

7.3. Stage theory

In most respects the stage theorist is in agreement with the perdurantist picture we presented in the last section. They both accept that we do not, *contra* the endurantist, persist through time by being wholly present at different times, and both accept that the universe contains perduring worms made up of temporal parts. They differ, however, when it comes to the question of whether objects such as Young-Rooney and Old-Rooney are persons in their own right. As we have seen above, the perdurantist claims that they are not insisting instead that they are temporal parts of larger space-time worms, some of which are themselves persons. The stage theorist, by contrast, claims that it is these temporal parts (or stages) which are persons, rather than the worms themselves. And what applies to persons applies

also to other ordinary objects. On the perdurantist view, the object presently standing in the Champ de Mars is merely a temporal part of a larger space-time worm which is itself the Eiffel Tower. The stage theorist, by contrast, maintains that the present stage of the tower is itself the Eiffel Tower.

We will shortly go on to ask how the stage view stacks up against the two views of persistence we have considered thus far. Before doing so, though, it is worth pausing to highlight one immediate worry. We said at the beginning of this chapter that the 'obvious fact' which motivated the debate between endurantists and perdurantists is that objects (such as people) persist through time. If the stage theorist is right, though, then people are identical with certain instantaneous objects: their present stages. Doesn't this mean, then, that the stage theorist must deny our obvious fact? The answer to this question is not a straightforward matter. Certainly, the stage theorist will deny that Young-Rooney and Old-Rooney are strictly identical, just as they will deny that the person you are now is identical with the person who existed a mere moment ago. They do, however, attempt to offer an account according to which it is true that you existed a moment ago and (we hope) true that you will exist a moment from now. We will say more about this account towards the end of this section when addressing the argument from lack of change. First, though, we'll look at some considerations in favour of the stage theoretic view.

To understand why someone might find the stage view attractive, let's look at the responses which the stage theorist can offer to the problems we've raised for rival views earlier in this chapter. The stage theorist can easily respond to the problem of temporary intrinsics since they, like the worm theorist, will deny that Young-Rooney and Old-Rooney are identical. The alternative story they offer is, however, importantly different. The stage theorist agrees with the perdurantist that Young-Rooney and Old-Rooney are distinct objects, but claims that these two objects are both persons in their own right, rather than merely being temporal parts of the same person. They do, however, maintain the key claim that Young-Rooney and Old-Rooney are non-identical and so encounter no worries concerning Leibniz's Law or incompatible properties. The stage theorist is likewise able to give a simple and straightforward account of fission cases. Eliza, Beth and Elizabeth are distinct objects (just as Eliza now is distinct from Eliza one second ago). This response is, of course, a version of the first solution we surveyed in the last section and, as such, encounters the same worries. As we will see below, though, the stage theorist is able to adopt a response to this worry which is unavailable to the endurantist. The stage theorist is also able to provide a straightforward solution to the problem we raised for the worm theorist above. The stage theorist is not only able to explain the common-sense answer that two individuals exist post-fission but also the common sense answer that

only one individual exists pre-fission. The stage theorist identifies persons with stages rather than worms and there is only one person stage present at the moment immediately before the fission (whereas there are two stages present at the moment immediately after).

So why might someone reject the stage theoretic view? Here's one prominent argument against the view:

No Change Argument

(1) If the stage view is true then objects don't genuinely change.

(2) Objects genuinely change.

Therefore,

(3) The stage view is false.

The *No Change Argument* is clearly valid, but is it sound? We'll take it for granted that premise 2 is true and that objects do undergo genuine change. What we need to investigate, then, is whether we have good reason to accept premise 1.

Before doing so, though, it is worth noting that an argument very closely paralleling the *No Change Argument* can also be raised against the perdurantist view we discussed in the previous section. To understand the worry for the perdurantist, consider, again, the debate between Russell and McTaggart we considered in Chapter 3. The main thrust of McTaggart's argument for the claim that Russell's account of change is no account at all is (as we discussed already in Chapter 3) the claim that Russell's view cannot account for changes in events. However, McTaggart also makes the claim that changes in objects of the sort Russell proposes are not instances of genuine change. He argues, for example, that in the case of the poker which is hot on a particular Monday and cold at all other times that it

> is always a quality of that poker that it is one which is hot on that particular Monday. And it is always a quality of that poker that it is one which is not hot at any other time. Both these qualities are true of it at any time […] And therefore it seems to be erroneous to say that there is any change in the poker. (1927: 14–15)

Rephrasing this argument in terms of temporal parts, we can say that the poker has one temporal part 'Hot' that always has been and always will be hot and another 'Cold' that always has been and always will be cold. Neither Hot nor Cold ever undergoes any change. Nor, the argument goes, does the larger space-time worm of which they are parts; at any time it is true to say of

the worm that it has a part (located at a certain time) that is hot and another (located at a different time) that is cold. The question becomes whether this is sufficient for genuine change. This question is a difficult and controversial one with some, such as Heller (1992), maintaining that it is while others, such as Lombard (1994), demur. We will not, however, address this debate here but will focus instead on the 'no change' problem as it applies to the stage theorist.

This version of the challenge appears – at least at first glance – to be even more worrisome than the version faced by the perdurantist. Recall that, according to the stage view, you are identical to your current stage and your current stage is only an instantaneous object. Whatever genuine change requires, though, it is surely something that has to happen over a time rather than at an instant. Given this, it looks as if the stage theorist must deny that it is ever possible for you to undergo change. And what applies to you applies, of course, to all of the other objects we ordinarily think of as undergoing change. To see how the stage theorist might respond to this kind of worry, we need to return to the earlier question of how they are able – given their commitment to the view that ordinary objects are identical to instantaneous stages – to account for our 'obvious fact': the fact that these persist through time? Katherine Hawley (2001: 46) presents the worry as follows:

> Is stage theory genuinely a viable account of persistence? Some readers may already have their doubts, which I will now begin to address. One worry concerns 'sameness' over time. According to stage theory, many present stages are bananas, and many stages tomorrow are bananas. But this seems to omit the important fact that some of those stages are intimately linked, that certain stages today are the *same* banana as certain stages tomorrow.

In discussing the endurantist position above, we took it for granted that saying that *a* and *b* are the same person (or the same banana for that matter) commits us to the claim that *a* and *b* are numerically identical. And this is, of course, a claim that the stage theorist must deny with respect to Young-Rooney and Old-Rooney. It is not obvious, though, that sameness of person must be interpreted in this way. Indeed Hawley herself explicitly denies this. She begins by noting that

> According to perdurance theory, some series of stages form persisting people, some series form persisting chairs, and some series don't form anything interesting, like the mixed-up collection of your stages and mine. Similarly, stage theory has it that some stages are 'the same person' as each other […] whereas other stages, the members of other more

> mixed-up series, do not stand in any such interesting relations to one another. (ibid.: 69)

She then turns to ask what it is – given that it cannot be numerical identity between stages – that makes two stages the same person according to the stage theorist. Her response to this is to appeal to the idea of 'suitable relations' between stages. When it comes to the question of what these suitable relations are, there are a number of possible answers, but there is no need to provide a definitive answer here (though see Hawley 2011: 68–99 for Hawley's own account). Instead, we can merely note that the stage theorist is able to appeal to a number of plausible accounts of what makes two stages the same person (accounts paralleling those concerning e.g. mental continuity and connectedness which the perdurantist gives of what makes two temporal parts parts of the same person).

With this notion of 'same person' in place, it is easy to see how the stage theorist might go about responding to the concerns we have raised above. With respect to the worry about persistence they can say that even though you are, strictly speaking, an instantaneous object, it is still true to say of you that you persist through time if some other instantaneous object which existed in the past, or will exist in the future, bears this same person relation (however we ultimately explain this) to you. With respect to change, the stage theorist can maintain that you have undergone change if there is one instantaneous stage which is the same person as you which has some property *p* and another instantaneous stage which is the same person as you which lacks this property. This account may not satisfy everyone – since it appears to always be true of the relevant stages themselves that they have or lack the properties in question – but it at least seems to put the stage theorist on an even footing with the perdurantist. Finally, returning to our discussion of fission cases above, we can see in more detail why the stage theorist appears to be in a better position than their rivals. While the stage theorist must deny that Elizabeth is identical to either Beth or Eliza they can accept that she bears the same person relation to both of them, the very same relationship that, they claim, we all bear to our past and future selves. The same person relation is importantly different to identity in some key respects. In particular, it is not transitive, so we are not committed to the claim that because Elizabeth is the same person as both Eliza and Beth, they are the same person as each other (consider, for example, that there is no relationship of mental continuity and connectedness between Eliza and Beth).

7.4. Persistence and temporal ontology

In Chapter 5 we looked at the debate between the presentist, the eternalist and the growing blocker over the ontology of time. In this section we will ask whether there are any interesting connections between these debates and the controversy concerning persistence we have considered in this chapter. We will focus primarily on the relationships between the presentism vs. eternalism debate and the endurantism vs. perdurantism debate since these have been the locus of most of the recent debate on this issue.

Philosophers have often taken these two debates to be very strongly linked to the extent that, as Sider (2001: 68) correctly notes, 'many early writers seemed to think of eternalism and perdurance interchangeably'. Those who endorse presentism will, the standard view maintains, adopt an endurantist account of persistence, whereas those who favour eternalism will adopt a perdurantist account. What motivates this connection though? One possible motivation is the thought that presentism provides the only possible way to consistently adopt an endurantist account of persistence. Consider an individual who reasons as follows.

> The endurantist account of persistence is clearly more intuitively plausible than the perdurantist account. Given this, I should adopt the endurantist view if (but only if) it is possible to do so in a way which is consistent with my other metaphysical beliefs. If I am a presentist then it is possible to adopt endurantism in a way that is consistent with my other metaphysical beliefs. So I should accept endurantism. If, on the other hand, I am an eternalist then it is not possible to adopt endurantism in a way that is consistent with my other metaphysical beliefs. So I should reject endurantism in favour of perdurantism.

Of course this line of reasoning neglects some live options in the relevant debates (such as the stage view) but – leaving such complications aside for the time being – is it cogent? There are a number of reasons to think not. It is not obvious, for example, that the eternalist is unable to adopt an endurantist account of persistence. The main worry we have considered for this combination of views is the problem of temporary intrinsics, but someone who is attracted to either the time-relativized properties response, or the adverbialist response to this objection, would likely claim that this combination is not so problematic after all. On the other hand, it also remains unclear whether a presentist can reasonably adopt an endurantist account. The problem of temporary intrinsics is not the only worry which the endurantist faces, and adopting a presentist ontology will not in itself allow us to avoid a number

of these additional problems (such as the worries concerning fission cases discussed above).

Even if we leave such worries aside, though, and grant that the presentist can consistently adopt an endurantist account (while the eternalist cannot), this doesn't necessarily show that they ought to do so. There are a number of arguments in favour of the perdurantist view, only some of which we've had space to cover in this chapter (though see further readings for some additional suggestions). Further, not everyone is convinced by the claim that the perdurance view is really as counterintuitive as we have suggested. Lewis (2002: 441), for example, notes that very many philosophers reject his perdurantist view as 'counterintuitive, or revisionist, or down-right crazy', but claims to find it a mystery why this is the case. It is not unreasonable to suppose, then, that at least some presentists would also be attracted to the idea of adopting a perdurantist account of persistence. Are they consistently able to do so though?

There initially seems to be good reason to suppose that they could not. Trenton Merricks (1995: 525), for example, highlights an apparent conflict between presentism and the key worm theoretic claim that

> objects which last over time have parts—temporal parts—which exist at many different times and that not all of their parts exist at any single time; thus, not all of a perduring object's parts could exist at the single time which is present. If presentism is true, then those parts of an object which do not exist at the present time do not exist at all. So if presentism is true, a perduring object has some parts—the vast majority of its parts, in fact—which do not exist.

According to the perdurantist, objects persist by having temporal parts at different times and ordinary objects are composed of these temporal parts. If presentism is true, though, then there are no other times for these parts to exist in. As such, the combination of the two views appears to commit us to the absurd view that ordinary objects have the majority of their parts at other times but that these other times (and their contents) do not exist. Things may not, however, be as simple as they seem. Sider (2001: 71), for example, notes that while the perdurantist view is normally stated in eternalist terms, which postulate multiple temporal parts existing at different times, there is no obvious reason why they

> *must* state their position in this way. When one becomes a presentist one must reword many assertions about the past. Instead of saying that there are dinosaurs located in the past, one must speak with tense operators and say that it WAS the case that there existed dinosaurs. Similarly, instead

> of saying that an object *has* (timelessly) past and future temporal parts, a presentist must say that it WAS or WILL be the case that it has these temporal parts. Talk of temporal parts, then, will have the same status as talk of anything else in the past or future.

It seems, then, that while the presentist cannot accept the standard interpretation of perdurantism – formulated as it is in eternalist terms – there is no barrier to them putting their own gloss on the perdurantist view. How plausible this reinterpretation is will likely depend a great deal on how convincing we take the presentist's account of other statements made with respect to the past and future to be (see Chapter 5 for discussion of this issue).

7.5. Summary

In this chapter we asked how ordinary objects persist through time. We saw that the commonplace notion that various objects are capable of persisting through time and chance is surprisingly difficult to account for. The main focus of our discussion was the strengths and weaknesses of three influential views of persistence: endurantism, perdurantism and stage theory. As well as evaluating the views themselves, we also saw that they bear some interesting connections to some of our discussions in earlier chapters, in particular to our discussion of what is required for genuine change in Chapter 3 and the debates concerning the ontology of time that formed the main focus of Chapter 5. In the next chapter we move on to ask whether there is anything interesting to say about the metaphysics of our *experience* of time.

Study Questions

1. What is the problem of temporary intrinsics? How should the endurantist respond to this problem?
2. What account does the perdurantist give of how ordinary objects persist through time?
3. Which of the three accounts of persistence we've looked at in this chapter do you find the most plausible? Why?
4. Why might someone deny that a presentist can also be a perdurantist? Do you find any of the arguments for this claim convincing?

FURTHER READINGS

Hawley (2001) provides an excellent overview of the debate over persistence as well as a sustained argument for the stage theory. Effingham (2012) provides a more recent overview of the debate. Prominent defenders of endurantism include Thomson (1983), Haslanger (1992), van Inwagen (1990) and Fine (2006). Defences of worm theoretic versions of perdurantism include Quine (1950), Heller (1984), Lewis (1986: 202–4) and Copeland et al. (2001). The stage theory is defended in Hawley (2001), Sider (2000a) and Parsons (2015). Moss (2012) defends a new kind of perdurantist account. For one influential (though highly technical) account of how the endurantist should define their key notion of 'wholly present' see Crisp and Smith (2005). Donnelly (2011) argues that the debate between the perdurantist and the endurantist is best framed as debate over whether objects are three or four dimensional (rather than whether they have temporal parts). For additional discussions of the problem of temporary intrinsics see Hawley (1998), Sider (2000b), Wasserman (2003) and Brower (2010). For an overview of the debate concerning Leibniz's Law – and its application in metaphysics – see Magidor (2011). Fission cases (and their relevance for debates concerning persistence) are discussed in Lewis (1976) and Rea (1998: 251–7). Worries about the perdurantist's ability to account for change are discussed in Wilson (1955), Brogaard (2000) and Sider (2001: 212–16). Hales and Johnson (2007) argue that change actually provides a problem for the endurantist. For some additional worries concerning endurantism not discussed in this chapter see Barker and Dowe (2005) and Hales and Johnson (2003). Additional worries for perdurantism include Rea (1998) and Zimmerman (1998b). Merricks (1995) and Benovsky (2009) argue that presentists cannot accept perdurantist views. Lombard (1999) and Brogaard (2000) reject this claim. Merricks (1995) argues that endurantism is incompatible with eternalism. Mellor (1981) and Johnston (1987) defend eternalist versions of endurantism. For further discussion of the relationships between theories of persistence and the ontology of time see Zimmerman (1996).

8

The experience of time

This chapter focuses on various aspects of our temporal experience, *viz.* that our experiences themselves seem to have a duration, that they seem to be directly *of* changes and that they have a stream-like quality. There are two main accounts that attempt to explain these aspects of our temporal experience: extensionalism and retentionalism. We describe these views and consider the opposition between them, before turning to some implications that they have for further issues in the metaphysics of time.

Our experiences of the world are in some sense *essentially* temporal in nature, and have a dynamic feel to them. It *seems* to us that time passes. Many of our experiences are experiences that seem to be of temporally extended events and changes external to our minds occurring in a continuous succession. And even in those moments when we are not contemplating external events (when, for example, we sit with our eyes closed in a silent room), we still seem to *feel* the passage of time. Indeed, it is difficult, if not impossible, to conceive of how one could have experiences that are not like this, but are instead 'stationary', devoid of an (apparent) awareness of time's passage. In other chapters of this book we have seen that these features of our temporal experiences are taken to give at least a *prima facie* justification to particular metaphysical views, and to offer up challenges to others. In particular we saw in Chapter 4 that the way things seem to us makes certain metaphors about the *flow* of time seem particularly apt, and that this is taken to be evidence for the truth of an A-theoretic conception of temporal passage according to which there is some truth in these metaphors. There we also saw that B-theorists, who deny that there is any truth in such metaphors, bear an explanatory burden: they must be able to explain why our experiences

make these metaphors seem apt if, as they maintain, there is no truth in them at all.

In this chapter we focus on understanding the nature of temporal experiences as a topic in its own right. Viewed in a certain way, the attempt to gain such an understanding is in itself a metaphysical problem, albeit one of a slightly different nature than those considered in other chapters of this book. Broadly speaking, the debates considered in other chapters are debates regarding the metaphysical nature of reality external to our minds. But there are also good questions we can ask about the metaphysical nature of reality *internal* to our minds. That we have *experiences*, i.e. mental states that possess a phenomenal character (a *what-it-is-likeness*) and that represent there being a world external to our minds, is in itself a fact about the world. This fact is just as secure as the fact that there is an external world itself, replete with objects and their properties (indeed, that we have our *own* experiences is a fact that is perhaps known to each of us with *greater* degree of certainty than the fact that there is an external world). And so, we can take our experiences and their phenomenal characters to be genuine features of reality in their own right and ask about their nature ('*phenomenology*', in one use of the term, refers to this enterprise). Such questions, so understood, are metaphysical questions that have just as much legitimacy as those considered in other chapters.

In section 8.1 we begin by distinguishing between two questions that we can ask about our temporal experiences that will provide a framework within which to discuss the issues dealt with in this chapter. The first regards how they seem to us, and the second regards their true nature. In section 8.2 we consider the first of these two questions, and distinguish between three aspects of how our temporal experiences seem to us, *viz.* that they seem to have a duration, that they seem to be directly *of* changes and that they seem to have a stream-like quality. In sections 8.3 to 8.6 we then consider the second of our two questions and examine the two most popular answers that have been given to it, the retentionalist answer and the extensionalist answer. In sections 8.3 and 8.4 respectively we consider two early versions of these answers due to Augustine and John Locke. Then in sections 8.5 and 8.6 respectively we consider some more modern versions. Finally, in section 8.7 we consider what implications these answers have for the A-theory/B-theory debate discussed in Chapter 4, and for the presentism/eternalism debate discussed in Chapter 5.

8.1. Two questions about our temporal experiences

It is obvious to each of us that our direct experiences are confined to the present. We have memories of the past, and we anticipate the future, and such things can certainly have a phenomenal quality to them (there is, that is, *something it is like* to have a memory or to anticipate something). But, there is an obvious difference between memories and anticipations on the one hand, and our direct experiences of the present on the other. Our topic in this chapter is the nature of these latter experiences. They have what we can call a 'phenomenal content' – i.e. they represent the world as being a certain way by having features that, if they represent it correctly, correspond to features of external reality. In discussing the various issues that arise when considering the nature of our temporal experiences and their phenomenal contents, it is useful to have a framework within which to discuss them. Sometimes the frameworks laid down are quite complex, but our approach is to provide a very simple framework by distinguishing between two questions that we can ask about our temporal experiences.

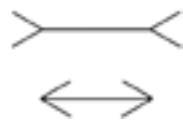
In order to state our two questions we first need to make a distinction between how our experiences *really are* and how they *seem to us*. At first sight, this distinction might strike one as being confused, for according to one natural thought our experiences just *are* how things seem to us; to say, for example, that one is having an *experience* that represents there being a fiery sunset occurring is just to say that it *seems to one* that there is a fiery sunset occurring. So, it might be suggested, how our experiences really are is just how they seem to us to be. But a little reflection makes it clear that the distinction is a sensible one.

To see this consider first that our experiences can alter without our being aware that they are altering. A simple example that illustrates this is the following. Consider that one is staring continuously and without moving at a clock that has only an hour and a minute hand that sweep continuously round its face (i.e. they don't tick across in jerky movements as the minutes and hours pass). Consider what one's experiences will be like. As the minute and hour hands move slowly, from second to second, one will be unable to notice any change in one's visual experiences no matter how closely one attends to them. And yet, after (say) 15 minutes have passed, one will certainly notice that there *has been* a change in one's experiences. The minute hand will have moved a quarter of the way round the face of the clock, and this will be reflected in one's experiences. The crucial point here is that, because the minute hand is moving continuously, it must be that your experiences themselves are also altering continuously throughout the 15 minutes,

albeit in a way that is not noticeable. So, this example illustrates that we can be mistaken about how our experiences are. In this case, although it *seems* that one's experiences are not changing from second to second, they are in fact changing. So, it is possible to make the distinction between how our experiences really are, and how they seem to us.

The above example is one regarding our experiences across time, and so one might be tempted to locate the source of our mistake about them in our memories of them, and so claim that we cannot be mistaken *at a time* about how our experiences are *then*. But it is possible to give further examples that suggest more strongly that we can be mistaken about how our experiences are at a time. One common experience that illustrates this is the following. Suppose that one is lying in a bathtub, and suppose that one feels a drop of water from the tap hit one's toe. One may well experience that drop as being cold, but then find that the drop was in fact a drop of hot water and come to realize that one's experience was not in fact an experience of a cold drop, but in fact an experience of a hot drop after all. That is, one might well come to realize that one has mistaken a phenomenological experience that is in fact a hot experience for being a cold experience. In this case although one's experience is a hot-drop experience, it *seems* to one at the time at which one has it that it is a cold-drop experience.

Other plausible examples come from the phenomenon of optical illusions. In the famous Muller-Lyer illusion, for example, it seems that two lines that are in fact the same length are of different lengths:



However, it is implausible to suppose that the lengths of the lines in one's experience are in fact of different lengths, as one finds that a stick that perfectly occludes one of the lines when held at a certain length in front of oneself will also perfectly occlude the other when held at the same length, yet nothing one's experiential field seems to alter when one does so (it is necessary here to close one eye to get this effect, but this does not matter, as the illusion works just as well with just one eye anyway). Here, although the lines presented in one's experience seem to be of different lengths, in fact they are not. Another similar example is the 'moon illusion' where the moon seems to be larger than it is when viewed close to the horizon than when it is viewed high in the night sky. Once more, it is implausible that the moon as it is represented in one's experience is in fact larger when close to the horizon than when high in the night sky, as once more holding up a small disc at arm's length that perfectly occludes the moon in the first experience

also perfectly occludes the moon in the other. So, we have good reason to think that our experiences can seem a certain way to us, even though they are in fact not that way. With this distinction made, then, we can state our two questions as follows:

Q1: How do our temporal experiences seem to us?
Q2: What is the real nature of our temporal experiences?

These two questions are about the phenomenal content of our experiences. Q1 is about how that content presents itself to us, and Q2 is about the true structure of that content. Of course, just because these two questions could have two different answers, this does not mean that they *do* have different answers. As we will see, while some think that Q1 and Q2 have different answers – they think that how our experiences seem to us are different from how they really are – others think that they have the same answer – they think that how our experiences seem to us are how they really are.

An analogy with semantic content is useful here. In the philosophy of language there are debates regarding the structure of the propositions expressed by the sentences we utter. Although they seem to have a certain structure, many think that their true structure is quite different. One of the most famous examples of this is Bertrand Russell's (1905) analysis of sentences containing definite descriptions – e.g.:

- The present King of France is bald.

At the surface level this sentence seems to contain a term whose function is to refer to a particular individual, i.e. the term 'the present King of France', and a term whose function is to attribute the property of *being bald* to that individual, i.e. the term 'is bald'. So, it seems that the proposition expressed has the following structure (where 'B' stands for the property of being bald and 'a' for the present King of France):

- Ba

However, Russell thinks, and most agree (but see Strawson 1950 for an example of a dissenter), that the proposition expressed does not have this structure, for the simple reason that its having a meaning requires there to be a present King of France, which there is not. Instead, Russell argues, the description 'the present King of France' functions here in a quantificational manner and that the proposition expressed in fact has the following structure:

- There exists a unique x such that x has the property of being the present King of France and x is bald.

This proposition is of course false, but its having a meaning does not require there to be a present King of France. So, some claim, just as there is here a distinction between the apparent structure of the content expressed by this sentence and its genuine structure, there is a distinction between the apparent structure of the content of our experiences, and its genuine structure.

8.2. The specious present and the stream of consciousness

We start by considering Q1: how do our temporal experiences seem to us? One much-discussed answer that has been given to this question emphasizes the fact that our experiences of the present do not appear to us as if they are successive momentary occurrences, like single-frames of a slowed down movie-reel clicking by one after another. Rather, they appear to us as themselves having some temporal breadth. We seem to directly experience movements, changes and duration itself. In a famous passage from *The Principles of Psychology* William James puts this point as follows:

> [T]he practically cognized present is no knife-edge, but a saddle-back, with a certain breadth of its own on which we sit perched, and from which we look in two directions into time. The unit of composition of our perception of time is a duration, with a bow and a stern, as it were – a rearward- and a forward-looking end. It is only as parts of this duration-block that the relation of succession of one end to the other is perceived. We do not first feel one end and then feel the other after it, and from the perception of the succession infer an interval of time between, but we seem to feel the interval of time as a whole, with its two ends embedded in it. (James 1890: 609–10)

Following E. Robert Kelly – who wrote under the pseudonym E. R. Clay (1882: 168) – James calls what our experience seems to represent, replete with its apparent duration, 'the specious present'. The term 'specious' means something like 'misleading in appearance' – and so suggests that here there is a difference between how our temporal experiences seem to us, and how they really are. James himself, at least in the *Principles*, takes this view. But it should be noted that the term 'the specious present' is often used simply to pick out how our experiences of the present seem to us without any implication that they are misleading in any way. Indeed, as we will see, some think that our experiences really do in fact have a duration. So, for now

all we are doing is describing a certain phenomenon, that our experiences of the present themselves seem to us to have a temporal duration, that we are calling 'the specious present'.

How long is the specious present? That is, what precise duration do our experiences seem to have? It is generally thought that the durations that our experiences seem to have vary considerably depending upon the kind of experience it is and the state in which we are in while having it, so better questions would perhaps be: How long is the typical specious present? What is the maximum duration of a specious present? There are no agreed answers to these questions. Attempts have been made to answer them using empirical means. Early attempts prompted James himself to endorse the view that the specious present can have a duration as long as 12 seconds (James 1890: 630), but most now agree that this is far too long. More recent empirical attempts give more modest estimates ranging from 0.75 seconds to 3 seconds (see, e.g. Fraisse 1984: 30; Pöppel 2004: 298; Albertazzi 2001: 115). And philosophers, who have often found reasons to doubt the empirical claims, have made suggestions of their own. Dainton (2000: 171), for example, suggests around 0.5 seconds, Lockwood (2005: 381) around 1–1.5 seconds and Strawson (2009: 5.9) around 0.3 seconds.

Another aspect to how our experiences seem to us is that many of them appear to be experiences *of* changes themselves. A change, in at least in one sense of the term 'change', is a temporally extended event – i.e. an event that has some duration. One paradigm of this is *motion*, in which an object undergoes a change by successively (and perhaps continuously) occupying distinct spatial regions. One feature of the specious present is that we seem to be directly aware of such changes and motions taking place. We seem, that is, *in a single act of awareness* to experience bodies occupying distinct spatial positions in succession, and thus to experience bodies actually *moving*. And crucially, this is not the same as having an experience that something *has* moved (as one does, for example, when one re-enters a room to see that the furniture has been rearranged in one's absence). Emphasizing this point, C. D. Broad offers the following useful description:

> [I]t is a notorious fact that we do not merely notice that something has moved or otherwise changed; we also often see something moving or changing. This happens if we look at the second-hand of a watch or look at a flickering flame. These are experiences of a quite unique kind; we could no more describe what we sense in them to a man who had never had such experiences than we could describe a red colour to a man born blind. It is also clear that to see a second-hand moving is a quite different thing from 'seeing' that an hour-hand has moved. (Broad 1923: 351)

The above, then, gives an answer to Q1. Our experiences of the present seem to us to have a duration and to be direct experiences *of* changes.

One final aspect of how our experiences seem to us relates to those metaphors regarding time's flow that seem apt to us. That our experiences seem to have a duration and that we seem to experience changes directly goes some way to giving content to this aspect of our experiences, but there is more that can be said. Our experiences also seem to be *stream-like* – as they change from one moment to the next they seem to flow, merging seamlessly into one another. Another famous passage from James's *Principles* illustrates the notion well:

> Consciousness, then, does not appear to itself chopped up in bits. Such words as 'chain' or 'train' do not describe it fitly as it presents itself in the first instant. It is nothing jointed: it flows. A 'river' or a 'stream' are the metaphors by which it is most naturally described. *In talking of it hereafter, let us call it the stream of thought, of consciousness, or of subjective life.* (James 1890: 233, emphasis in the original)

This again gives an answer to Q1. Our experiences seem to us to flow.

We have identified three aspects of how our experiences seem to be:

(1) They seem to have a duration.

(2) They seem to be directly *of* changes.

(3) They seem to have a stream-like quality.

The question encapsulated by Q2 is whether our experiences really have these aspects. In the remainder of this chapter we consider the two main answers that have been given to this question: the retentionalist and the extensionalist answers. Each explains aspect 3 of how our experiences seem to us in different ways, but the main difference between them lies in their treatment of aspects 1 and 2. According to retentionalists our experiences are in fact momentary occurrences and we do not experience change directly – so the true nature of experiences with respect to aspects 1 and 2 is in fact quite different from how they seem to us. According to extensionalists our experiences really are temporally extended and we really do experience change directly – so the true nature of our experiences with respect to aspects 1 and 2 is just as it seems to us. These two answers have undergone considerable development in recent years, but they are not new answers. Our main purpose is to describe the current state of the debate, but it is worth briefly considering two historical precursors of the views.

8.3. Augustine's proto-retentionalism

As we saw in Chapter 1, according to Augustine, the present must be an instantaneous moment that divides the past from the future, and so must itself possess no duration (i.e. temporal extension). Augustine reasoned from this view, together with his view that the past and future do not exist, to the view that all of our experiences of the present must themselves be of instantaneous moments (see, e.g. Augustine, in Gale 1968: 42–5). He accepted, that is, something like the following argument:

(1) Only the present exists.

(2) The present is an instantaneous moment.

(3) Our experiences can only be of what exists.

Therefore,

(4) Our experiences of the present must be of instantaneous moments.

The conclusion here is about the true nature of our experiences and not about how they seem to be to us, and so gives an answer to Q2 and not Q1. Augustine thus owes us an account of why it seems to us that they have temporal duration and why it seems to us that we perceive changes directly, and indeed, he does provide one. But before we come to that, we should also note that this view raises questions about how we can come to have the concepts of *succession* and *duration*, which seem to be basic notions in our conceptual schemes. The concept of succession is one of things following one after another. The concept of duration differs in being one that involves temporal breadth – durations are temporally extended wholes or units and not merely a series of discrete instantaneous parts standing next to one another. The problem for the Augustinian view is that if it is true, we never have an experience of succession itself, but only a succession of experiences. And clearly, as each experience is an experience of an instantaneous moment, we never have an experience of duration either. So at least *prima facie* it seems we cannot derive the concepts of succession or duration directly from any of our experiences, which is problematic if we accept even a modest form of empiricism (i.e. the view, roughly, that our experiences form the basic building blocks out of which we build our concepts). Augustine's answer to the question of why it seems to us that our experiences are temporally extended and why we seem to directly experience change, however, offers a solution to this problem too. He appeals to our past experiences and our expectations of future experiences. He says, for example:

> I am about to repeat a Psalm that I know. Before I begin, my expectation is extended over the whole; but when I have begun, how much soever of it I shall separate off into the past, is extended along my memory; thus the life of this action of mine is divided between my memory as to what I have repeated, and expectation as to what I am about to repeat. (Augustine, in Gale 1968: 51–2)

In this way Augustine explains, by an appeal to our memories and expectations, why it seems to us that our experiences extend across time even though they in fact do not, and why it seems to us that we directly experience changes even though in fact we do not. Moreover, it seems that this can also serve as an explanation of how we can come to possess the notions of succession and duration. As Augustine thus believes that our experiences are in fact durationless, even though they seem to us to have temporal breadth, he thus endorses a form of retentionalism.

8.4. Locke's proto-extensionalism

The question of how we derive the concepts of succession and duration from our experiences was one that occupied the British Empiricists Locke, Berkeley and Hume. Each had a similar view, according to which our sensory experiences are constituted by a series of discrete mental events that pass one after another before our minds, and that the concept of duration is parasitic upon the concept of succession, which is gained from reflecting upon the succession of discrete sensory mental events themselves. Consider, for example, the following passage from Locke:

> 'Tis evident to any one who will but observe what passes in his own Mind, that there is a train of *Ideas*, which constantly succeed one another in his Understanding, as long as he is awake. *Reflection* on these appearances of several *Ideas* one after another in our Minds, is that which furnishes us with the *Idea* of *Succession*: And the distance between any parts of that Succession, or between the appearance of any two *Ideas* in our Minds, is that we call *Duration* … [i]t is to me very clear, that Men derive their *Ideas* of Duration, from their *Reflection on the train of the* Ideas, they observe to succeed one another in their own Understandings, without which Observation they can have no Notion of *Duration*, whatever may happen in the World. (Locke 1975: 182–3)

What are we to make of this? At first sight Locke appears to think that all of our experiences are discrete instantaneous mental events that pass before

our minds in succession, just as Augustine thinks. It thus seems, at least *prima facie*, that he endorses the view that our experiences do not have any temporal breadth and that we do not experience changes directly. Indeed, we may suppose that this must be true, because otherwise Locke's claim that we gain the concept of duration from reflection upon the *succession* of our experiences is inexplicable: for if our experiences have temporal breadth, we could gain the concept of duration from reflection upon a *single* such experience. But, in fact, there is a reading of Locke's view available here in which this supposition is not quite correct. As Locke uses the term, 'reflection' has a meaning similar to 'introspection', which is itself a type of experience. So, at least on one reading of Locke's view, there are two types of experiences. The first type of experiences are first-order sensory experiences, which can be taken to be instantaneous, and that pass through the mind successively. The second type of experiences are higher-order introspective experiences *of* those successive experiences, which span a multitude of them at once and form the basis of both our concepts of succession and duration in so doing. So, succession is derived from our higher-order experiences of the series considered as an ordering, and duration from our experiences of the distances between particular parts of that series. This reading of Locke's view is inconsistent with Augustine's, as at least some experiences (i.e. introspective experiences of successions of sensory experiences) are not instantaneous. On this reading of Locke's view, then, he accepts that at least some of our experiences (i.e. our second-order experiences) do have temporal breadth, and that these experiences are also direct experiences of changes. So, on this reading, Locke has no reason to deny that the true nature of our experiences is as they seem to us to be. This makes Locke's view a version of extensionalism.

8.5. Modern versions of retentionalism

Retentionalists are united in thinking that our temporal experiences are not in fact how they seem to be. They believe that they are momentary events, and so cannot be, as they seem to be, extended over time. And as a consequence of this, they believe that we do not directly experience changes either. Augustine's argument for retentionalism relied on presentism as a premise. And indeed, it seems hard to see how extensionalism can be true if presentism is. For how could our experiences really be extended over time if there are no extended periods of time for them to extend over? But although some modern retentionalists also appeal to arguments from presentist premises (e.g. Kelly 2005: 230), many modern retentionalists also think that their view can be justified without an appeal to presentism. They find it hard to see how our experiences,

being unified acts of awareness as they are, *can* extend over a span of time. In order to be unified, they think, they must occur *at* a time. They think, that is, that single unified acts of awareness must be understood as being such that the various different elements of that awareness are grasped *simultaneously*, and so must be grasped all at once at a single time. This is often put in terms of the idea that succession and duration cannot themselves feature in our experiences unless there is some *representation* of succession and duration within our experiences that is grasped at a time. As Izchak Miller puts it:

> No succession of awarenesses – no matter how close together in time they come – can, by itself, account for an awareness of succession; it must be the case that an awareness of succession derives from *simultaneous* features of the structure of that awareness. (Miller 1984: 109, our emphasis)

What this quote also makes clear is that retentionalists owe us an account of the true structure of our experiences – of how, that is, succession and duration *can* be represented within a momentary experience. They must give such an account in order to explain why it seems to us that our experiences are extended over time, and why it seems to us that we experience changes directly. As we have seen, Augustine appeals to memories and expectations in giving his account. But most modern retentionalists would reject such an appeal, at least if the terms 'memory' and 'expectation' are understood in their normal senses. The problem with such an appeal is that, as we said above, there is an obvious difference between having a memory or expectation of something, and having a direct experience of it. So, because memories and expectations present themselves to us in a very different way from direct experiences, they cannot play the explanatory role that they are meant to play for the retentionalist. Consider once more an experience *of* movement. On Augustine's account the true nature of this experience is explained as being one of a stationary object that occurs together with a memory of it *having been* at certain close-by positions and an expectation that it is *going to be* at certain other close-by positions. But this explanation is inadequate, since a memory of something *having been* at a certain place is manifestly different from the experience of an object *being at* various positions successively, and so it is implausible that one can explain why our experiences seem to be of the latter in terms of them being of the former. Recall, once more, Broad's comments about the difference between seeing that the second hand *is* moving, and seeing that the hour hand *has* moved.

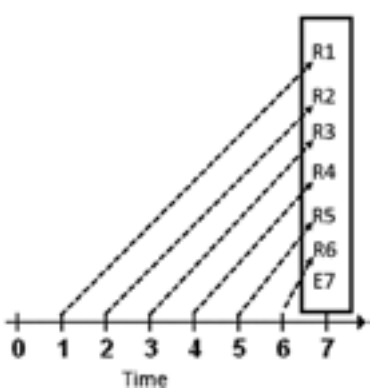
Modern retentionalists instead most often appeal to the notion that our current direct experiences themselves retain within them a trace of our immediately preceding direct experiences. Here they are following Edmund Husserl, who is considered to be the first modern retentionalist. On Husserl's view (see Husserl 1991) retained traces are not *memories* of

our preceding experiences but, rather, they are the experiences *themselves*, which remain within our consciousness in some way. The idea is that as new phenomenological sensations arise in us, they get stacked up in our experiences alongside the sensations that most recently arose in us, with older ones gradually fading away or disappearing. This still does not constitute a full explanation, however, of why it seems to us that our experiences have a duration and why we seem to experience changes directly. For we can ask: if we have a bunch of sensations stacked up within our experiences, and those experiences are instantaneous occurrences so the sensations are grasped simultaneously, how *can* they seem to us to have a temporal order and to be spread out across time? If this account is right, shouldn't they appear to us all at once, jumbled together, imposed one on top of the other?

Again, Husserl's answer to this question is a popular one. He invokes a primitive kind of intentionality (i.e. a *way* of being aware) that we bear towards our sensations. The most recent one to arise in us is experienced as *being-now*, while those that are retained in our experiences are experienced as *having-just-been*. He says, for example:

> During the time that a motion is being perceived, a grasping-as-now takes place moment by moment; and in this grasping, the actually present phase of the motion itself becomes constituted. But this now-apprehension is, as it were, the head attached to the comet's tail of retentions relating to the earlier now-points of the motion. (Husserl 1991: 32)

Sensations arise in us, and are experienced as *being-now*. They are then retained in our experiences as new sensations arise, but become experienced as *having-just-been* in an increasing manner until they finally slip away from our experiences altogether, from which point they may remain accessible to us only by ordinary memory. We can thus represent the retentionalist's view of the true nature of our experiences as follows:



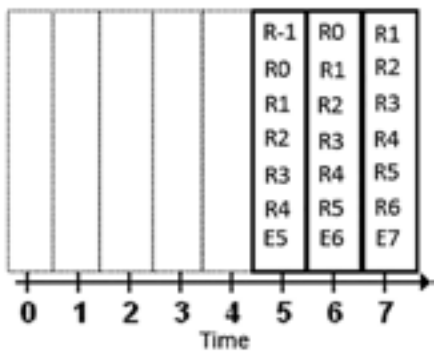
- The time interval from 1–7 is the duration that our experiences seem to have
- The box above time 7 represents the contents of an instantaneous experience at that time
- E7 is a direct experience obtained at time 7
- R1–R6 are retentions and the dotted arrows indicate the times from which they are retained

Sean Kelly serves as a good example of a contemporary philosopher who accepts this basic view. Kelly (2005: 232) further explicates the idea of a retained sensation by attempting to give content to the notion of intentionality that Husserl leaves undefined. He draws upon an analogy with experiences in which things within our visual field go from being clear to being vague, and from being vague to being clear. This is a difficult phenomenon to describe, but one that is continually occurring and one he thinks we are all familiar with. An example that illustrates the basic idea well is the following. Suppose that one is viewing a scene, a shipyard for example, as dawn breaks. At a certain point, as the level of light rises, one may become vaguely aware of the shapes that make up the funnels of the ships, but not recognize them as such. Soon after one's experiences may begin to slowly resolve themselves, becoming clearer until one sees the funnels clearly for what they are. (This example is based upon one due to Merleau-Ponty 1962: 17 that Kelly quotes.) On Kelly's view, the process of our retentions becoming *having-just-been* in an increasing manner in successive experiences is analogous to this, but in reverse. As they fade away from our experiences we begin to lose our 'perceptual grip' on them and they become ever more vague before disappearing altogether. This, Kelly suggests, not only explains what it means for retentions to be experienced as *having-just-been*, but is also accurate phenomenologically, and so strengthens the retentionalists' explanation of why it seems to us that our experiences have temporal breadth:

> Gaining and losing perceptual grip on an object are things I can now experience myself to be doing. Indeed, as we navigate through the world and our attention is caught now by this object and now by that, gaining and losing our perceptual grip is something we are almost always doing. But at every moment it is a dynamic process, one that distinguishes sharply between what is imminent and what is receding. (Kelly 2005: 233)

The above gives a summary of how retentionalists explain aspects 1 and 2 of how our experiences seem to us. But how do they explain aspect 3, i.e. their stream-like nature? In fact, they utilize a feature of their account that has already been outlined. They note that on their view our successive instantaneous experiences have overlapping contents – they contain within them elements that are shared with those immediately surrounding them, and claim that it is the overlap between the experiences that gives rise to their stream-like quality. In other words, they claim that although our experiences over time are constituted by distinct experiences, they have overlapping contents, and in virtue of this each successive experience seems to flow into the next. For example, if my instantaneous experience at one time is constituted by the elements R0-R1-R2-R3-R4-R5-E6 (where the Rs are retentions

of previous direct experiences, and E6 is the current direct experience), then in the succeeding instantaneous experience R0 will fade away, E6 will be retained as a retention R6 and a new direct experience E7 will take its place. Thus the new instantaneous experience will be constituted by the elements R1-R2-R3-R4-R5-R6-E7. If one compares the contents of the two succeeding momentary experiences one can see that they overlap a great deal and so, according to the retentionalist, will have a stream-like quality. Adapting our previous picture, we can illustrate this as follows:



- The three solid boxes represent the contents of three successive instantaneous experiences (the dotted boxes are experiences whose contents are not shown).
- For example: E5 appears in experience first at time 5, and is then retained as R5 at times 6 and 7.
- The overlap in content between the successive experiences is used to explain the stream-like nature of experience over time.

Whether this explanation is ultimately satisfactory is a controversial issue. The major controversy surrounds whether the retentionalist does enough here to integrate our experiences over time. Despite the overlap between successive instantaneous experiences, it has been objected that they nonetheless remain distinct from each other and so fragmented in a problematic way. (See Dainton 2010 for further discussion.)

8.6. Modern versions of extensionalism

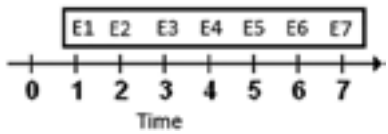
Extensionalists reject the retentionalist view that our experiences are durationless and that we do not directly experience changes. They maintain instead that they really do have a duration and that we really do experience changes directly. Extensionalists thus have the advantage of being able to explain aspects 1 and 2 of how our experiences seem to us in a much simpler manner than retentionalists. They seem to us to have duration simply because they *do* have a duration, and we seem to experience change directly simply because we *do* experience change directly. They thus answer the two questions we posed in section 8.1 in the same way. The fundamental challenge that extensionalists face is making sense of how our experiences *can* extend over a span of time. As we have seen, retentionalists typically find this hard to fathom, and maintain that in order for our experiences to be unified

their various different elements must be grasped *simultaneously*. Although there have been various attempts to meet this challenge, the most sustained attempt comes from Barry Dainton in his book *Stream of Consciousness* (2000). Dainton introduces the notion of 'co-consciousness', and over the course of the book argues that this is a basic relation that serves to unify our experiences both *at* a time and *over* time. The following passage explains how he thinks an appeal to such a relation can be used to defend extensionalism:

> [T]he diachronic [i.e. cross-time] unity of experience is no different, in essentials, from the synchronic [i.e. at a time]: both are the product of co-conciousness. Just as simultaneous experiences, such as thought, a bodily sensation and a visual experience, can be experienced together, so can successive experiences, experiences occurring at different (but not distant) times. My current experiences belong to the same stream of consciousness as those I had on first waking several hours ago, but they are not directly co-conscious with them; the same applies to experiences I had a minute ago: I am no longer directly aware of these either. Diachronic co-consciousness is a very short-term affair, spanning at most a second or so – the duration of the so-called 'specious present'. (Dainton 2000: 113)

What, in more detail, is co-consciousness? If Dainton is right that it is a basic relation, then it cannot be defined in more simple terms. Nevertheless, even if it is a basic notion, it is one that we can get a handle on by giving certain descriptions. The idea is that although it cannot be defined, it can be *explained* to any conscious subject who is capable of reflecting upon their experiences. Consider: at any particular moment there are many things going on within our experiences. Standing on a hilltop, for example, one might have a variety of appearances within one's visual field – the appearance of a tree in its right-hand side, some cows grazing in the centre, the blue of the sky at the top and the green of the grass at the bottom. Within the very same act of awareness there might also be the tactile feeling of the ground beneath one's feet, of the cold air upon one's skin and the auditory sensation of birds chirping, along with various thoughts and emotions that might be occurring as one views the scene. Each of these distinct phenomenal awarenesses is related by being united into a single experiential whole – a unitary integrated experience that binds each together into one subjective awareness. The relation of co-conciousness, then, is the relation that stands between each distinguishable part of this unitary experience. If Dainton is right one can do nothing more to explain this concept than to give descriptions such as this – but as, we assume, the readers of this book are themselves conscious subjects capable of reflection, we hope they will be able to grasp this concept well enough on the basis of these descriptions.

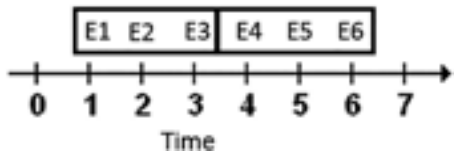
The above description, then, supplies one with the concept of co-consciousness. But in this description it is applied to elements within an experience *at* a time. However, on the basis of this we are supposed to be able to grasp how to extend the notion to elements that occur at different (close-by) times. If we conceive of our experiences at a time as forming a unitary whole (with each element united by the relation of co-consciousness), the idea is that a succession of these experiences can also be united into a unitary whole by the relation of co-consciousness. This is perhaps best illustrated by considering a diagram that contrasts with the one given above to illustrate retentionalism:



- The time interval 1–7 is the duration our experiences seem to have.
- The box again represents the contents of a single experience, but this time the experience is itself spread across time.
- This relation of co-consciousness holds between E1–E7 uniting them into a whole.

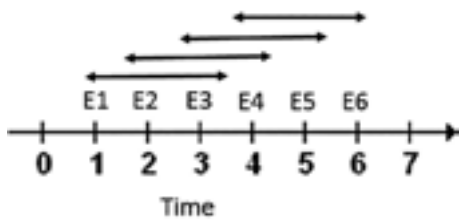
Above we saw that retentionalists must be able to answer the question of why the sensations stacked up within our experiences do not appear to us all at once, imposed one on top of the other. Is there a parallel question here that causes trouble for the extensionalist? That is, do they owe us a substantive answer to the following question: if the relation of co-consciousness unites experiences occurring at different times into a unified whole, why is it that they do not appear to us all at once, imposed one on top of other? On this issue there seems to be something of an impasse in the literature. Le Poidevin (2004: 111, 2007: 87), for example, insists that the question is a pressing one for extensionalists. Dainton (2010: §5.1), by contrast, thinks that it poses no difficulty for the view, claiming that it misses the point that 'the defining trait of the Extensional approach is the rejection of the confinement of consciousness to momentary stream-phases'.

What account of aspect 3 do extensionalists give? In fact, extensionalists here face a problem that is not faced by retentionalists. To see what this problem is, recall that retentionalists explain the stream-like nature of experiences by appealing to the fact that our experiences over time are constituted by *distinct* experiences that share overlapping *contents*. Now note that if extensionalists wish to claim that our experiences over time are constituted by distinct experiences, it seems that they cannot claim that they have overlapping contents. Suppose, for the sake of illustration, that our direct experiences span just three moments of time. If extensionalists claim that our experiences over time are constituted by distinct successive experiences they must picture two successive direct experiences as follows:



- The two boxes represent two distinct experiences.
- The first experience spans time 1–3 and the second spans time 4–6.
- Note that the two experiences do not have any content in common.

The problem with this is that, without any overlap of content, it is hard to see how this offers any explanation of the stream-like nature of our experiences over time. On the contrary, this picture suggests that our experiences should be disjointed affairs made up of successive blocks. But what other option is available to the extensionalist? The only other option, it seems, is for the extensionalist to claim that our experiences over time are constituted by direct temporally extended experiences that *themselves* overlap, in something like the following way:



- Here each double-arrow represents the spans of distinct experiences, and their contents are given below.
- Note that each of these experiences is had by a single subject.

But it is at least *prima facie* difficult to make sense of this picture. One problem is that there is a 'doubling-up' of experiences and contents at each moment of time. If this is the true nature of our experiences over time, then why don't we experience this 'doubling-up' and have multiple copies of the same experiences present to our awareness at each time? Consider time 3, for example. Three direct extended experiences overlap at that time, and each contains E3. So why at that time don't we have three copies of E3 present in our experience? (Some extensionalists have replied to this worry by saying that it is plausible that when two or more experiences with identical contents are present in our awareness they are not noticeable at the phenomenological level.) Whether either of the extensionalist accounts can ultimately be made to work is again a controversial matter. (See Le Poidevin 2007 and Dainton 2008 for more on these positions.)

8.7. Consequences for other metaphysical debates

In Chapter 4 we considered the A-theory/B-theory debate. There we saw that it is often claimed that the dynamic nature of our temporal experiences

gives evidence for the truth of the A-theory. We also saw that B-theorists are thought to bear the explanatory burden of explaining why it seems to us that time flows if, as they claim, it in fact does not. What are we to make of these claims in the light of the above? Although some are now working on just this issue, this is one area in the metaphysics of time where more work is needed. However, at least *prima facie*, it seems that the claims are misguided. Retentionalists and extensionalists both claim to give an account of the dynamic nature of our temporal experiences, but both seem to be perfectly compatible with the B-theory of time. At least, it seems that nothing in their views suggests that there is a privileged present moment. On both views, our experiences of time's flow can be explained, it seems, in terms of the existence of distinct but successive experiences arranged across a temporal dimension. And this fact causes problems for the A-theorist. It undercuts one of the main reasons for holding the A-theory.

The issues considered in this chapter also have consequences for the presentism/eternalism debate. As retentionalists think that our experiences of time occur at instantaneous moments, retentionalism seems at least *prima facie* perfectly compatible with presentism. Extensionalism, however, does not. As we saw, plausible suggestions for the duration of the specious present (i.e. the duration that our experiences *seem* to have) range from 0.3 seconds up to around 2 or 3 seconds. If extensionalism is true, then our experiences themselves actually span such durations, and so the time intervals of such durations must exist. But, is this consistent with presentism? Presentists believe that only the present exists, so they will have to maintain that the present moment can have a duration of between 0.3 to 3 seconds.

In section 5.6 we considered the thick and thin objection to presentism which consisted, in part, of the claim that presentists cannot allow that the present moment has any duration. Allowing that it does have a duration, it seems, undermines their reasons for rejecting eternalism. According to eternalists multiple times exist: reality has a temporal span that extends across billions of years (and is perhaps infinite). For a variety of reasons, presentists often find this aspect of eternalism problematic. But if they admit that the present has some duration, then it seems they must too admit that multiple times exist (for durations are spans across times) and so admit that reality has some temporal span. Of course, they will admit that *fewer* times exist, and that reality's span is much shorter than the eternalist thinks, but this is a difference of degree and not kind. So it seems difficult to see how presentists can have any principled reason for finding this aspect of eternalism problematic if they admit that the present has a duration. Presentists can perhaps rebut the thick and thin objection by claiming that the present moment has some *minimum* duration known as a 'chronon' – i.e. a

duration such that no smaller duration is possible (this is plausibly the planck time, around 10^{-43} seconds). But this does not allow the presentist to square their view with extensionalism. As Jiri Benovsky puts it:

> [E]ven if the present were said to be of a short non-zero duration – like a 'chronon', a quantum of time, a discrete and indivisible "unit" of time of non-zero length—its length would still be *much* shorter than the length of a specious present. (Benovsky 2013: 193)

The upshot is that presentism seems to be incompatible with extensionalism. Whether or not this is really so is an open question. (See Dainton 2011 and McKinnon 2003 for discussion.)

8.8. Summary

In this chapter we have identified three aspects of how our experiences seem to us: that they seem to have a duration, that they seem to be directly of changes and that they have a stream-like quality. We have examined the two main accounts of why it is that our experiences seem this way: retentionalism and extensionalism. According to the former, our experiences are in fact instantaneous occurrences and so quite different from how they seem to us, while according to the latter our experiences do have a duration and so are just as they seem to us. We first looked at some historical precursors of these two views, before turning to more modern versions. We have seen that there are reasons for holding each view, although neither is without its problems. We finished by returning briefly to the A-theory/B-theory debate and the presentism/eternalism debate, and considered what impact the debate about the nature of our experiences has on them. In the next chapter we turn to a different issue and inquire into whether time travel is logically possible, or whether any attempt to make sense of the notion leads one into contradiction.

Study Questions

1. We give a number of examples to illustrate the distinction between how our experiences really are and how they seem to us. Can you think of any other examples?
2. What is the specious present? What duration does it have?

3. Our experiences seem to have a duration. How do retentionalists explain this? How do extensionalists? Which account is more plausible?
4. Our experiences have a stream-like quality to them. How do retentionalists explain this? How do extensionalists? Which account is more plausible?
5. Is extensionalism compatible with presentism?

FURTHER READINGS

The contemporary literature on the experience of time is not as expansive as the literature on the other topics discussed in this book, but is growing. For an in-depth overview of the literature we recommend consulting Dainton (2008, 2011). Dainton (2000) is the standard modern defence of extensionalism, although see also Foster (1984) for an earlier defence. Husserl (1991) is probably still the most thorough defence of retentionalism. Miller (1984) provides an accessible introduction. Le Poidevin (2007) offers criticism of extensionalism and discusses the impact that our experience of time has on other debates in metaphysics (see especially chapter 5 for his discussion of our experience of time and the A-theory). Other important recent papers in this nascent area of study include Grush (2007), Hoerl (2013) and Phillips (2014). Finally, see Dennett (1991) for a completely different take on the debate.

9

Time travel

This chapter focuses on the question of whether time travel is logically possible (with special attention given to the influential work on this subject by David Lewis). Section 9.5 contains discussion of some subtle and complex issues which some of those new to this material may wish to omit on their first reading. Those looking for further explanation of these issues are encouraged to start with Sider (2001: 101–9).

'Time travel, I maintain, is possible. The paradoxes of time travel are oddities, not impossibilities' (Lewis 1976b: 145). So begins the most famous philosophical discussion concerning time travel: David Lewis's 'The Paradoxes of Time Travel'. In section 9.1 we outline what time travel of the relevant kind entails and what it means to say that time travel of this kind is (im)possible. In section 9.2 we present some of the most prominent 'paradoxes of time travel' before proceeding – in section 9.3 – to consider Lewis's reasons for claiming that such paradoxes generate oddities, rather than impossibilities. In section 9.4 we look at some of the worries that have been raised concerning the Lewisian account. In section 9.5 we ask whether the debate over the possibility of time travel has any implications concerning some of the controversies we've addressed in earlier chapters (in particular those from Chapters 5 and 7).

9.1. The possibility of time travel

Time travel has proven to be one of the most popular and enduring mainstays of science fiction writing, and it is not difficult to see why. The allure of travelling

to witness some famous historical event or catching a glimpse of humanity's (we hope) gleaming future is one which many of us can appreciate. Others may see the appeal of time travel not merely as a means for cross-temporal tourism but as a way to – to borrow a phrase from a famous science fiction programme – put right what once went wrong. Who hasn't felt the desire at some point in their lives to rectify some past mistake or rephrase some ill-thought-out remark?

Are such activities really possible though? In order to answer this question we need to first get clear on what time travel of the relevant kind would entail, and on what it means to say that it is (or isn't) possible. There is, of course, a sense in which we are all travelling in time already – ten years ago we occupied the year 2004 and now, as we write these words, we occupy the year 2014 – so time travel in the relevant sense cannot merely be a matter of our moving from occupying one time to occupying another. (Of course this talk of our *moving* from occupying one time to occupying another, if taken literally, seems to entail some form of endurantism. We could, however, easily translate the relevant points into perdurantist-friendly language.) What, then, would it require for someone to time travel in a way relevant to our discussion in this chapter? Lewis (1976b: 145) offers the following account:

> Any traveler departs and then arrives at his destination; the time elapsed from departure to arrival (positive, or perhaps zero) is the duration of the journey. But if he is a time traveler, the separation in time between departure and arrival does not equal the duration of his journey. He departs; he travels for an hour, let us say; then he arrives. The time he reaches is not the time one hour after his departure. It is later, if he has traveled toward the future; earlier, if he has traveled toward the past. If he has traveled far toward the past, it is earlier even than his departure.

Lewis mentions two different types of time travel here: travel towards the future (forward time travel) and travel towards the past (backwards time travel). Of these two, backwards time travel has received far more philosophical attention and it is not difficult to see why. An individual's travelling for only an hour and yet arriving at a time many thousands of years from now would certainly be a curiosity, but there is no obvious reason to regard it as an impossibility. Indeed, denying the possibility of forward time travel seems (as discussed in e.g. Nerlich 2004) to straightforwardly conflict with the picture of the physical world offered by contemporary physics. By contrast, the possibility of backwards time travel appears, as we will discuss shortly, to generate a number of worrying paradoxes. As such, our focus in this chapter will be on whether it is possible for an individual to travel backwards in time, towards the past and, in particular, whether it is possible for the time of their arrival to be earlier than the time of their departure.

So what precisely does backwards time travel involve? We have mentioned above Lewis's claim that someone who travels into the past is able to arrive 'earlier even than his departure' but this very quickly generates an apparent problem. Imagine that a time traveller leaves her home in 2024 and, after travelling for precisely an hour, arrives in 2014. It looks, then, as if we should say of the time traveller's arrival, both that it is *one hour later* than the time of her departure and that it is *ten years earlier* than the time of her departure. In order to describe such cases consistently, Lewis appeals to the distinction between *external time* and *personal time*.

Talk of external time is relatively easy to understand. External time is merely time as we ordinarily conceive of it. How we should think about the nature of time has, of course, been a major theme of this book, but let's assume for now that Lewis and his fellow eternalists are right and that the 'world – the time traveler's world, or ours – is a four-dimensional manifold of events' (ibid.: 145). It is with respect to external time that time travellers have unusual careers: flashing in and out of existence, moving backwards as well as forwards and so forth. The event of the time traveller's arriving in 2014 is, in terms of external time, ten years earlier than her departure from 2024. We can say, then, that a person has travelled backwards in time in the relevant sense if the (external) time of their arrival is earlier than the external time of their departure.

Explaining personal time, by contrast, is a little more complicated. First, it is important to note that talk of 'personal time' does not refer to our own subjective experiences of time's passage (though see Chapter 8 for a discussion of this issue). If Rosie and Jim were to watch the same movie, the former finding it tedious and the latter enthralling, then this activity would still occupy equal amounts of their respective personal times (even if the experience *seemed* to Rosie to drag on for hours and to Jim to fly by in moments). Rather, on Lewis's picture, personal time is usefully thought of as something like time as it is represented by the time traveller's wristwatch. If the time traveller's watch as she activates her machine in 2024 reads 8.15 and when she touches down in 2014 it has moved forwards 60 minutes to 9.15 then her arrival takes place an hour later *in personal time* than her departure.

Of course, this is only an illustration and Lewis doesn't mean to define personal time purely by reference to the fallible time-keeping powers of the traveller's wristwatch. Instead, he defines personal time as 'that which occupies a certain role in the pattern of events that comprise the time traveler's life' (ibid.: 146). Lewis begins by asking us to consider the stages of an ordinary person's life which

> manifest certain regularities with respect to external time. Properties change continuously as you go along, for the most part, and in familiar

> ways. First come infantile stages. Last come senile ones. Memories accumulate. Food digests. Hair grows. Wristwatch hands move. (ibid.)

With respect to ordinary individuals like us, changes of these kinds line up in a straightforward fashion with the progression of external time. The external time at which we are elderly is later than the external time at which we are infants, the external time at which we eat the ice cream is earlier than the external time at which we digest it, and so forth. With respect to the time traveller, though, things are different and there is no guarantee that changes of this kind will match up in such a tidy way with the progression of external time. Still, though, there is a way of ordering the various events and changes within the time traveller's life so as to form an ordinary-seeming sequence of changes, ensuring that the time traveller's infancy comes before her old age, that her memory of inventing the time machine comes later than her original notion of inventing such a device, and so on. According to Lewis it is this ordering of the events of the time traveller's life that constitutes her personal time. Personal time, Lewis concedes, isn't strictly speaking a genuine kind of time (just as rubber ducks aren't really a kind of duck). Nonetheless, Lewis argues that with respect to the time traveller it is

> enough like time so that we can—with due caution—transplant our temporal vocabulary to it in discussing his affairs. We can say without contradiction, as the time traveler prepares to set out, "Soon he will be in the past." We mean that a stage of him is slightly later in his personal time, but much earlier in external time, than the stage of him that is present as we say the sentence. (ibid.)

With respect to personal time the time traveller has a perfectly standard existence; infancy precedes adolescence which itself precedes old age. The event of the time traveller's arriving in 2014 is one hour later in personal time than her departure from 2024.

Having established what time travel of the relevant kind entails, we need to ask what it means to ask whether it is (im)possible. One question we could be asking is whether, at present, human beings actually possess the technology required to travel in time. We *could* be asking this, but it would not be a philosophically interesting question since – with the exception of a smattering of internet conspiracy theorists – everyone agrees that we should answer this question in the negative. A different question we could be asking is whether time travel is *physically* possible, that is, whether the physical laws that govern our universe are such as to permit objects to travel backwards in time. This is certainly an interesting question to ask, but it will not be our focus here (though see further readings for debates concerning these issues,

and Chapter 10 for discussion of the relationship between the laws of physics and the metaphysics of time). Instead, we will be focusing on asking whether time travel is *logically possible*. To claim that time travel is logically possible is to claim that there is no *contradiction* involved in an individual's travelling in time. Those who would argue that time travel is logically impossible, then, must show us that some contradiction arises from the supposition that time travel has taken place.

9.2. The paradoxes of time travel

So, why might one think that time travel is logically impossible? There are a number of common arguments for this claim. First, consider the following species of argument presented – though not endorsed – by Horwich (1975: 433–4):

> [T]ime travel is incompatible with Leibniz's law. For suppose Charles, who was clean-shaven in 1960, has by 1970 grown a beard, and then travels back to 1960. The early Charles, $Charles_1$, is the same person as the time traveler, $Charles_2$. Therefore, according to Leibniz's law, $Charles_1$ and $Charles_2$ should have the same properties. Yet $Charles_2$ is bearded whereas $Charles_1$ is not.

It seems, as we've already discussed in Chapter 7, that there is good reason to hold that if $Charles_1$ and $Charles_2$ are really the same person (in the sense of being numerically identical) then they must have all the same properties (or, at the very least, that they can't possess incompatible properties such as being bearded and being clean-shaven). It also seems, though, as if the two don't share all the same properties since the latter is bearded and the former is not. As such, it looks like we must deny that they are the same person. If Charles has really time travelled, though, then surely the person who steps into the time machine must be the same person who comes out of it. This leaves us with the following argument against the possibility of time travel:

Incompatible Properties Argument

(1) If time travel is possible then $Charles_1$ and $Charles_2$ must be the same person.

(2) It is not possible for $Charles_1$ and $Charles_2$ to be the same person (since they possess incompatible properties).

Therefore,

(3) Time travel is not possible.

Secondly, time travel apparently allows for problematic 'causal loops'. Lewis (ibid.: 149) asks us to consider the case of a time traveller who talks with his younger self and instructs him on how to go about building the time machine that his time travelling older self has just arrived in.

> That information was available in no other way. His older self knew how because his younger self had been told and the information had been preserved by the causal processes that constitute recording, storage, and retrieval of memory traces. His younger self knew, after the conversation, because his older self had known and the information had been preserved by the causal processes that constitute telling.

When we ask how the younger man acquired his knowledge of time travel the answer is simple: he learned it via the testimony of his older self. The answer to the question of how the older man attained this knowledge is similarly straightforward: he remembers being told it as a young man. Still, a mystery remains. It seems, though, as if we don't have an answer as to where this information came from in the first place. By way of comparison consider a case from Le Poidevin (2003: 180–1) where

> Peter and Jane, both 20 years old, are out for a walk one day in 1999 when suddenly a time machine appears in front of them. Out steps a strangely familiar character who tells Jane that he has an important mission for her. She must step into the machine and travel forward to the year 2019, taking with her a diary the stranger hands to her. In that diary she must make a record of her trip. Obligingly, she does as she is asked and, on arrival, meets Peter, now aged 40. She tells Peter to travel back to 1999, taking with him the diary she now hands him, and recording his trip in it. On arrival in 1999, he meets two 20-year-olds called Peter and Jane, out for a walk, and he tells Jane that he has an important mission for her.

Again, there is an easy answer to the question of where Jane got the diary from (she was given it in 1999 by Peter who had travelled back from the year 2019) and an easy answer to the question of where Peter got the diary from (he was given it by Jane who had travelled forward from the year 1999). There appears, however, to be no answer to the question of where the diary itself came from. Such strange cases involve what are known as 'causal loops': cases where some particular event A is among the causes of some other event B but where B is also among the causes of A. It seems that – as we hope the cases above illustrate – causal loops have the potential to generate all manner of paradoxes which might make us inclined to deny that they are even so much as possible. If time travel is possible, though, it looks as if we

must allow that causal loops of this kind are also possible. This leads us to our second argument against the possibility of time travel:

Causal Loop Argument

(1) If time travel is possible then causal loops are possible.

(2) Causal loops are not possible.

Therefore,

(3) Time travel is not possible.

Finally, there is the probably most famous worry concerning time travel, the 'Grandfather Paradox', a paradox which – perhaps not surprisingly given its subject matter – owes its origin not to a philosopher but to the science fiction writers Nathaniel Schachner (1933) and René Barjavel (1943). There are, as we will see later, a number of competing accounts as to exactly how this paradox is best formulated but to begin to see the force of the paradox consider the case of Tim (from Lewis 1976b: 149) who would dearly love to kill his grandfather

> but alas he is too late. Grandfather died in his bed in 1957, while Tim was a young boy. But when Tim has built his time machine and traveled to 1920, suddenly he realizes that he is not too late after all. He buys a rifle; he spends long hours in target practice; he shadows Grandfather to learn the route of his daily walk […]; he rents a room along the route; and there he lurks, one winter day in 1921, rifle loaded, hate in his heart, as Grandfather walks closer, closer, …

Now consider the following question: can Tim kill Grandfather? There is an embarrassing abundance of good answers to this question. First answer: clearly he can. Human beings are sadly all too easy to kill and we can tweak the story any way we like (within the bounds of logical possibility) to turn things to Tim's advantage: imagining that he is an Olympic level marksman with nerves of steel or that he has hired dozens of exemplary time travelling assassins to assist him in his task. Second answer: clearly he cannot. Grandfather died in 1957 not in 1921 and, of course, the story is set up so that Grandfather's surviving beyond 1921 is a necessary condition of Tim's father being born and thus of Tim's being born and thus of this particular time travelling expedition's occurring in the first place. It looks, then, as if we arrive at a contradiction:

Grandfather Argument

(1) If time travel is possible then Tim can kill Grandfather.

(2) If time travel is possible then it's not the case that Tim can kill Grandfather.

(3) It's not the case that Tim both can and can't kill Grandfather (since this is a clear contradiction).

Therefore,

(4) Time travel is not possible.

If any of these three arguments are sound then we will have to concede that the paradoxes of time travel present genuine impossibilities and not merely (as Lewis maintains) oddities. In the next section we consider Lewis's reasons for rejecting the three arguments we have considered.

9.3. Lewis's account

Recall that, according to Lewis, we should think of the world of the time traveller as being – as the eternalist believes – a four-dimensional manifold of events. Further, Lewis (ibid.: 146) maintains that this manifold is occupied – as the perdurantist claims – by four-dimensional worms with temporal parts. Given that we accept this picture, Lewis's solution to the *Incompatible Properties Argument* is remarkably straightforward. We can respond to this worry in the same way as the worm theorist responds to standard worries concerning temporary intrinsics (see Chapter 7). The two versions of Charles are not (strictly speaking) the same person but rather distinct temporal parts – one bearded, the other clean-shaven – of the same person. As such, there is no contradiction involved here. Of course these temporal parts are rather unusually arranged. Ordinary individuals typically have only a single temporal part at any given time; here, Charles has two temporal parts ($Charles_1$ and $Charles_2$) sharing a single time. This is, however, merely a consequence of Charles's unusual travel arrangements and doesn't entail any contradiction.

Lewis's response to the *Causal Loop Argument* is similarly straightforward. The first premise of the Causal Loop Argument is questionable – indeed it has been questioned by, for example, Bradley Monton (2009) who argues that it is possible to have time travel without causal loops. However, Lewis (1976b: 148) himself remains agnostic with respect to premise 1, choosing to focus instead on premise 2. Lewis asks us to consider again how we should answer the question of where the information passed between the time traveller and his younger self ultimately comes from. With respect to such questions Lewis (ibid.: 159) maintains that

> There is simply no answer. The parts of the loop are explicable, the whole of it is not. Strange! But not impossible, and not too different from inexplicabilities we are already inured to. Almost everyone agrees that God, or the Big Bang, or the entire infinite past of the universe, or the decay of a tritium atom, is uncaused and inexplicable. Then if these are possible, why not also the inexplicable causal loops that arise in time travel?

Lewis concedes, then, that causal loops have some strange and potentially worrisome consequences. Philosophers are typically keen to minimize the number of things left unexplained by their theories – and theories which explain more tend, all else being equal, to be favoured over those which explain less – but it is generally accepted that explanation must end somewhere and that some facts will ultimately remain unexplained. As such, Lewis suggests, there is no principled reason to claim that the inexplicable facts resulting from causal loops are impossibilities rather than merely oddities. So far so good for the prospective time traveller. Unfortunately, though, anyone travelling into the past with the desire to alter it, rather than merely observe it, is in for an unfortunate surprise, as we will see when we consider in detail Lewis's response to the *Grandfather Argument*.

Consider again Lewis's (ibid.: 149) case of Tim, lying patiently in wait for Grandfather to step into his crosshairs. Is it possible for Tim to kill Grandfather? There are a number of easy ways out of this problem. As Sider (1997: 139) suggests

> We could tell a consistent time travel story in which Tim kills Grandfather, but Grandfather is miraculously resurrected. Or one in which Tim kills Grandfather, but in which Grandfather has already had a child. Or one in which Tim kills Grandfather permanently, before Grandfather has any children, but in which Tim's grandfather is someone other than Grandfather.

Such manoeuvres may serve as moderately satisfactory resolutions to science fiction tales but they don't address the underlying philosophical worry (as Sider himself is keen to stress). Whatever else we would want to say about such cases, they aren't genuine instances of changing the past. What we want to know is whether Tim can genuinely change the past by permanently killing his actual (and childless) grandfather in 1921. If the *Grandfather Argument* is sound then someone who admits the possibility of time travel is committed to giving contradictory answers to this question. Is the argument sound though? Lewis (1976b: 150) thinks not, since, on his view it rests on an equivocation: the argument would only be sound if 'can' means the same thing in premise 1 as in premise 2, but this is not the case.

To say that something can happen is, Lewis (ibid.) maintains, to say 'that its happening is compossible with certain facts'. To say that Tim can kill Grandfather (as premise 1 maintains) is to say that it is consistent with certain facts obtaining that he kills Grandfather; to say that he cannot do so (as premise 2 maintains) is to say that it is inconsistent with certain facts obtaining that he kills Grandfather. It is not clear, though, that the very same facts are relevant in each case. To see why, consider a comparison with the claim that human beings can run a mile in under three minutes. Is this claim true? It seems so. There is certainly nothing contradictory in the claim that a human being ran a mile in under three minutes and it is (so far as we can see) compatible with various biological facts concerning the kind of creatures that human beings are that one could run a mile in, say, two minutes and fifty eight seconds. Yet, it also seems not. The best human athletes have all fallen well short of accomplishing this feat and it is very likely that at present there is no human being whose athletic abilities are consistent with their running a mile in two minutes and fifty eight seconds. There is, however, no *contradiction* here. We have claimed merely that it is consistent with one body of facts that a human being runs a mile in less than three minutes, but not consistent with another, *distinct*, body of facts that they do so.

So how does this apply in the case of Tim? Lewis (ibid.: 152) maintains that there are a number of ways to interpret 'can' in premise 1 such that this premise comes out true since Tim's killing Grandfather is consistent with a

> fairly rich set of facts: the facts about his rifle, his skill and training, the unobstructed line of fire, […] the absence of any chaperone to defend the past, and so on. Indeed it is compossible with all the facts of the sorts we would ordinarily count as relevant in saying what someone can do.

Relative to a different body of facts, though, it is true that (as premise 2 claims) Tim cannot kill Grandfather. The fact that Grandfather dies in 1957, rather than 1921, for example is inconsistent with Tim's killing him in 1921 as are 'various other facts about Grandfather's doings after 1921 and their effects: Grandfather begat Father in 1922 and Father begat Tim in 1949' (ibid.: 151). No matter how well prepared he is, no matter how many times he tries, Tim will never kill Grandfather in 1921 since Grandfather doesn't die until 1957. And his repeated failures may well require all manner of odd coincidences (mysteriously jammed weapons, sudden gusts of wind etc.) since, as Lewis (ibid.: 150) famously quips, the 'forces of logic will not stay his hand!' Such coincidences may be vastly improbable, though even this is disputed (see further readings), but they are not contradictory. And what applies in the case of killing Grandfather will, of course, hold with respect to any other attempt at changing the past which Tim makes. Given that certain things *did* happen

in 1921 there will be nothing Tim can do to prevent them from happening. Yet, their not happening remains consistent with various other facts concerning Tim's abilities, knowledge and so forth. So, Lewis concludes, Tim can kill Grandfather (relative to some body of facts) and cannot kill Grandfather (relative to a different body of facts). The apparent contradiction is resolved.

We have seen that the world of a Lewisian time traveller would certainly be a strange one filled with all manner of oddities. However, Lewis (ibid.: 145) maintains that these oddities only demonstrate something 'which few would have doubted: that a possible world where time travel took place would be a most strange world, different in fundamental ways from the world we think is ours'. A world populated by time travellers would certainly be an odd one, but isn't this what we would have expected all along?

9.4. Worries concerning the Lewisian account

The Lewisian picture of time travel that we presented in the last section has proven extremely influential, attaining something like the status of philosophical orthodoxy. There are, however, some who remain unconvinced. So, why might someone take issue with Lewis's account? Recall that Lewis argues for two main claims in his paper: that time travel is possible and that changing the past is not. As such, an obvious strategy to pursue in objecting to Lewis's view would be to reject one (or more) of these claims. The debate with respect to the (im)possibility of changing the past is certainly a live one but not one which we will consider here (though see the further readings for this chapter as well as those for Chapter 6 for more on this debate). In terms of the logical possibility of time travel, in contrast, we know of no even *prima facie* convincing case for the claim that Lewis has failed to show that time travel yields no contradictions. As such we will not consider attempts to argue that time travel entails genuine impossibilities rather than mere oddities but, rather, on attempts to demonstrate that some of the oddities that result from time travel are rather more theoretically costly than Lewis would have us believe. There are two possible ways to show that some of the oddities resulting from time travel are more problematic than Lewis allows. The first is to argue that one, or more, of the paradoxes Lewis discusses in his paper is more powerful than Lewis himself believed. The second is to argue that even if Lewis has shown these particular paradoxes to be benign, other, more robust, paradoxes lurk nearby. In this section we consider one example of each of these strategies.

One immediate worry many people have with respect to Lewis's resolution of the *Grandfather Argument* is that it somehow undermines Tim's free

will. As you will recall from Chapter 6, people often think that in order for an individual to have free will at a time it must not already be true *at that time* that they will act in a particular way in the future. With respect to Tim, though, this condition doesn't seem to have been met. It is not just the fact that Grandfather dies in 1957 which is already fixed as Tim enters his time machine to begin the journey back to 1921 but also various facts about what Tim himself will do during his trip (actions which are in the past with respect to external time but in the future in terms of Tim's own personal time). Imagine that Tim had somehow brought with him in his time machine a complete and accurate history of everything that happens in 1921. This history will include not only the actions of the ordinary inhabitants of that time (such as Grandfather) but also Tim's own actions. It will record not only that Tim failed to kill Grandfather but the exact manner in which he failed, what he did immediately before and after his attempt and so on. It seems, then, that Tim cannot meet this proposed necessary condition for having free will.

Yet, for the eternalist, the case of Tim generates no new problems (for discussion of whether it raises any problems for the non-eternalist see further readings). As Lewis (ibid.: 150–2) himself points out the eternalist will also hold that a non-time travelling individual in 1921 will be unable (in the relevant sense) to kill Grandfather given that he does not die until 1957. And, likewise, you will be unable (in this sense) to stay in bed tomorrow for a minute more or less than you will stay in bed. Whether a lack of openness of this kind is incompatible with free will is, of course, controversial (as we have discussed at length in Chapter 6). Regardless of our position on this issue, though, this lack of openness is already entailed by standard versions of eternalism rather than resulting from the possibility of time travel.

Deutsch and Lockwood have argued, however, that Lewis's response here fails to get to the heart of the *Grandfather Argument*. They claim (1994: 71) that Lewis's discussion of the grandfather paradox misses the point somewhat and that the

> real core of the grandfather paradox is not the violation of free will but of a fundamental principle that underlies both science and everyday reasoning; we call this the autonomy principle. According to this principle, it is possible to create in our immediate environment any configuration of matter that the laws of physics permit locally, without reference to what the rest of the universe may be doing.

According to Deutsch and Lockwood it is the autonomy principle and not worries concerning Tim's freedom that is at the centre of the *Grandfather Argument*. According to the autonomy principle, it is possible for us *right here and now* to create any arrangement of matter permitted by the laws

of nature irrespective of how things are elsewhere in time and space. Tim's case seems, though, to be a violation of this constraint since his creating a certain local arrangement of matter (one featuring Grandfather's dead body) is rendered impossible by some non-local facts (such as the fact that Grandfather doesn't die until 1957).

Deutsch and Lockwood take themselves to have uncovered a new, and more powerful, version of the grandfather paradox which lies at the core of the *Grandfather Argument*. They maintain that, even if Lewis is successful in resolving the apparent contradiction concerning Tim's freedom of action, we still face a more fundamental worry concerning the autonomy principle. Yet, some are not convinced. Sider (1997: 141), for example, demurs claiming that the argument they present 'is nothing more than the original free will version of the paradox in disguise'. Why does Sider think this? Well, consider that the autonomy principle makes a claim concerning what configurations of matter it is *possible* to create but does not clearly state what kind of possibility is relevant here. As such the Lewisian can respond as follows. In one sense the autonomy principle is certainly true. If what we mean when we say it is possible for Tim to create the relevant arrangement of matter is that it is consistent with his abilities etc. that he does so then this is certainly correct, but it provides no challenge to the Lewisian position (since this was Lewis's claim all along). If, on the other hand, what we mean is that it is consistent with all other facts about what happens elsewhere in time and space, then this is certainly inconsistent with the Lewisian view; but this version of the principle is clearly implausible. Even setting aside time travel cases and the eternalist's views concerning future truths, counterexamples to this principle abound. Imagine that, right now, Jack has the only cheese sandwich in existence. *Given this fact,* it is of course impossible for you to have presently arranged some matter so as to form a cheese sandwich. It is, however, also clear that such restrictions do not threaten either our everyday or scientific reasoning.

Even if we accept, though, that Lewis has defused the *Grandfather Argument* – as well as the other paradoxes which formed the main focus of his paper – we might still have additional worries concerning time travel. In this section we will only focus on one such worry (for discussion of a range of other putative paradoxes see the further readings). Consider, again, Le Poidevin's (2003) case of Jane and Peter from section 9.2. When we discussed this case above we treated it as merely providing an instance of the *Causal Loop Argument*. However, Le Poidevin argues that it also highlights a deeper worry. Recall that Jane is instructed by Peter's future self to keep a record of her trip in the diary. She then passes the diary on to Peter instructing him to write a record of his own journey in the diary and so on. Le Poidevin (2003: 181) asks us to consider the following question: '[H]ow many entries

are there in the diary when Jane first steps into the machine?' The obvious answer is that there are no entries at all. The diary is full of blank pages waiting for Jane and Peter to inscribe the records of their respective journeys. However, this answer can quickly be seen to be inadequate since

> this is the very same diary as the one Jane hands to the 40-year-old Peter, which by then contains her entry. And by the time Peter arrives back in 1999, it will contain his entry too. But then, if the diary already contained two entries when Jane was handed the diary, then it would contain three entries when she handed it to Peter, who would then add another one, so the diary would have contained four entries when it was first handed to Jane, and so on.

The problem here is not merely that there is an unexplained fact that the diary contains, say, seven entries when first handed to Jane but that there doesn't appear to be any satisfactory answer to the question of how many entries are in the diary. Consider any number *n* which we might supply in answer to this question. It looks like whatever number *n* is, it must be the wrong answer, since, after the diary is handed to Jane, she will write an additional entry in it before passing it on to Peter who will then also write an additional entry. It seems, then, that when the diary is handed to Jane it will actually have *n*+2 entries in it; but, of course, this can't be the right answer either, since, after the diary is handed to Jane, she will write an additional entry and so on and so forth.

What are we to make of this case? Certainly the scenario as Le Poidevin describes it isn't logically impossible. There is, for example, no contradiction in claiming that there is only a single entry (Peter's) when Jane receives the diary which will mysteriously vanish as the machine travels forward in time just as the new entry which Jane writes will somehow disappear during Peter's return trip. This answer doesn't entail a contradiction, but it is still problematic. Not only are we multiplying individual unexplained facts here, we are also postulating unexplained *regularities*, since whenever a case like this occurs we will have to claim that similar mysterious vanishings occur at the appropriate junctures. So, while consistent, this account does seem to significantly increase the theoretical cost of permitting the possibility of time travel.

A different, and perhaps more satisfactory, answer is to maintain that our initial reaction was correct but not for the reason we initially thought. There are no entries in the diary when it is handed to Jane, not because she and Peter have yet to write their entries, but because they will never write any entries at all. Perhaps their pens will malfunction, or they will be distracted by their fantastical situation, or perhaps they merely dislike being given

instructions by pushy time travellers. The response given here is, of course, parallel to the one which Lewis gives to the question of why it is that Tim fails to kill Grandfather. It must be the case that Jane fails to write in the diary (since this would lead to all manner of theoretical difficulties) but the mere fact that this action would lead to paradox cannot be what would prevent her from performing this action.

9.5. Time travel and the ontology of time

On the standard picture of time travel offered by Lewis, we are asked to think of time as a four-dimensional manifold of events. This is, of course, how Lewis and his fellow eternalists take our own world to be; but is the world being this way essential to the possibility of time travel? Or is it possible for those who hold alternative ontologies of time – such as the presentist – to consistently accommodate time travel? In this section we will look at some reasons for doubting that the presentist is able to account for the possibility of time travel.

The most obvious arguments for the claim that the presentist must reject the possibility of time travel are variants of what Simon Keller and Michael Nelson (2001: 334) call 'the Nowhere Argument'.

> According to the [eternalist], the past, present, and future all exist. If you want to travel to the past or to the future, you have a destination. There is somewhere for you [to] go. The past and future are there waiting, as it were, for the time traveller to pay them a visit. But this is not the case on the presentist model. On the presentist model, the past and future do not exist, so there is nowhere for the time traveller to go.

The reason why we are able to travel to Norway but unable to travel to Narnia is that the former exists while the latter does not. Similarly, if presentism is true, the past does not exist and so is unavailable as a destination for cross-temporal vacationing. Yet, as Keller and Nelson (ibid.: 335) point out, the Nowhere Argument gets us nowhere. Recall that (as we discussed in section 9.1) there is a sense in which each of us is travelling in time. That is to say that the time we now occupy is different from the time we occupied an hour ago (indeed it is one hour later) and different from that which we will occupy in an hour's time (indeed it is one hour earlier). It seems, then, that our ability to move from occupying one time to occupying another is something that any successful theory of time is going to need to account for. If the presentist can account for this simple fact then there is no obvious reason to think that they cannot

account for the worries raised by the Nowhere Argument. If they cannot then any difficulty in accommodating time travel will be the least of their worries.

Of course the presentist will maintain that I can never occupy any time which is not the present, but this raises no more problem in time travel cases than it does in ordinary cases of objects moving through time. The time one hour in the future isn't now present (indeed it doesn't even exist) but it *will* be present (and will exist) in an hour's time when you come to occupy that time. Likewise the time 100 years in the past isn't now present (and doesn't now exist) but we can insist, nonetheless, that it *was* present (and did exist) when the time traveller's machine arrived there 100 years ago.

So the *Nowhere Argument* looks to be a non-starter; is there a better argument available? One possibility is to appeal to the presentist's preferred account of persistence to explain their inability to account for time travel cases.

Persistence and Time Travel Argument

(1) Presentism is only compatible with an endurantist account of persistence.

(2) An endurantist account of persistence is incompatible with time travel.

Therefore,

(3) Presentism is incompatible with time travel.

What are we to make of this argument? It is certainly valid but is it sound? We have already discussed premise 1 at length in Chapter 7 and seen that it remains controversial. Let's assume for now, though, that we are happy to accept it and ask what we should make of premise 2. According to this premise an endurantist account of persistence is incompatible with time travel. Why would someone think this though? A first argument for premise 2 is presented (and rejected) by Keller and Nelson (2001: 342) who ask us to consider cases of 'bilocation' where a time travelling individual occupies the same time as her past self.

> At first glance, it seems that the endurantist must rule out bilocation. How can a single object be *wholly present* in two different places at the same time? Whatever this mysterious phrase 'being wholly present' means, it seems that nothing can be wholly present twice over.

If it is impossible for a single object to be wholly present in two different places at the same time and the endurantist is committed to saying that the bilocated individual will be wholly present in two places at the same time, then the endurantist will be unable to accommodate bilocation. It is not clear,

though, that we should accept either part of the antecedent of this conditional. A number of philosophers (such as Armstrong 1989) have proposed accounts according to which certain objects – such as the property of redness – are able to be wholly present in multiple locations at the same time. Further, some have denied (as we will see shortly) that the endurantist is committed to saying that a bilocated individual is wholly present in two places.

An initially much more promising argument is offered by Sider (2001: 101).

> Suppose I travel back in time and stand in a room with my sitting 10-year-old-self. I seem to be both sitting and standing, but how can that be? The [perdurantist]'s answer is that there are two distinct person stages, one standing, the other sitting […] If [endurantism] is true, on the other hand, the case involves only a single 'wholly present' person, which seems to be both sitting and standing.

Surely, though, the endurantist's account of this case cannot be the correct one since the same person cannot be both sitting and standing. At first glance this may appear as if we are merely rehearsing the problem of temporary intrinsics which we discussed in Chapter 7 but this is not quite right. Consider that the solutions we surveyed to this problem in Chapter 7 won't help the endurantist here. It will not do, for example, to appeal to time relativized properties since both Sider and his 10-year-old self now occupy the same time. What we have is not a case of an individual sitting at *t1* and standing at *t2* but rather a case of the same individual both sitting at *t1* and standing at *t1*. Nor can denying the existence of the past and future resolve our quandary since we can construct a case where both Siders occupy the present. How, then, might the endurantist respond to this worry?

A first response to this objection is to appeal to restrictions on the kinds of time travel which are available. The problem which Sider advances is not a result of time travel as such but rather of the ability to travel to a time *already occupied by your past self*. The endurantist could maintain that while time travel is possible it is not possible to travel to times already occupied by your past (or future) self. An obvious worry is that this response is merely an arbitrary and *ad hoc* attempt to avoid this particular worry but, as Keller and Nelson (2001: 344) point out, it is not so obvious that this restriction is genuinely arbitrary. If it really is the case that time travel of this kind would lead to a contradiction then we have an excellent reason to hold that it is impossible. The restriction is no more arbitrary than is Tim's inability to kill Grandfather in 1921 given the fact that Grandfather doesn't die until 1957.

For those who find this response unsatisfactory there are also endurantist accounts which allow for the possibility of bilocation. One such response, offered by Ned Markosian, argues that the perdurantist's account 'can be

used as a model for generating a[n endurantist] solution to the problem' (2004b: 672). Consider, for example, that the endurantist is not committed to denying that individuals have parts but only to denying that they have *temporal* parts. As such the endurantist might maintain that neither Sider nor his past self are persons in their own right but rather two distinct *spatial* parts of the same person. Once this move is made, the endurantist can then appeal to an explanation paralleling that which the perdurantist offers with respect to temporal parts. It is not that the same individual is both sitting and standing at a time but rather that there are two distinct spatial parts of the same individual located at that time: one of which is sitting, the other standing. It seems, then, that we have yet to find a compelling argument for the claim that presentism (or endurantism) is incompatible with time travel.

9.6. Summary

In this chapter we have looked in detail at David Lewis's influential discussion of the logical possibility of time travel. We have seen that Lewis was able to offer convincing responses to some traditional, and apparently fatal, objections to the possibility of time travel. We also saw that Lewis's account seems to have the resources to deal with some more recent putative paradoxes of time travel. Lewis's own account combines an eternalist account of the ontology of time (which we discussed in Chapter 5) with a perdurantist account of persistence through time (as outlined in Chapter 7). We have seen, though, that it is by no means obvious that such a combination is required to account for the possibility of time travel. Indeed, a number of recent accounts have tried to combine the possibility of time travel with a presentist ontology of time, an endurantist account of persistence or both. In the next, and final, chapter we consider how some of the debates we've considered so far in this book intersect with some views in contemporary physics.

Study Questions

1. What is the difference between external time and personal time?
2. How does Lewis respond to the three 'paradoxes of time travel' we consider in this chapter? Do you find his responses convincing?
3. Does accepting the possibility of time travel commit us to a particular view of the ontology of time?
4. Does accepting the possibility of time travel commit us to a particular view of how objects persist through time?

FURTHER READINGS

The main focus of this chapter has been Lewis (1976b) and this paper is certainly worth reading in its entirety. For some useful overviews of debates concerning time travel see Horwich (1975) and Richmond (2003). For some more recent proposed paradoxes of time travel see Grey (1999) and Le Poidevin (2005). Deutsch and Lockwood (1994) and Arntzenius and Maudlin (2002) discuss whether time travel is physically possible. See Smith (1997) and Goddu (2007) for a debate concerning whether cases like Tim's would necessitate an improbable series of coincidences. For an interesting recent defence of the possibility of a time traveller changing the past see van Inwagen (2009). For criticisms of this view, and some proposed amendments, see Hudson and Wasserman (2010). For a further defence see Goddu (2002). For an account of how the presentist should account for time travel see Keller and Nelson (2001). Objections to this account include Miller (2006a). For general discussions of the relationship between time travel and the ontology of time see Sider (2005) and Simon (2005). For additional discussions of Sider's argument concerning the incompatibility of endurantism and time travel see Miller (2006b) and Carroll (2012). Effingham and Robson (2007) present a further argument for the incompatibility of endurantism and time travel. Gilmore (2007) argues that the possibility of time travel raises worries for the perdurantist.

10

Physics and the philosophy of time

This chapter focuses on giving an overview of special and general relativity, and draws out some important issues that arise from consideration of them in the metaphysics of time. Specifically, we return to the substantivalism/relationism debate introduced in Chapter 2, and we assess the objection that presentism is incompatible with special relativity. We have tried to keep the technical details to a minimum, although given the nature of the topics covered, it is not possible to avoid all technicalities. Those who find the material in this chapter difficult are encouraged to supplement their studies with some of the material mentioned in the further readings. Kennedy (2003), in particular, gives the most accessible philosophically orientated introduction to the issues covered in this chapter.

In this final chapter we turn to how developments in current physics bear on debates in the philosophy of time. In section 10.1 we trace the developments in physics of the late nineteenth and early twentieth centuries and describe the aether theory, according to which light travels as a wave through an underlying medium that permeates the entire universe. This leads into a (relatively) non-technical overview of Einstein's special theory of relativity in 10.2. In section 10.3 we compare Einstein's theory with an alternative theory due to Hendrik Lorentz. In section 10.4 we then give a brief account of Einstein's general theory of relativity, before turning to some philosophical issues. In 10.5 we revisit the substantivalism/relationism debate and discuss the implications that relativity has for it. In 10.6 we then consider an objection to presentism that we have postponed from Chapter 5, *viz.* that it is incompatible with special relativity and so ought to be rejected. In 10.7 we very briefly consider the implications that recent work in fundamental physics has for the philosophy of time, focusing on quantum mechanics and quantum gravity. We summarize the chapter in 10.8.

10.1. The aether theory

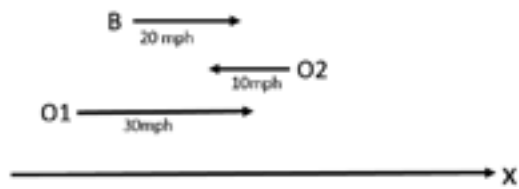
In Chapter 2 we introduced Newton's theory of space and time. According to Newton all material bodies move relative to an independently existing space and time. We said that space and time can be thought of as an invisible four-dimensional fixed grid marked out by uniform units that pervades the entire universe and is such that material objects travel through it. However, in view of the issues that will arise when we discuss the special theory of relativity in section 10.3, it is probably better to describe it as a 3+1-dimensional grid. On Newton's view space and time are independent of each other in the following sense: the spatial distances between events do not depend upon the temporal distance between them – they are fixed facts that are the same for all observers (and possible observers) in the universe. Space has three dimensions across which objects are arranged, and time has one dimension through which objects persist, and these are independent of each other – hence, the grid is well-conceived of as being a 3+1-dimensional grid. Thinking of space and time in this way vindicates the following two (related) common-sense views that we have:

1. Time flows at the same rate for everyone. No matter where you are located in the universe or how fast you are travelling relative to others, the passage of time is the same for you as it is for everyone else. This means that everyone ages at the same rate. It also means that two accurate clocks synchronized at a time will agree on how much time has passed when brought together and compared at any later time, no matter how they have moved relative to each other in the intervening period.
2. The distance and time between any two events is a fixed matter that cannot vary from observer to observer. Any two observers with accurate rulers and clocks will agree on both the distance and time between two events. In addition, the distance between two events is independent of the time between two events. One can measure either without having to measure the other. As a corollary of this, whether two events happen at the same time (i.e. simultaneously) is also a fixed matter that cannot vary between observers. The entire universe can be split into sets of events such that each event in a set is simultaneous with every other event in the set, and simultaneous with no events in any other set (sometimes such sets are called 'hyperplanes of simultaneity').

With the advent of special relativity, however, Newton's view of space and time came under considerable pressure, and was eventually abandoned by most in

favour of one in which time and space are not independent of each other. (It is this conception of space and time combined, *viz*. of *spacetime*, that can be thought of as a true four-dimensional grid.) And along with it went the common-sense views mentioned above. In order to understand why it is first necessary to understand how special relativity developed in the context of the developments that occurred in late nineteenth and early twentieth century physics.

First we need to introduce the notion of an *inertial frame of reference*. There is some difficulty in defining this notion in a non-circular manner, but for our purposes we can think of an inertial frame of reference as being a path through space and time in which things are not subject to any forces that cause them to undergo acceleration. (See Disalle 2009 for an overview of the notion and some associated philosophical problems.) We saw in Chapter 2 that in Newton's theory only acceleration relative to absolute space and time is empirically significant, and so an inertial frame of reference in Newtonian physics is one in which objects are either at rest or are undergoing uniform velocity relative to absolute space. One characteristic feature of Newtonian physics is that all laws of motion are the same in every inertial reference frame (so, for example, the mass multiplied by the velocity of any moving object will be the same according to the measurements taken in every inertial frame), and the velocity that a moving body has relative to any particular inertial reference frame can be worked out by applying simple transformation rules (called the 'Galilean Transformation rules') to the velocity that it has relative to any other. As a simple illustration suppose, for example, that an observer O1 is moving at a constant velocity of 30mph relative to absolute space along one spatial dimension x, that an observer O2 is moving in the opposite direction along x at a constant velocity of 10mph and that a body B is moving along x at a constant velocity of 20mph in the same direction as O1:



In this situation, although O1 and O2 are undergoing uniform motion at a particular velocity relative to absolute space, there will be no way for them to discover this fact. However, O1 will be able to measure the velocity that B (and also O2) has relative to its reference frame, and O2 will be able to measure the velocity that B (and also O1) has relative to its reference frame. O1 will measure B as having a negative velocity of –10mph along the x-axis (and will measure O2 as having a negative velocity of –40mph along the x-axis). O2, by contrast, will measure B as having a positive velocity of

30mph along the x-axis (and will measure O1 as having a positive velocity of 40mph along the x-axis). But, moreover, O1 will be able to work out by following the Galilean Transformation rules what velocity O2 will measure B as having, and O2 will be able to work out by following the same rules what velocity O1 will measure B as having. So, there is a symmetry among the measurements that observers make in inertial frames of reference in Newton's theory, which suggests that (if the theory is true) observers in different reference frames are tracking the same objective underlying facts about the movements of material objects.

Now, recall Leibniz's criticism of the notions of rest and uniform velocity in Newton's theory (see section 2.5). Leibniz objected to the fact that in Newton's theory there is no way to measure whether we are at rest or undergoing uniform velocity relative to absolute space. New work in the 1860s on electrical and magnetic phenomena by (among others) James Clerk Maxwell promised to solve this problem. Maxwell's work strongly suggested that electrical and magnetic phenomena were in fact part of a single phenomenon, and that when electrical and magnetic fields interact they produce electromagnetic waves. How, then, did this promise to solve the problem of measuring uniform velocity relative to absolute space? The answer lies in five facts. First, all previous work on the propagation of waves suggested that waves are simply disturbances in some underlying medium (think, for example, of waves in a pond, which are disturbances in the water in the pond). As such, it was assumed that electromagnetic waves must also be disturbances in an underlying medium, which came to be known as 'the aether'. Second, the velocity at which waves propagate relative to their underlying medium does not depend upon the velocity of their source relative to that medium. So, for example, the waves produced by a boat on a pond propagate at (i.e. roughly, 'spread out at') the same velocity through the water no matter how fast the boat is moving relative to it. Third, Maxwell's equations gave a prediction for how fast electromagnetic waves would propagate through the aether – around 300,000,000 metres per second. Fourth, light had already been measured experimentally to have (within a margin of error) this same velocity. This led Maxwell to propose that light itself is an electromagnetic wave that propagates through the aether at 300,000,000 metres per second. Fifth, and finally, after some debate it was agreed that the aether must itself be at absolute rest relative to absolute space. As such, because light travels at a constant velocity through the aether, light must also be travelling at a constant velocity through absolute space itself – i.e. with an *absolute* velocity of 300,000,000 metres per second. (See Hendry 1986 for a presentation of Maxwell's development of electromagnetism.) Putting all this together, then, we get:

- Light is an electromagnetic wave that travels through absolute space at an absolute velocity of 300,000,000 metres per second.

And this gives us a way to measure whether a material object in an inertial frame of reference is at rest or undergoing uniform motion relative to absolute space. All that has to be done is to measure the velocity at which a wave of light passes the object. If it passes at 300,000,000 metres per second, then the object must be at absolute rest relative to absolute space. And if it passes at a slower or faster velocity then the object must itself be moving at a particular velocity through absolute space. For example, if a wave of light passes a material object at 250,000,000 metres per second, then the object must be moving at 500,000 metres per second through the aether (and so absolute space) in the same direction as the wave:

- If light travels through absolute space at a constant velocity of 300,000,000 metres per second, then if O1 is at rest relative to it light will pass it at that velocity, and if O2 is travelling at 500,000 metres per second relative to it, then light will pass it at 250,000,000 metres per second.

In the 1880s two experimental physicists, Albert Michelson and Michael Morley, took up the challenge of testing the theory of the aether. They reasoned that the Earth must be moving at different velocities relative to the aether at different points as it travels around the sun, and so set up an experiment in which light waves were sent out in different directions and reflected back to a device that measured the time of the light's journey, which they repeated at different times of the year. They expected to find that some of the light waves would take slightly longer to make their journey than others, depending upon whether the Earth was travelling in the same direction as them through the aether or in the opposite direction. But their results were unexpected. They were unable to find any discrepancy between the journey times of any of the light waves that they sent out. The conclusion thus seemed to be that light waves pass material objects at the very *same* velocity, no matter how fast the objects are moving relative to one another. To see how counterintuitive this conclusion is, consider two objects *a* and *b* travelling in the same direction along an x-axis at different relative velocities. Suppose, for example, that *b* is travelling 500,000 metres per second faster than *a*. Now consider a wave of light travelling along the x-axis in the same direction as *a* and *b*. We would expect *a* to measure the light wave as passing it at a much faster velocity than *b* measures it to be. But, this is not so. Both *a* and *b* measure the light wave to be passing at precisely the same velocity, i.e. 300,000,000 metres per second.

The aether theory seemed to have been refuted. However, some physicists (and in particular Hendrik Lorentz) reacted to the Michelson-Morley results by arguing that light doesn't *really* pass all material objects at the same velocity irrespective of how fast they are moving. Instead, they argued that this is just an artefact of measurement. They maintained that the aether does exist, and that light does travel at a constant speed though it, but argued that as a material object travels through it various compensatory effects occur that mask the true velocity of light making it impossible to measure its true velocity. The compensatory effects required are radical. In order to mask the true velocity of light through the aether measuring instruments must contract and clocks must slow down by a particular amount, resulting in lengths, intervals of time and the velocity of light being *mis*measured in most cases. Nonetheless, because of the counterintuitive consequences of accepting that light passes all observers at the same speed, defenders of the Lorentz view believed that this is the only conclusion that can be sensibly drawn. However, Albert Einstein famously drew a different conclusion.

10.2. Einstein's special theory of relativity

The special theory of relativity was introduced by Einstein in his renowned 1905 paper 'On the Electrodynamics of Moving Bodies'. In that paper Einstein made two basic assumptions. The first is that *all* laws of nature (and not just the laws of motion) are the same in all inertial frames of reference. Einstein included in these laws the fact that light travels at 300,000,000 metres per second, and so the second assumption is that light really *does* pass material objects at the same velocity no matter how fast they are moving relative to one another. In order to account for these two assumptions Einstein had to suppose that observers in different frames of reference would obtain different results when measuring the spatial and temporal intervals between events. And this in turn meant that he had to suppose that as one observer undergoes uniform motion relative to another, the first will be measured by the second to have shrunk from his original size, and to have slowed down, *and vice versa*, even though neither observer *mis*measures anything.

Suppose for example that an observer O2 is moving away from another O1 at 500,000 metres per second, and suppose that both O1 and O2 are carrying a ruler and a clock. As a wave of light passes O1 and O2, each will measure it as passing at 300,000,000 metres per second. But O1 can consider himself at rest, and so consider O2 as moving at a velocity of 500,000 metres per second. Then from O1's perspective O2's ruler (as measured by O1's ruler) will have contracted and so will have become shorter by a certain amount,

and O2's clock (as measured by O1's clock) will be running slow by a certain amount. So, given that velocity is length divided by time, this explains from O1's perspective why O2 measures the velocity of light as travelling at 300,000,000 metres per second even though O2 is moving at 500,000 metres per second relative to O1. Einstein's first assumption, however, implies that O2 can reason in an exactly parallel way. O2 can, with equal justification, consider *herself* to be at rest, and so consider O1 to be moving away from *her* at a velocity of 500,000 metres per second. So, from O2's perspective it is O1's ruler (as measured by O2's ruler) that will have contracted and so will have become shorter by a certain amount, and O1's clock (as measured by O2's clock) that will be running slow by a certain amount. Thus, given that velocity is length divided by time, this explains from O2's perspective why O1 measures the velocity of light as travelling at 300,000,000 metres per second even though O1 is moving at 500,000 metres per second relative to O2. The key point here that differentiates Einstein's view from Lorentz's is *that neither O1 nor O2 is wrong* when they consider themselves to be at rest. The length that things have, and the time that passes between distinct events, is not an objective or fixed matter, but depends (i.e. it is *relative* to) on an inertial frame of reference. And this immediately implies that many aspects of the common-sense views described above are false. Time does *not* flow at the same rate for everyone. How fast time flows for you compared to how fast it flows for others depends on how fast you are moving relative to them. People age at *different* rates, and two accurate clocks synchronized at a time may *disagree* on how much time has passed when compared at a later time, depending on how they have moved relative to each other in the intervening period. Moreover, the distance and time between any two events is *not* a fixed matter and *can* vary from observer to observer. Two observers with accurate rulers and clocks may *disagree* on the distance and time between two events, even though neither makes any mistake. (See, e.g. Kennedy 2003 for an accessible description of these effects.)

One might be puzzled by these statements. If disagreement can occur between observers moving relative to each other about these matters, how come we never notice these effects in everyday life? The reason is that the effects that Einstein's theory says there are, are only said to be significant at very high velocities (close to the speed of light). In our everyday interactions with each other we never come anything close to such velocities, and so although shrinking and time dilation are said by Einstein's theory to occur in everyday life, their effects are so small that they could never be noticed.

There is one final aspect of the common-sense view that we have so far not mentioned, *viz.*, that whether two events happen simultaneously is a fixed matter that cannot vary between observers. What becomes of this in Einstein's theory? In short, it too must be abandoned. Indeed, Einstein's

view regarding simultaneity serves as a particularly good illustration of the opposition between him and those who defended the Lorentz view. Einstein argued that the notion of simultaneity, understood in its traditional sense, is meaningless once the effects of special relativity are taken into account. Einstein's view here is based upon a strong positivist conception of meaning according to which a statement has no meaning unless it can somehow be explained how its truth can be established empirically. (See Ayer 1936 for a classic defence of positivism and Holton 1970 for an overview of Einstein's positivism.) Leibniz objected to Newton's notion of absolute space and time because it gave rise to the existence of empirically indistinguishable possible states that the world can be in, and here Einstein objects to the notion of simultaneity on similar grounds, arguing that the only concepts with any content are those with clearly defined empirical applications:

> The only justification for our concepts and systems of conception is that they serve to represent the complex of our experiences; beyond this they can have no legitimacy. I am convinced that the philosophers have had a harmful effect upon the progress of scientific thinking in removing certain fundamental concepts from the domain of empiricism, where they are under our control, to the intangible heights of the *a priori* … This is particularly true of our concepts of time and space, which physicists have been obliged by the facts to bring down from the Olympus of the *a priori* in order to adjust them and put them in a serviceable condition. (Einstein 1922: 2)

Einstein's complaint about the concept of absolute simultaneity is that we have no immediate (i.e. instantaneous) observational access to spatially separated events, and so in order to judge that they are absolutely simultaneous we must rely upon signals that travel from those two events, and our knowledge of how long it has taken them to reach us. For example, suppose an observer O sees two flashes of light in the sky from distant galaxies. As O has no immediate access to the sources of those distant events, in order to judge that these two flashes originate from their sources simultaneously, O must judge that the two light waves have taken the same time to reach her. And this in turn depends upon O's judging that the velocity of each light wave divided by the distance it has travelled is the same in both cases. But, according to special relativity, the distance that O will measure as being between her and the distant sources depends on how fast she is moving relative to them. Another observer moving at a different velocity relative to the distant sources may well find that according to his measurements the two flashes did not originate from their sources simultaneously. So, because our measurements are all we have to go by, which of the two observers is right is something we have no empirical means of checking.

Einstein reacts to this by rejecting the idea that it makes sense to say that one of the observers is right and the other wrong. He thus also rejects the common-sense intuition that whether two events happen simultaneously is a fixed matter that cannot vary between observers. According to Einstein, there is no observer-independent way to divide the universe into hyperplanes of simultaneity. Instead, he argues, we must take the notion of simultaneity itself to be a relative notion – events can be simultaneous according to one observer, but not according to another, *even though neither observer makes any mistake*. Taking this view, Einstein proposed that we should *redefine* simultaneity in a relativistic manner in terms of light signals. The idea, roughly put, is to hold two events to be simultaneous at a time *t* as measured within a frame of reference F iff light emitted from those two events would reach F at *t*, or light emitted from F would reach those two events at *t* (according to measurements made in F) (See, e.g. Einstein 1920: 26). The idea has two components. First, imagine that one is located within a frame of reference F (say, one is located in an ordinary residential street at night). Now imagine shining a light into the sky at time *t* as measured by a clock within F. At some later time *t*+1 as measured by the same clock in F this light will have reached a number of events occurring within the universe. The first component of Einstein's idea is to treat each of the events that the light has reached at *t*+1 (again, as measured by the clock in F) as being simultaneous with the events occurring in F at *t*+1. Second, imagine standing and looking into the sky at night from F at some time *t* as measured by a clock in F. Many waves of light will impact upon one's senses at t, some of which will be coming from events originating in stars at great distances away, and some will be coming from events that originated in nearby houses and streetlamps. The idea is to count each of these events as being simultaneous with the events occurring in F at *t* on the basis that the light from each of them is reaching you *now* (i.e. at the current time *t* as measured by clocks in F). The upshot of this is that for *each* frame of reference there will be a way to split the universe into hyperframes of simultaneity (at least for those events from within the frame of reference that it is possible for light to reach and be reached from), but the hyperplanes for each frame will be different from the hyperplanes in all others. (See Jammer 2006: chapter 7 for more on simultaneity in special relativity, and see Sider 2001: 42–5 for more on hyperplanes in special relativity.)

10.3. Einstein vs. Lorentz

Einstein, then, was firmly committed to the view that the common-sense views of space and time we listed above are all false. Many positivistically

inclined physicists and philosophers embraced this view wholeheartedly (see Friedman 1983: 24–5). But those who held the Lorentz view remained unconvinced. They rejected Einstein's positivistic conception of meaning, and maintained that the notion of simultaneity was perfectly coherent despite not having a clear *empirical* application. On their view there is a *privileged* inertial frame of reference in which observers are at rest relative to the aether (and absolute space), and so in which rulers measure *genuine* distances and clocks measure the *genuine* flow of time. In other frames of reference movement through the aether causes rulers to contract and clocks to slow down so that observers *mis*measure the genuine lengths of things and genuine temporal intervals between events. As such, time and space remain as they were on Newton's view, a fixed 3+1-dimensional grid through which material objects (and now light waves) move. Lorentz, in fact, developed this view in such a way as to be able to account for all the phenomena that Einstein's theory predicted, and as such he defended a theory that was, at least in terms of its empirical predictions, indistinguishable from Einstein's. The fundamental difference between Einstein's theory and Lorentz's is that there remain possible states of the universe that are empirically indistinguishable in the latter. There is no possible experiment which could identify whether one is within the privileged frame of reference or in one in which there are mismeasurements of genuine lengths and times, and no way to identify the genuine hyperplane of simultaneity. Nonetheless, on Lorentz's theory, our commonsense views regarding space and time are maintained. (Lorentz's view is given its most full expression in Lorentz 1916. For discussion of his view and its contrast with Einstein's see Schaffner 1974.)

One important aspect of both Einstein's and Lorentz's view is that the symmetry present in Newton's view is retained (see section 10.1). Observers in one reference frame can work out using a certain set of rules what velocity observers in any other reference frames will measure moving objects as having (these rules were in fact formulated by Lorentz himself, and so are called 'the Lorentz Transformation rules'). These rules are more complicated than the ones needed in Newton's theory, but the fact that the symmetry holds still suggests that (if either theory is true) observers in different reference frames are tracking the same objective underlying facts about the movements of material objects. However, on this score, Einstein's theory has an advantage over Lorentz's.

To see why first remember that on Newton's view the spatial distance between events does not depend upon the temporal distance between them. This is retained in Lorentz's theory, but abandoned in Einstein's. But, two facts here combine that put pressure on Lorentz's theory. First, in Lorentz's theory, there is no way for any observer to discover the genuine spatial and temporal distance between events. Most observers *mis*measure such

facts, and only those within the privileged frame of reference get them right, although there is no way for any observer to know whether they are in the privileged frame. Second, although the measurements of spatial and temporal distances between events differ in different frames of reference, there *is* a measureable relation that holds between events in *all* frames of reference in both Einstein's and Lorentz's theories. The Lorentz Transformation rules entail that any observer in any reference frame, despite disagreeing about the spatial and temporal distances between events, will agree about a certain *spatiotemporal* distance that holds between them. But while this fact is easily explained on Einstein's view, it is not easily explained on Lorentz's.

In 1908 Hermann Minkowski, the German mathematician and former teacher of Einstein, developed an elegant geometrical framework from the Lorentz Tranformation rules in which Einstein's theory can be represented (see Minkowski 1908). And Minkowski's framework is a genuine *four*-dimensional one. Points in his four-dimensional framework represent events that are related not by separate spatial and temporal relations, but by a single *spacetime* relation containing four terms. It is this spacetime distance (or 'interval') between distinct events that is measured to be the same by observers in *all* inertial frames of reference. That the measurements made of such intervals by all observers *agree* strongly suggests that they reflect genuine features of reality itself. This in turn suggests that the measurements of spatial and temporal distances between events that together determine the spacetime distance, despite being different in different frames of reference, are nonetheless genuine features of reality too. And this gives substance to the idea that all observers are tracking genuine features of reality in their measurements of the velocities of moving objects. But while this is something that Einstein can maintain, the Lorentzian has some difficulty. The fundamental point is that although observers will disagree in their measurements of spatial and temporal distances in Einstein's theory, no observer makes any *mistake* – spatial and temporal distances as measured in reference frames are in that sense objective *despite being relative*. And this allows Einstein to say that measured distances and temporal intervals accurately reflect genuine, *albeit relative*, features of reality that together determine the spatiotemporal distance between events. By contrast, in Lorentz's theory, it is only observers in the privileged frame of reference that accurately measure spatial and temporal distances – all others *mis*measure them – and so the Lorentzian cannot say that spatial and temporal distances as measured in reference frames are objective in the same sense. This in turn means that the Lorentzian cannot say that the measurements accurately reflect genuine features of reality that together determine the spatiotemporal distance between events. And this leaves the status of the spatiotemporal distances themselves in doubt. Why should the measured spatiotemporal distance

between events be the same for all observers, even though most obtain it on the basis of mismeasurements of spatial and temporal distances? It is difficult to see what plausible answer the Lorentzian can give to this question. (See Bohm 1996 for more on this issue.)

10.4. Einstein's general theory of relativity

Despite the fact that the special theory of relativity was widely accepted by physicists by 1911, Einstein was nonetheless not satisfied with it. His reason was that the theory only applies in reference frames in which no forces act upon objects, and so no acceleration takes place (i.e. it only applies in inertial reference frames), and so in particular it says nothing about the effects of gravitational forces upon bodies. In 1916, after more than ten years of work, Einstein introduced the general theory of relativity, which incorporated the basic ideas of the special theory but also explained the effects of gravity (Einstein 1916). The fundamental insight from which the general theory was developed is that there is no way to test from *within* a particular frame of reference whether one is undergoing uniform motion, or undergoing uniform *acceleration*. If one were locked inside a windowless spaceship somewhere in outer space, everything would seem exactly the same whether one was travelling under the influence of no forces, whether one was being uniformly accelerated under the gravitational force of a nearby star or planet or whether one was being uniformly accelerated by a (silent) rocket attached to the ship. Nothing that one could do, from within the spaceship, would enable one to tell which situation one was in. As such, Einstein realized that he was able to extend the first assumption of special relativity (that the laws of nature hold in all inertial frames) to non-inertial frames in which one is undergoing uniform acceleration (this is known as the 'equivalence principle').

According to Newton's conception of gravity, it is a *force* that acts instantaneously across distances. If a massive body (say, a planet) were to suddenly come into existence at a certain distance from a second, the second would feel the gravitational effects of the first *immediately* (and *vice versa*). On Newton's view, this was simply a basic fact about the universe that was not to be explained in terms of any further fact. Massive bodies exert a *direct* influence upon others across spatial distances. But, armed with the fundamental insight described above, Einstein came to see that this conception of gravity can be recast, along with the conception of an inertial frame of reference itself. In effect, Einstein realized that the gravitational influence that massive bodies exert upon each other *can* be explained in terms of some further fact, namely, in terms of their having an influence on spacetime itself.

His leading idea was to extend the notion of an inertial frame of reference such that the paths of bodies accelerating under the influence of gravity are also within inertial frames of reference. This in turn was explained by proposing that spacetime itself is warped by objects depending upon their mass. An analogy that is often used to illustrate this leading idea is that of a heavy ball on a sheet of rubber. Objects travelling along inertial paths can be thought of as ball-bearings moving frictionlessly across huge sheets of rubber. Rubber sheets can be deformed in various ways, but if a sheet is completely flat, a ball-bearing will continue to travel along it in a straight path unless it is impacted upon by an external force (e.g. by another ball-bearing colliding with it, or by it being caught in a magnetic field). Spacetime in general relativity can be thought of as being like a rubber sheet that can also be deformed in various ways. If spacetime is flat then an object, like a ball-bearing on a rubber sheet, continues to travel along a straight path unless it is acted upon by some force. So, just as one way for a ball-bearing to accelerate is for some force to cause it to change in its motion along a rubber sheet, one way for an object to accelerate is for some force to cause it to change its motion in spacetime. And just as, if a rubber sheet is flat, the *only* way for a ball-bearing to accelerate is for some force to act upon it, if spacetime is flat, this too is the only way for an object to accelerate. Consequently, in order to account for gravity in a flat spacetime one has to think of it as being a force that acts directly (albeit at a distance) upon an object causing it to change its motion through spacetime.

But now imagine that a ball-bearing passes a very large heavy metal ball while travelling along a rubber sheet. Because the large heavy metal ball will create a significant dip in the rubber sheet, the ball-bearing will veer towards it following the curvature of the dip, and so will accelerate in the process. The large heavy metal ball here does not exert a *force* directly upon the ball-bearing. Rather, the large heavy metal ball creates a dip in the rubber sheet, and it is this that causes the ball-bearing to alter its path and accelerate. Similarly, according to general relativity, if a spaceship were to pass a more massive object like a planet, the planet will cause a significant 'dip' in spacetime, and so the spaceship will veer towards it, and accelerate in the process. Again, the planet does not exert a *force* directly on the spaceship. Rather, the planet creates a 'dip' in spacetime, and it is this that causes the spaceship to alter its path and accelerate. So, just as another way for a ball-bearing to accelerate is for something to cause the rubber sheet itself (and so the ball-bearing's path) to change, another way for an object to accelerate is for something to cause spacetime itself (and so the object's path) to change. So, acceleration can occur in two ways in general relativity: it can occur if some force directly impacts upon a body changing its motion through spacetime, or it can occur if something causes spacetime itself to

change 'beneath' the object. The first of these corresponds to the action of what is known in general relatively as a '*true* force', and the second to the action of gravity. An object undergoing only the first kind of acceleration is said to be undergoing 'proper acceleration' and an object undergoing only the second is said to be in 'free fall'. Crucially, an object in free fall along a warped spacetime path is thought to be in the same state as an object travelling along a straight path in flat space – both are simply following the curvature of the spacetime they find themselves in (so objects travelling along straight paths are also said to be in free fall). In Einstein's general theory of relativity, then, gravity just *is* the warping of spacetime caused by massive objects. Just as a heavier object will create a bigger dip in a rubber sheet, and so cause a ball-bearing to roll towards it with a greater increase in velocity, a more massive object will create a bigger 'dip' in spacetime and cause other objects to 'roll' towards it with a greater increase in velocity. It is this that accounts for the greater gravitational attraction that more massive bodies have.

The above excludes many of the details of general relativity, but what has been said should make the following crucial point comprehensible: according to the general theory of relativity, spacetime is very unlike Newton's space and time – it is not an unchanging 3+1-dimensional fixed grid marked out by uniform units that pervades the entire universe and through which material objects travel. Rather, it is a dynamic four-dimensional grid that is both *affected by* objects that move through it and *affects* objects that move through it.

10.5. Substantivalism vs. relationism revisited

As we saw in Chapter 2, the question of whether space and time are entities that exist independently of material objects and the relations they stand in to one another is a question that exercised early physicists in the seventeenth and eighteenth centuries. Newton argued from observed phenomena such as that seen in his bucket scenario (see section 2.3) that although space and time do not have any direct effects on material objects, they must nevertheless have an independent existence in order to account for the fact that acceleration gives rise to the operation of forces. Leibniz denied this, arguing that there is no need to posit space and time as independent entities in order to account for the observed phenomena. But what becomes of this debate in the context of special and general relativity? At least on first impressions, special relativity, by virtue of its rejection of absolute space and time, seems to support relationism. Some, e.g. Dorling (1978) and Maudlin (2003), have also argued that Newton's bucket argument in favour of substantivalism

loses its force in the setting of special relativity. In effect, they point out that a rotating bucket, unlike one at rest, undergoes length contraction and time dilation and the effects seen in the rotating bucket case can be explained in terms of these with no need to posit spacetime as an independently existing entity.

When one turns to general relativity, this first impression is reversed. The fact that spacetime has direct causal effects on material objects and material objects have direct causal effects on it strongly suggests that spacetime should be viewed as being an entity in its own right. Indeed, this was the view that Einstein himself took (see Einstein 1922: 18). However, although many agree that this first impression is more-or-less right, matters are not quite as straightforward as they first appear to be. In order to see why requires a little more work. The first thing to note is that the geometrical four-dimensional framework in which (special and) general relativity is usually formulated is, at base, only a *representation* of reality. And like with any representation, certain elements within it may not correspond to genuine features of what it represents. Consider, for example, representing a configuration of parked cars using oblong wooden blocks. Such a representation may be a perfectly good one, and certain elements of it may well correspond to genuine features of reality (e.g. the relative distances and orientations of the blocks may correspond to the relative distances and orientations of the cars). But other elements of the representation certainly do not correspond to reality: cars themselves are neither oblong nor wooden, for example. So although spacetime features as an independent entity within the four-dimensional framework usually employed in presenting general relativity, we still need to ask: is there a genuine feature of reality that corresponds to it?

Within the geometric four-dimensional framework of general relativity spacetime can be bent, twisted and curved in various ways, and can differ greatly from one part of the universe to another. The way in which spacetime bends, twists and curves across the entire universe is given by what is called a '*metric field tensor*' – this, in effect, describes the global structure of spacetime. One way to answer the question about whether spacetime in the geometrical framework corresponds to a genuine feature of reality, then, is to ask whether the properties ascribed to it by the metric field tensor are in fact fully determined by the distribution of material objects across the universe (i.e. by the global spatiotemporal relations that hold between material objects). If they are fully determined by the distribution of matter in this way, then it is plausible to think of spacetime as being a mere artefact of the framework rather than as an element that represents a genuine feature of reality. And this makes a relationist view of spacetime more plausible than a substantivalist one. But if spacetime can have features that are independent of the distribution of matter across the universe, then the role that spacetime

plays in the framework is ineliminable and so it is plausible that it does correspond to a genuine feature of reality. And this seems to entail a substantivalist view of spacetime. So, does the distribution of matter fully determine the metrical properties of spacetime? The answer, it seems, is that in the actual world it does, but that there are possible ways the universe could be in which it does not.

Roughly put, in the general theory of relativity, the different possible ways in which matter can be distributed across the universe and the possible metrical properties of spacetime are constrained by a number of (rather complicated) equations formulated by Einstein. Possible states that matter and space can be in are given by solutions to these equations, and particular solutions are known as '*models*', which can be given geometrically. Although we do not know quite which model best represents the actual universe, some have argued that any that is likely to represent it is one in which the distribution of matter (at least in the regions of the universe close enough for us to see) *does* determine the metrical properties of spacetime (see, e.g. Wheeler and Cuifollini 1995: 42). However, there are also models of general relativity in which the distribution of matter does *not* determine the metrical properties of spacetime. One such model was found by Gödel (1949), for example. In that model the entire universe rotates even though matter is arranged across it in the same way as it would be were the matter stationary. So, because the distribution of matter (and so the relations between material objects) in such a universe does not determine the metrical properties of spacetime, it seems that those properties must be genuine features of reality, and so it seems that general relativity vindicates substantivalism after all. It seems, that is, that the following argument is sound:

(1) If it is possible for the universe to be a certain determinate way with regard to the movement of matter within in it, and its being that way is not determined by the distribution of matter within it, then substantivalism is true.

(2) The existence of certain models in general relativity, such as Gödel's, shows that (if the theory is true) it is possible for the universe to be a certain determinate way with regard to the movement of matter within it, and its being that way is not determined by the distribution of matter within it.

Therefore,

(3) Substantivalism is true.

So, if general relativity is true, it seems that spacetime must be thought of as being an entity in its own right, distinct from the material objects that exist

within it. However, we emphasize here that this is perhaps *only* how things 'seem'. There are a number of other important issues that bear upon this debate that we do not discuss here. For more on these the reader should see the further readings at the end of the chapter.

10.6. The incompatibility of special relativity with presentism

We now turn to one of the most discussed objections to presentism, the argument from special relativity. The argument centres on the idea that presentism is incompatible with the relativity of simultaneity. And, since the relativity of simultaneity is an entailment of the special theory of relativity (and this entailment is retained by the general theory), this is thought to be a sufficient reason for rejecting presentism. The argument assumes that our metaphysical views should be consistent with the entailments of our best physical theories. This assumption has been denied by a few. Arthur Prior (1996), for example, agrees that special relativity and presentism are incompatible, but argues in the other direction by taking this to be a sufficient reason for rejecting special relativity. And Bradley Monton (2010) argues that despite being (some of our) *best* physical theories, we have good reason to think that special and general relativity are in fact false, and so we have no reason to reject presentism on the basis of their being incompatible with something they entail (see section 10.7 for more on this). But the vast majority of philosophers who have engaged with the argument from special relativity have thought that being incompatible with our best physical theories is a serious problem for presentism, and have thought that presentists must take one of two options:

1. Deny that presentism is genuinely incompatible with special relativity.
2. Deny that special relativity is one of our best physical theories.

Before we come to what has been said about these options, let us first spell out the incompatibility claim in a little more detail.

According to presentists, the only things that exist$_{\text{simpliciter}}$ are present things. But what are *present* things? Some argue that presentists must spell out this notion by saying that if two things are present, then they must exist simultaneously with each other. Consider, for example, how Ernani Magalhaes puts it:

> It seems that given that X is present, something Y is present only if Y is simultaneous with X. How could X and Y both be present if X is either earlier or later than Y? (Magalhaes 2010: 225)

This expresses the idea that it is a necessary condition for two individuals being present that they exist simultaneously with each other. Given that only present things exist$_{simpliciter}$ according to presentism, we can strengthen this to a sufficient condition, for we can ask: if X is present and so exists$_{simpliciter}$, and Y exists simultaneously with X, then how can Y fail to exist$_{simpliciter}$, and so be present? We can express this as follows:

> Present simultaneous connection (PSC): Two individuals x and y are co-present if and only if x and y are simultaneous with each other.

But this, in the presence of special relativity, becomes deeply problematic for the presentist. Precisely why this is so has been spelled out in a variety of ways – but the basic idea is that, in the presence of special relativity, presentism seems to entail that reality itself becomes fragmented in an objectionable way. Consider:

(1) Simultaneity is relative to reference frames. [Entailed by special relativity.]

(2) Individuals are co-present only if they exist simultaneously with each other. [Entailed by PSC.]

(3) Which individuals are present is relative to reference frames. [From 1 and 2.]

(4) An individual x is present iff x exists$_{simpliciter}$. [Entailed by the definition of presentism.]

Therefore,

(5) Which individuals exist$_{simpliciter}$ is relative to reference frames. [From 3 and 4.]

So it seems that if both presentism and special relativity are true, then each reference frame has associated with it its own sphere of existence$_{simpliciter}$ such that what exists$_{simpliciter}$ for an observer in one is different from what exists$_{simpliciter}$ for an observer in another. The following example serves to make this clearer.

Suppose that three observers, A, B and C, are moving at high velocities relative to each other (and so in different reference frames). Then, if special relativity is true, the following two propositions are jointly possible:

(i) In A's reference frame, B exists simultaneously with A, but C does not.

(ii) In B's reference frame, both A and C exist simultaneously with B.

But (i) and (ii) together with PSC entails:

(iii) In A's reference frame, A and B are present but C is not, and in B's reference frame each of A, B and C are present.

And given that the only things that $\text{exist}_{\text{simpliciter}}$ are present things according to presentism, this entails:

(iv) In A's reference frame, B $\text{exists}_{\text{simpliciter}}$ but C does not $\text{exist}_{\text{simpliciter}}$, and in B's reference frame both A and C $\text{exist}_{\text{simpliciter}}$.

So, there will be a time shared by A and B at which they agree that they each $\text{exist}_{\text{simpliciter}}$, but will disagree about whether C $\text{exists}_{\text{simpliciter}}$. Moreover, neither of them will be making any mistake. Furthermore, given that the Lorentz Transformation rules allow any observer to work out from within a reference frame what an observer in a different frame will take to be simultaneous with her, each of A and B will be able to work out that the other will hold a conflicting view about C's $\text{existence}_{\text{simpliciter}}$, and each will also know that both themselves and the other is correct in holding such a conflicting view. This is the way in which reality becomes fragmented if special relativity and presentism are both true. This, in its essentials, is the problem that was first articulated by Hilary Putnam in his influential 1967 paper 'Time and Physical Geometry'. Readers are encouraged to study Putnam's presentation of it.

We now consider some representative examples of those who have taken the two different options in responding to the argument from relativity. Option one, recall, was to deny that presentism is incompatible with special relativity. Mark Hinchliff (2000) provides the best example of someone who defends this response. One simple way of reconciling presentism with special relativity that Hinchliff considers involves reducing the scope of what $\text{exists}_{\text{simpliciter}}$ to a single spacetime point. If presentists adopt this view, known as 'here-nowism', they can maintain that all that is strictly-speaking present is a single point of spacetime. By doing this, presentists can in effect deny PSC and so avoid the problems that it brings with it in the presence of special relativity. However, Hinchliff prefers a second way of reconciling presentism with special relativity.

Hinchliff first argues that the presentist can simply accept that reality is fragmented in the way described above. He points out that reality being fragmented in this way only *shows* that presentism is false on the assumption that something like the following principle is true:

The transitivity of existence (TE): If x $\text{exists}_{\text{simpliciter}}$ for y, and y $\text{exists}_{\text{simpliciter}}$ for z, then x $\text{exists}_{\text{simpliciter}}$ for z. (See Hinchliff 2000: S587.)

Consider again our example from above. In the situation described C exists$_{\text{simpliciter}}$ for B, and B exists$_{\text{simpliciter}}$ for A, but C does not exist$_{\text{simpliciter}}$ for A. And this contradicts TE. But, Hinchliff argues, presentists are free to reject TE and thus adopt a version of their view that is relativized to reference frames (or, individuals within those frames). He goes on to argue that presentists can endorse PSC but maintain that what is present is relative to reference frames (e.g. the one we are in now). According to this view everything in our reference frame exists$_{\text{simpliciter}}$, and so do all events that are such that light from them reaches our reference frame now. (He calls this view 'cone presentism' by virtue of the fact that light waves reaching us can be pictured as a cone stretching out back in time behind us.) Earlier we imagined standing on a residential street at night within a frame of reference F, and said that on Einstein's proposal the events that are to be counted as being simultaneous with one's looking out include those such that the light emitted from them reaches one *now*. On this way of reconciling presentism and special relativity, then, presentists count each of the objects that feature in such events as being present. However, because what is present is relativized to reference frames on this view, and because what is present is just what exists$_{\text{simpliciter}}$ according to presentists, this view does seem to be one in which existence$_{\text{simpliciter}}$ is also relativized to reference frames, and so one in which TE is rejected.

Other suggestions have also been made about how the presentist might reconcile presentism with special relativity, but many think that each fails to provide viable ways of taking option one for traditional presentists (see, e.g. Sider 2001: 45–52). The reason for this is that taking each of these ways involves accepting something that strays too far from the spirit of traditional presentism, and in so doing undermines the reasons for believing the view to be true. And it is not hard to see why many think this by considering the suggestions mentioned. Presentists, as we saw in Chapter 5, take themselves to be defending the common-sense view of time. But here-nowism involves accepting that only here-now exists, and accepting cone presentism involves denying that existence$_{\text{simpliciter}}$ is an absolute notion, each of which is a far more radical thesis than common sense would ever allow. Cone presentism also involves admitting that events that we ordinarily want to say are past, are in fact present, which clashes with common sense too. One example of this is the following. Physicists routinely say that the Cosmic Microwave Background Radiation is the current visible sign of events that occurred around fourteen billion years ago (it is just that it happened so far away and so long ago that their light has taken that long to reach us). According to cone presentists, however, those events are happening *now*. As the light from them is only now reaching us, they are simultaneous with the events that we now feature in, and so are present (see Savitt 1998: 6). The general conclusion that many draw, then, is that whatever independent

support the suggestions made by Hinchliff and others can be given, adopting one of them is not a good dialectical move for the traditional presentist to make in response to the argument from special relativity. So, many think, option one is closed to presentists.

We now turn to option two: the option of denying that special relativity is one of our best physical theories. Hinchliff also discusses this option and (following up on other suggestions in the literature) suggests that presentists can adopt the Lorenz theory instead of Einstein's special theory of relativity (Hinchliff 2000: S285). As we have seen, the Lorentz theory makes the same predictions about observations as Einstein's theory while retaining the notion that there is absolute simultaneity. And so if Lorentz's theory is better than (or equally good as) Einstein's, then presentism faces no problems from our best scientific theories. Of course, most physicists do think that Einstein's theory is better than the Lorentz theory on the basis of the reasons we have already considered, e.g. that unlike in special relativity, there are possible states of the universe that are empirically indistinguishable if Lorentz's view is true. But presentists can defend option two by arguing that despite facts such as these, the Lorentz view is still better than special relativity overall. This task has been taken up most thoroughly by William Lane Craig (2000b) (see also Craig 2001b), who develops a Neo-Lorenzian view in detail, concluding that 'despite the widespread aversion to a neo-Lorentzian interpretation of relativity theory, such antipathy is really quite unjustified' (Craig 2000b: 126). If Craig is right, then option two may be a viable option for presentists (but see Balashov and Janssen 2003 who argue that Craig is not right).

10.7. Quantum mechanics, quantum gravity and the philosophy of time

Finally, then, we turn briefly to the most recent developments in fundamental physics. In fact, though, we will say relatively little about how they impact upon the metaphysics of time. This is for two simple reasons: first, on this matter we are simply not in a position to judge. Much of the literature on quantum mechanics and quantum gravity, even in the philosophical literature, is technically advanced and only accessible to those with a background in physics (which we lack). Second, even judging from the side-lines, it is plain that as things currently stand, quite how they impact is anyway entirely unclear. So here we restrict ourselves to giving a sense of this unclarity. We begin with a very brief explanation of what quantum mechanics and quantum gravity are.

General relativity might well be the best physical theory that we have for dealing with large-scale phenomena – e.g. those involving the movements

and interactions of macroscopic bodies such as cars, people and (especially) large bodies such as planets and stars. But general relativity does not deal with phenomena at the microscopic level – i.e. those involving the interactions of subatomic particles like electrons and photons. The best theory we have that deals with such small scale phenomena is quantum mechanics. And here current physics faces something of a challenge, for it turns out that general relativity and quantum mechanics are not compatible with each other in their canonical forms. This is to say, there is no way to combine the formal theories in which general relativity and quantum mechanics are usually given. (This is why Monton 2010 suggests that we have good reason to think that general relativity is false despite it being one of our best current theories – see section 10.6. But note that, by the same lights, Monton thinks we have good reason to think that quantum mechanics is false too.) The study of *quantum gravity* is the area of physics devoted to the aim of unifying general relativity and quantum mechanics by giving a theory that describes the operation of gravity in a way that is consistent with both quantum mechanics and general relativity. Much work in this area is, as one might imagine, also highly technical, and there are a number of competing candidate approaches, each with its own formalism – covariant quantum general relativity, canonical quantum general relativity and string theory, to name a few (see Kiefer 2011: 666). There is disagreement among physicists about which approach is the most likely to succeed, and disagreement among philosophers about how best to interpret each approach, and about the implications that each has in the metaphysics of time. To give just one example, according to some, one conflict between how time is treated within general relativity and how it is treated within quantum mechanics is that time in quantum mechanics, unlike in general relativity, is Newtonian in the following sense – it ticks by in an absolute fashion and events evolve independently (albeit sometimes indeterministically) of it (see e.g. Scully 2008). So if this view is correct, something, it seems, has to give. And others have argued for the same conclusion via different routes. However, precisely what will give, most agree, it is too early to say. But some have argued that one of the most likely consequences is that both time and space themselves will turn out not to exist at all:

> Even though the field [i.e. of quantum gravity] continues to be wide open, many approaches seem to suggest that physical space, or physical time, or both, will not be part of the fundamental furniture of the world. If this is borne out, then the physical time we introduced to account for our ordinary experience will play no fundamental role in the world, and hence shouldn't in our metaphysics either. (Huggett, Vistarini and Wüthrich 2013: 261)

So it may be that future work in physics will bring us full circle. Though not for the reasons given by him, perhaps Parmenides's conclusion that time does not exist will turn out to be vindicated after all.

10.8. Summary

In this chapter we have outlined the special and general theories of relativity, before returning to two issues raised in previous chapters, *viz*. the substantivalism/relationism debate and the argument from special relativity against presentism. We then very briefly discussed how issues from the most recent developments in physics might impact on the metaphysics of time, and emphasized that there is currently no consensus on this issue.

Study Questions

1. What is an inertial frame of reference?
2. Does the fact that observers in all reference frames measure the speed of light to be the same give us sufficient evidence to believe that the aether theory is false and special relativity true? If so, why? If not, why not?
3. If general relativity is true, does this mean that substantivalism is true? If so, why? If not, why not?
4. Why do some claim that the truth of special relativity entails the falsity of presentism? How might presentists respond to this claim? Are any of those responses viable?

FURTHER READINGS

Special/general relativity

There are a vast number of books introducing special and general relativity. Einstein's own (1920) is still one of the best. Kennedy (2003) offers probably the most accessible philosophically orientated introduction. Dainton (2001) and Ray (1991) are also very good, but at a slightly higher level. For a text that focuses on special relativity we recommend Bohm (1996), and for one that focuses on general relativity we recommend Schutz (1990).

Lorentz's theory

Craig (2000b) provides the most detailed exposition and defence of Lorentz's theory and Neo-Lorentzian versions of it in the context of debates in the philosophy

of time. But see Balashov and Janssen (2003) for reservations about Craig's view. See also Zahar (1973) and Szabó (2011) for general discussions of the differences between Einstein's view and Lorentz's.

Substantivalism/relationism and modern physics
Here again Dainton (2001) is very good. Van Fraassen (1970) is also excellent. Also recommended are Sklar (1974) and Nerlich (1994). And for very recent developments see Huggett and Hoefer (2015) and references therein.

Presentism and special relativity
See Putnam (1967) for the classic statement of why presentism and special relativity are incompatible. See also Saunders (2002) and the references therein. Other important work on this topic includes Godfrey-Smith (1979), Stein (1994), Earman (1996), Savitt (1997), Callender (1998), Hinchliff (2000), Craig (2000a), Sider (2001) and Bourne (2006).

Quantum mechanics and quantum gravity
For those wishing to pursue the issue of how developments in quantum mechanics and quantum gravity impact on the metaphysics of time we recommend starting with Callender (2008). But see also Wüthrich (2010), and also Hilgevoord and Atkinson (2011) and Kiefer (2011), both of which are in Callender (2011b) (although be aware that both of these are difficult).

Bibliography

Adams, M. M. (1989), *William of Ockham*. Notre Dame: University of Notre Dame Press

Adams, R. M. (1986), 'Time and Thisness', *Midwest Studies in Philosophy* 11, pp. 315–29.

Albertazzi, L. (2001), 'Vittorio Benussi (1878–1927)', in L. Albertazzi, D. Jacquette and R. Poli (eds), *The School of Alexius Meinong*. Aldershot: Asghate, pp. 1–35.

Alper, J. S. and M. Bridger (1997), 'Mathematics, Models and Zeno's Paradoxes', *Synthese*, 110, pp. 143–66.

Altham, J. E. J. (2004), 'Reporting Indexicals', in T. J. Smiley and Thomas Baldwin (eds), *Studies in the Philosophy of Logic and Knowledge*. Published for the British Academy by Oxford University Press.

Anscombe, G. E. M. (1956), 'Aristotle and the Sea Battle', *Mind,* 65, pp. 1–15.

Anscombe, G. E. M. and P. T. Geach (1970), *Descartes: Philosophical Writings*. London: Oxford University Press Press.

Ariew, R. (2000), *GW Leibniz and Samuel Clarke: Correspondence*. Hackett: Indianapolis.

Aristotle (1984), 'Physics' (trans. W. D. Ross), in J. Barnes (ed.), *The Complete Works of Aristotle*. Princeton: Princeton University Press, pp. 602–851.

Aristotle (2006), *Categories, On Interpretation and On Sophistical Refutations*. Stilwell: Digireads.

Armstrong, D. M. (1989), *Universals: An Opinionated Introduction*. Boulder, CO: Westview.

Arntzenius, F. and T. Maudlin (2002), 'Time Travel and Modern Physics', *Royal Institute of Philosophy Supplement*, 50, pp. 169–200.

Arthur, R. (1985), 'Leibniz's Theory of Time', in Okruhlik and Brown (eds), *The Natural Philosophy of Leibniz*. Dordrecht: Reidel, pp. 263–313.

Augustine (2001), *The Confessions*. London: Everyman.

Ayer, A. J. (1936), *Language, Truth, and Logic*. London: Gollancz.

Balashov, Y. and M. Janssen (2003), 'Presentism and Relativity', *British Journal for the Philosophy of Science* 54 (2), pp. 327–46.

Barjavel, R. (1943), *Le Voyageur Imprudent*. Paris.

Barker, S. and P. Dowe (2005), 'Endurance is Paradoxical', *Analysis*, 65, pp. 69–74.

Barnes, E. (2010), 'Ontic Vagueness: A Guide for the Perplexed', *Noûs*, 44, pp. 607–27.

Barnes, E. and R. Cameron (2009), 'The Open Future: Bivalence, Determinism and Ontology', *Philosophical Studies*, 146, pp. 291–309.

Barnes, E. and R. Cameron (2011), 'Back to the Open Future', *Philosophical Perspectives*, 25, pp. 1–26.

Barnes, E. and J. R. G. Williams (2011), 'A Theory of Metaphysical Indeterminacy', in K. Bennett and D. Zimmerman (eds), *Oxford Studies in Metaphysics Volume 6*. Oxford: Oxford University Press, pp. 103–48.
Beall, J. (2012), 'Future Contradictions', *Australasian Journal of Philosophy*, 90, pp. 547–57.
Beebee, H. and J. Dodd (eds) (2005), *Truthmakers: The Contemporary Debate*. Oxford: Clarendon Press.
Beer, M. (1988), 'Temporal Indexicals and the Passage of Time', *Philosophical Quarterly* 38 (151), pp. 158–64.
Beer, M. (2008), 'Prior's "Thank Goodness that's Over" Objection to the B-theory', in Oaklander (ed.), *The Philosophy of Time, Vol III*. London: Routledge, pp. 28–34.
Benovsky, J. (2009), 'Presentism and Persistence', *Pacific Philosophical Quarterly*, 90, pp. 291–309.
Benovsky, J. (2013), 'The Present vs. the Specious Present', *Review of Philosophy and Psychology* 4, pp. 193–203.
Besson, C. and A. Hattiangadi (2014), 'The Open Future, Bivalence and Assertion', *Philosophical Studies*, 167, pp. 251–71.
Bigelow, J. (1996), 'Presentism and Properties', *Philosophical Perspectives* 10 (Metaphysics), pp. 35–52.
Black, M. (1951), 'Achilles and the Tortoise', *Analysis* 11, pp. 91–101.
Boethius (1969), *The Consolation of Philosophy*. London: Penguin.
Bostock, D. (1980), 'Aristotle's Account of Time', *Phronesis*, 25, pp. 148–69.
Bourne, C. (2002), 'When am I? A Tense Time for Some Tense Theorists?' *Australasian Journal of Philosophy*, 80, pp. 359–371.
Bourne, C. (2006a), *A Future for Presentism*. Oxford: Oxford University Press.
Bourne, C. (2006b), 'A Theory of Presentism', *Canadian Journal of Philosophy* 36 (1), pp. 1–23.
Bourne, C. (2011), 'Fatalism and the Future', in C. Callender (ed.), *The Oxford Handbook of Philosophy of Time*. Oxford: Oxford University Press, pp. 41–67.
Braddon-Mitchell, D. (2004), 'How Do We Know it is Now Now?' *Analysis* 64, pp. 199–203.
Briggs, R. and G. A. Forbes (2012), 'The Real Truth about the Unreal Future', in K. Bennett and D. Zimmerman (eds), *Oxford Studies in Metaphysics Volume 7*. Oxford: Oxford University Press, pp. 257–304.
Broad, C. D. (1923), *Scientific Thought.* London: Kegan Paul, Trench, Tubner.
Broad, C. D. (1933a), *Examination of McTaggart's Philosophy, Vol. 1*. Cambridge: Cambridge University Press.
Broad, C. D. (1933b), *Examination of McTaggart's Philosophy, Vol. 2*. Cambridge: Cambridge University Press.
Broadie, S. (2012), *Nature and Divinity in Plato's Timaeus*. Cambridge: Cambridge University Press.
Brogaard, B. (2000), 'Presentist Four-Dimensionalism', *Monist*, 83, pp. 341–56.
Brogaard, B. (2012), *Transient Truths: An Essay in the Metaphysics of Propositions.* Oxford: Oxford University Press.
Brower, J. E. (2010), 'Aristotelian Endurantism: A New Solution to the Problem of Temporary Intrinsics', *Mind*, 119, pp. 883–905.
Brower, J. E. (2014), *Aquinas's Ontology of the Material World: Change, Hylomorphism, and Material Objects*. New York: Oxford University Press.

Buller, D. J. and T. R. Foster (1992), 'The New Paradox of Temporal Transience', *Philosophical Quarterly,* 42 (168), pp. 357–66.
Button, T. (2006), 'There's No Time Like the Present', *Analysis* 66 (290), pp. 130–5.
Cajori, F. (1934), 'Newton's Scholium to the Definitions in *Philosophiae Naturalis Principia Mathematica*, Bk. 1 (1689)', rev. edn of Motte (trans.) (1729). Berkeley: University of California Press, pp. 6–12.
Callender, C. (2008), 'Finding "Real" Time in Quantum Mechanics', in W. L. Craig and Q. Smith (eds), *Einstein, Relativity and Absolute Simultaneity*. New York: Routledge, pp. 50–72.
Callender, C. (2011a), 'Time's Ontic Voltage', in A. Bardon (ed.), *The Future of the Philosophy of Time*. London: Routledge, pp. 73–98.
Callender, C. (ed.) (2011b), *The Oxford Handbook of Philosophy of Time*. Oxford: Oxford University Press.
Cameron, R. (2011), 'Truthmaking for Presentists', in K. Bennett and D. Zimmerman (eds), *Oxford Studies in Metaphysics 6*. Oxford: Oxford University Press, pp. 55–100.
Cameron, R. (2015), *The Moving Spotlight: An Essay on Time and Ontology*. Oxford: Oxford University Press.
Caplan, B. and D. Sanson (2011), 'Presentism and Truthmaking', *Philosophy Compass* 6, pp. 196–208.
Carroll, J. W. (2012), 'Self Visitation, Traveler Time, and Compatible Properties', *Canadian Journal of Philosophy*, 41, pp. 359–70.
Carter, J. W. (2011), 'St. Augustine on Time, Time Numbers, and Enduring Objects', *Vivarium* 49, pp. 301–23.
Chisholm, R. M. (1979), 'Objects and Persons: Revisions and Replies', *Grazer Philosophische Studien* 7/8, pp. 317–61.
Christensen, F. (1974), 'McTaggart's Paradox and the Nature of Time', *Philosophical Quarterly* 24 (97), pp. 289–99.
Coope, U. (2001), 'Why does Aristotle Say that there is No Time Without Change?', *Proceedings of the Aristotelian Society,* 101, pp. 359–67.
Coope, U. (2005), *Time for Aristotle: Physics Iv.10–14*. Oxford: Oxford University Press.
Copeland, J., H. Dyke and D. Proudfoot (2001), 'Temporal Parts and their Individuation', *Analysis* 61, pp. 289–93.
Copleston, F. C. (1946), *A History of Philosophy: Volume I: Greece and Rome: From the Pre-Socratics to Plotinus*. London: Burns, Oates and Washbourne.
Copleston, F. C. (1950), *A History of Philosophy: Volume II: Medieval Philosophy: From Augustine to Duns Scotus*. London: Burns, Oates and Washbourne.
Corish, D. (2005), 'McTaggart's Argument' *Philosophy* 80, pp. 77–99.
Correia, F. and A. Lacona (eds) (2013), *Around the Tree: Semantic and Metaphysical Issues Concerning Branching and the Open Future*. Dordrecht: Springer.
Cottingham, J. (1986), *Descartes*. London: Blackwell.
Cottingham, J., R. Stoothoff, D. Murdoch and A. Kenny (eds) (1984–91), *Philosophical Writings of Descartes* [3 volumes]. Cambridge: Cambridge University Press.
Craig, W. L. (1988), *The Problem of Divine Foreknowledge and Future Contingents from Aristotle to Suarez*. Linden: Brill.
Craig, W. L. (1996), 'Tense and the New B-Theory of Language', *Philosophy* 71, pp. 5–26.

Craig, W. L. (2000a), *The Tensed Theory of Time: A Critical Examination*. Dordrecht: Kluwer Academic.
Craig, W. L. (2000b), *The Tenseless Theory of Time: A Critical Examination*. Dordrecht: Kluwer Academic.
Craig, W. L. (2001), *Time and Eternity*. Illinois: Crossway Books.
Craig, W. L. (2003), 'In Defense of Presentism', in A. Jokic and Q. Smith (eds), *Time, Tense, and Reference*. Chicago: MIT Press, pp. 391–408.
Craig, W. L. and Q. Smith (2008), *Einstein, Relativity and Absolute Simultaneity*. New York: Routledge.
Cresswell, M. J. (2012), *The World-Time Parallel: Tense and Modality in Logic and Metaphysics*. Cambridge: Cambridge University Press.
Crisp, T. M. (2003), 'Presentism', in M. Loux and D. Zimmerman (eds), *The Oxford Handbook of Metaphysics*. Oxford: Oxford University Press, pp. 211–45.
Crisp, T. (2004), 'On Presentism and Triviality', in D. Zimmerman (ed.), *Oxford Studies in Metaphysics Volume 1*. Oxford: Oxford University Press, pp. 15–20.
Crisp, T. M. (2007), 'Presentism and the Grounding Objection', *Noûs* 41, 90–109.
Crisp, T. M. and D. P. Smith (2005), 'Wholly Present Defined', *Philosophy and Phenomenological Research* 71, pp. 318–44.
Dainton, B. (2000), *Stream of Consciousness*. London: Routledge.
Dainton, B. (2001), *Time and Space*. Chesham: Acumen.
Dainton, B. (2010), 'Temporal Consciousness', *The Stanford Encyclopedia of Philosophy* (Spring 2014 Edition), Edward N. Zalta (ed.), URL = http://plato.stanford.edu/archives/spr2014/entries/consciousness-temporal/ [last accessed 23 February 2015].
Dainton, B. (2011), 'Time, Passage and Immediate Experience', in C. Callender (ed.), *Oxford Handbook of Philosophy of Time*. Oxford: Oxford University Press, pp. 382–419.
De Clercq, R. (2006), 'Presentism and the Problem of Cross-Time Relations', *Philosophy and Phenomenological Research* 72, pp. 386–402.
Dennett, D. C. (1984), *Elbow Room: The Varieties of Free Will Worth Wanting*. Cambridge, MA: MIT Press.
Dennett, D. C. (1991), *Consciousness Explained*. Harmondsworth: Allen Lane.
Descartes, R. (1985), *The Philosophical Writings of Descartes*, J. Cottingham, R. Stoothoff and D. Murdoch (eds). Cambridge: Cambridge University Press.
Deutsch, D. and M. Lockwood (1994), 'The Quantum Physics of Time Travel', *Scientific American* 270, pp. 68–74.
Diekemper, J. (2004), 'Temporal Necessity and Logical Fatalism', *Proceedings of the Aristotelian Society* 104, pp. 289–96.
Diekemper, J. (2005), 'Presentism and Ontological Symmetry', *Australasian Journal of Philosophy* 83, pp. 223–40.
DiSalle, R. (2009), 'Space and Time: Inertial Frames', *The Stanford Encyclopedia of Philosophy* (Winter 2009 Edition), Edward N. Zalta (ed.), URL = http://plato.stanford.edu/archives/win2009/entries/spacetime-iframes/ [last accessed 23 February 2015].
Donnelly, M. (2011), 'Endurantist and Perdurantist Accounts of Persistence', *Philosophical Studies* 154, pp. 27–51.
Dummett, M. (1960), 'A Defense of McTaggart's Proof of the Unreality of Time', *Philosophical Review* 69, pp. 497–504.

Dummett, M. (1964), 'Bringing About the Past', *Philosophical Review* 73, pp. 338–59.
Dunne, J. W. (1929), *An Experiment with Time*. London: A&C Black.
Dunne, J. W. (1934), *The Serial Universe*. London: Faber & Faber.
Dyke, H. (2002), 'McTaggart and the Truth about Time', in C. Callender (ed.), *Time, Reality and Experience*. Cambridge: Cambridge University Press, pp. 137–52.
Dyke, H. (2003), 'Tensed Meaning: A Tenseless Account', *Journal of Philosophical Research* 28, pp. 65–81.
Dyke, H. (2008), *Metaphysics and the Representational Fallacy*. London: Routledge.
Dyke, H. and J. Maclaurin (2002), '"Thank Goodness That's Over": The Evolutionary Story', *Ratio* 15, pp. 276–92.
Effingham, N. (2012), 'Endurantism and Perdurantism', in R. Barnard and M. A. Manson (eds), *Continuum Companion to Metaphysics*. London: Continuum, pp. 170–97.
Effingham, N. and J. Robson (2007), 'A Mereological Challenge to Endurantism', *Australasian Journal of Philosophy* 85, pp. 633–40.
Einstein, A. (1905), 'On the Electrodynamics of Moving Bodies', *Annalen der Physik* 17 (891), p. 50.
Einstein, A. (1916), 'Die Grundlage der Allgemeine Relativitätstheorie', *Annalen der Physik* 49, pp. 769–822.
Einstein, A. (1920), *Relativity, the Special and the General Theory*. London: Methuen.
Einstein, A. (1922), *The Meaning of Relativity*. London: Chapman and Hall.
Einstein, A., H. A. Lorentz, H. Minkowski and H. Weyl (1952), *The Principle of Relativity*, W. Perrett and G. B. Jeffery (trans.). New York: Dover Books.
Finch, A. and M. Rea. (2008), 'Presentism and Ockham's Way Out', in J. Kvanvig (ed.), *Oxford Studies in Philosophy of Religion Volume 1*. Oxford: Oxford University Press, pp. 1–17.
Fine, K. (2005), 'Tense and Reality', in Kit Fine (ed.), *Modality and Tense: Philosophical Papers*. Oxford: Oxford University Press, pp. 261–320
Fine, K. (2006a), 'In Defense of Three-Dimensionalism', *Journal of Philosophy* 103, pp. 699–714.
Fine, K. (2006b), 'The Reality of Tense', *Synthese* 150, pp. 399–414.
Forbes, G. (1996), 'Logic, Logical Form, and the Open Future', *Noûs* 30, pp. 73–92.
Forrest, P. (2004), 'The Real but Dead Past: A Reply to Braddon-Mitchell', *Analysis* 64, pp. 358–62.
Forrest, P. (2010), 'Can a Soufflé Rise Twice? Van Inwagen's Irresponsible Time-Travelers', in D. Zimmerman (ed.), *Oxford Studies in Metaphysics Volume 5*. Oxford: Oxford University Press, pp. 29–40.
Foster, J. (1982), *The Case for Idealism*. London: Routledge & Kegan Paul.
Fraisse, P. (1984), 'Perception and Estimation of Time', *Annual Review of Psychology* 35, pp. 1–36.
Frankfurt, H. (1969), 'Alternate Possibilities and Moral Responsibility', *Journal of Philosophy* 66, pp. 829–39.
Frege, G. (1956), 'The Thought: A Logical Inquiry', *Mind* 65, pp. 289–311.
Friedman, M. (1983), *Foundations of Space-Time Theories: Relativistic Physics and Philosophy of Science*. Princeton: Princeton University Press.

Gale, R. M. (1966), 'McTaggart's Analysis of Time', *American Philosophical Quarterly* 3, pp. 145–52.
Gallois, A. (2004), 'Comments on Ted Sider: Four Dimensionalism', *Philosophy and Phenomenological Research* 68, pp. 648–57.
Gallop, D. (1984), *Parmenides of Elea: Fragments*. Toronto: University of Toronto Press.
Ganssle, G. E. (ed.) (2001), *God and Time: Four Views*. Illinois: Inter-Varsity Press.
García-Carpintero, M. (2013), 'Relativism, the Open Future, and Propositional Truth', in F. Correia and A. Iacona (eds), *Around the Tree: Semantic and Metaphysical Issues Concerning Branching and the Open Future.* Dordrecht: Springer, pp. 1–27.
Gilmore, C. (2007), 'Time Travel, Coinciding Objects, and Persistence', in D. Zimmerman (ed.), *Oxford Studies in Metaphysics Volume 3*. Oxford: Oxford University Press, pp. 177–98.
Goddu, G. C. (2003), 'Time Travel and Changing the Past: (Or How to Kill Yourself and Live to Tell the Tale)', *Ratio* 16, pp. 16–32.
Goddu, G. C. (2007), 'Banana Peels and Time Travel', *Dialectica* 61, pp. 559–72.
Goddu, G. C. (2011), 'Avoiding or Changing the Past?', *Pacific Philosophical Quarterly* 92, pp. 11–17.
Godfrey-Smith, W. (1979), 'Special Relativity and the Present', *Philosophical Studies XXXVI*, pp. 233–44.
Gorham, G. (2007), 'Descartes on Time and Duration', *Early Science and Medicine* 12, pp. 28–54.
Gorham, G. (2008a), 'Descartes on God's Relation to Time', *Religious Studies* 44, pp. 413–31.
Gorham, G. (2008b), 'Cartesian Temporal Atomism: A New Defence, A New Refutation', *British Journal for the History of Philosophy* 16, pp. 625–37.
Gorovitz, S. (1964), 'Leaving the Past Alone', *Philosophical Review* 73, pp. 360–71.
Gotshalk, D. W. (1930), 'McTaggart on Time', *Mind* 39 (153), pp. 26–42.
Gow, L. (2014), 'Colour', *Philosophy Compass* 9, pp. 803–13.
Graham, D. W. (2002), 'Heraclitus and Parmenides', in V. Caston and D. W. Graham, (eds), *Presocratic Philosophy: Essays in Honour of Alexander Mourelatos*. Aldershot: Ashgate, pp. 27–44.
Grey, W. (1999), 'Troubles with Time Travel', *Philosophy* 74, pp. 55–70.
Gross, C. (1999), 'Augustine's Ambivalence about Temporality: His two Accounts of Time', *Medieval Philosophy and Theology* 8, pp. 129–48.
Grünbaum, A. (1967), *Modern Science and Zeno's Paradoxes*. Middletown: Connecticut Wesleyan University Press.
Grush, R. (2007), 'Time and Experience', in T. Müller (ed.), *Philosophie der Zeit*. Frankfurt: Klosterman, pp. 27–44.
Guyer, P. and A. Wood (eds) (1998), *Critique of Pure Reason*. Cambridge: Cambridge University Press.
Hales, S. D. and T. A. Johnson (2003), 'Endurantism, Perdurantism and Special Relativity', *Philosophical Quarterly* 53, pp. 524–39.
Hales, S. D. and T. A. Johnson (2007), 'Time for Change', *Southern Journal of Philosophy* 45, pp. 497–513.
Hall, A. R. and M. Boas Hall (eds and trans) (1962), *Unpublished Scientific Papers of Isaac Newton.* Cambridge: Cambridge University Press.

Hartz, G. and J. A. Cover (1988), 'Space and Time in the Leibnizian Metaphysic', *Noûs* 22, pp. 493–519.
Haslanger, S. (1992), 'Ontology and Pragmatic Paradox', *Proceedings of the Aristotelian Society* 92, pp. 293–314.
Hatfield, G. (2006), 'Kant on the Perception of Space (and Time)', in P. Guyer (ed.), *The Cambridge Companion to Kant and Modern Philosophy*. Cambridge: Cambridge University Press, pp. 61–93.
Hausheer, H. (1937), 'St. Augustine's Conception of Time', *Philosophical Review* 46, pp. 503–12.
Hawley, K. (1998), 'Why Temporary Properties are not Relations between Physical Objects and Times', *Proceedings of the Aristotelian Society* 98, pp. 211–216.
Hawley, K. (2001), *How Things Persist*. Oxford: Oxford University Press.
Hazlett, A. (2011), 'How the Past Depends on the Future', *Ratio* 24, pp. 167–75.
Heathwood, C. (2005), 'The Real Price of the Dead Past: A Reply to Forrest and to Braddon-Mitchell', *Analysis* 65 (287), pp. 249–51.
Heil, J. (2003), *From an Ontological Point of View*. Oxford: Oxford University Press.
Heller, M. (1984), 'Temporal Parts of Four-Dimensional Objects', *Philosophical Studies* 46, pp. 323–34.
Heller, M. (1992), 'Things Change', *Philosophy and Phenomenological Research* 52, pp. 695–704.
Helm, P. (1988), *Eternal God*. Oxford: Oxford University Press.
Hendry, J. (1986), *James Clerk Maxwell and the Theory of the Electromagnetic Field*. Boston: Adam Hilger Ltd.
Hestevold, H. S. (2008), 'Presentism: Through Thick and Thin', *Pacific Philosophical Quarterly* 89, pp. 325–47.
Hilgevoord, J. and D. Atkinson (2011), 'Time in Quantum Mechanics', in C. Callender (ed.), *The Oxford Handbook of Philosophy of Time*. Oxford: Oxford University Press, pp. 647–63.
Hinchliff, M. (2000), 'A Defense of Presentism in a Relativistic Setting.' *Philosophy of Science Vol. 67 (supplement)*, pp. S575–86.
Hintikka, J. (1964), 'The Once and Future Sea Fight: Aristotle's Discussion of Future Contingents in De Interpretatione ix', *The Philosophical Review* 73, pp. 461–92.
Hoerl, C. (2013), 'A Succession of Feelings, in and of Itself, is not a Feeling of Succession', *Mind* 122, pp. 373–417.
Holton, G. J. (1970), 'Mach, Einstein, and the Search for Reality', *Boston Studies in the Philosophy of Science Volume 6,* pp. 165–99.
Horwich, P. (1975), 'On Some Alleged Paradoxes of Time Travel', *Journal of Philosophy* 72, pp. 432–44.
Hoy, R. C. (1994), 'Parmenides' Complete Rejection of Time', *Journal of Philosophy* 91 (11), pp. 573–98.
Hudson, H. (2001), *A Materialist Metaphysics of the Human Person*. Ithaca: Cornell University Press.
Hudson, H. and R. Wasserman (2010), 'Van Inwagen on Time Travel and Changing the Past', in D. Zimmerman (ed.), *Oxford Studies in Metaphysics Volume 5*. Oxford: Oxford University Press, pp. 41–9.
Huggett, N. (2010), 'Zeno's Paradoxes', *Stanford Encyclopedia of Philosophy* (Winter 2010 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/win2010/entries/paradox-zeno/>.

Huggett, N. and C. Hoefer (2015), 'Absolute and Relational Theories of Space and Motion', *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta (ed.), URL = http://plato.stanford.edu/archives/spr2015/entries/spacetime-theories/ [last accessed 23 February 2015.]

Hume, D. (1748/2004), *An Enquiry Concerning Human Understanding*. New York: Dover.

Husserl, E. (1991), *On the Phenomenology of the Consciousness of Internal Time*, trans. J. Brough. Dordrecht: Kluwer.

Inwagen, P. van (1983), *An Essay on Free Will*. New York: Oxford University Press.

Inwagen, P. van (1990), 'Four-Dimensional Objects', *Noûs* 24, pp. 245–55.

Inwagen, P. van (2002), *Metaphysics*. Boulder: Westview Press.

Inwagen, P. van (2004), 'The Argument from Evil', in P. van Inwagen (ed.), *Christian Faith and the Problem of Evil*. Grand Rapids: Eerdmans, pp. 55–73.

Inwagen, P. van (2010), 'Changing the Past', in D. Zimmerman (ed.), *Oxford Studies in Metaphysics Volume 5*. Oxford: Oxford University Press, pp. 3–28.

James, W. (1890), *The Principles of Psychology*. New York: Dover.

Jammer, M. (2006), *Concepts of Simultaneity: From Antiquity to Einstein and Beyond*. Baltimore: Johns Hopkins University Press.

Janiak, A. (2012), 'Newton and Descartes: Theology and Natural Philosophy', *Southern Journal of Philosophy* 50, pp. 414–35.

Johnston, M. (1987), 'Is there a Problem about Persistence?', *Proceedings of the Aristotelian Society Supplementary Volume* 61, pp. 107–35.

Jokic, A. and Q. Smith (eds) (2003), *Time, Tense, and Reference*. Chicago: MIT Press.

Kant, I. (1998), *Metaphysical Foundations of Natural Science*, M. Friedman (trans.). Cambridge: Cambridge University Press.

Kant, I. (2005), *Critique of Pure Reason*, P. Guyer and A. W. Wood (trans.). Cambridge: Cambridge University Press.

Kaplan, D. (1977/89), 'Demonstratives', in J. Perry, J. Almog and H. K. Wettstein (eds), *Themes From Kaplan*. Oxford: Oxford University Press, pp. 481–563.

Keefe, R. (2008), 'Vagueness: Supervaluationism', *Philosophy Compass* 3, pp. 315–24.

Keller, S. (2004), 'Presentism and Truthmaking', in D. Zimmerman (ed.) *Oxford Studies in Metaphysics Volume 1*. Oxford: Oxford University Press, pp. 83–104.

Keller, S. and M. Nelson (2001), 'Presentists Should Believe in Time-Travel', *Australasian Journal of Philosophy* 79, pp. 333–45.

Kelly, S. D. (2005), 'Temporal Awareness', in D. Woodruff Smith and A. L. Thomasson (eds), *Phenomenology and Philosophy of Mind*. Oxford: Oxford University Press, pp. 222–34.

Kennedy, J. B. (2003), *Space, Time and Einstein: An Introduction*. Chesham: Acumen.

Kenny, A. (2012), *A New History of Western Philosophy*. Oxford: Oxford University Press.

Kiefer, C. (2011), 'Time in Quantum Gravity', in C. Callender (ed.), *The Oxford Handbook of Philosophy of Time*. Oxford: Oxford University Press, pp. 663–78.

Kierland, B. and B. Monton (2007), 'Presentism and the Objection from Being-Supervenience.' *Australasian Journal of Philosophy* 85, pp. 485–97.

King-Farlow, J. (1974), 'The Positive McTaggart on Time', *Philosophy* 49 (188), pp. 169–78.
Kirk, G. S., J. Raven and M. Schofield (1983), *The Presocratic Philosophers: A Critical History with a Selection of Texts*. New York: Cambridge University Press.
Kodaj, D. (2014), 'Open Future and Modal Anti-realism', *Philosophical Studies* 168, pp. 417–38.
Kripke, S. (1980), *Naming and Necessity*. Cambridge, MA: Harvard University Press.
Le Poidevin, R. (1991), *Change, Cause and Contradiction: A Defence of the Tenseless Theory of Time*. London: Macmillan.
Le Poidevin, R. (2002), 'Zeno's Arrow and the Significance of the Present', *Royal Institute of Philosophy Supplement* 50, pp. 57–72.
Le Poidevin, R. (2003), *Travels in Four Dimensions: The Enigmas of Space and Time*. Oxford: Oxford University Press.
Le Poidevin, R. (2004), 'A Puzzle Concerning Time Perception', *Synthese* 142, pp. 109–42.
Le Poidevin, R. (2005), 'The Cheshire Cat Problem and Other Spatial Obstacles to Backwards Time Travel', *The Monist* 88, pp. 336–52.
Le Poidevin, R. (2007), *The Images of Time*. Oxford: Oxford University Press.
Le Poidevin, R. and D. H. Mellor (1987), 'Time, Change, and the "Indexical Fallacy"', *Mind* 96, pp. 534–8.
Lear, J. (1981), 'A Note on Zeno's Arrow', *Phronesis* 26, pp. 91–104.
Leibniz, G. W. (1896), *New Essays Concerning Human Understanding*, A. G. Langley (trans.). New York and London: Macmillan.
Leibniz, G. W. (1908), *Discourse on Metaphysics*, G. R. Montgomery (trans.). Chicago: Open Court
Levy, K. (2005), 'Is Descartes a Temporal Atomist?', *British Journal for the History of Philosophy* 13, pp. 627–74.
Lewis, D. (1976a), 'Survival and Identity', in A. O. Rorty (ed.), *The Identities of Persons*. Berkeley: University of California Press, pp. 17–40.
Lewis, D. (1976b), 'The Paradoxes of Time Travel', *American Philosophical Quarterly* 13, pp. 145–52.
Lewis, D. (1981), 'Are we Free to Break the Laws?', *Theoria* 47, pp. 113–21.
Lewis, D. (1986), *On the Plurality of Worlds*. Oxford: Basil Blackwell.
Lewis, D. (1988), 'Rearrangement of Particles: Reply to Lowe', *Analysis* 48, pp. 65–72.
Lewis, D. (1993), 'Many, but Almost One', in J. Bacon, K. Campbell and L. Reinhardt (eds), *Ontology, Causality and Mind*. Cambridge: Cambridge University Press, pp. 23–42.
Locke, J. (1975), *An Essay Concerning Human Understanding*, P. H. Nidditch (ed.) Oxford: Clarendon Press.
Lockwood, M. (2005), *The Labyrinth of Time*. Oxford: Oxford University Press.
Lombard, L. B. (1994), 'The Doctrine of Temporal Parts and the "No-Change" Objection', *Philosophy and Phenomenological Research* 54, pp. 365–72.
Lombard, L. B. (1999), 'On the Alleged Incompatibility of Presentism and Temporal Parts', *Philosophia* 27, pp. 253–60.
Lorentz, H. A. (1916), *The Theory of Electrons and its Applications to the Phenomena of Light and Radiant Heat*. Leipzig: BG Teubner.

Lowe, E. J. (1988), 'The Problems of Intrinsic Change: Rejoinder to Lewis,' *Analysis* 48, pp. 72–7.
Łukasiewicz, J. (1952), *Aristotle's Syllogistic*. Oxford: Clarendon Press.
MacFarlane, J. (2003), 'Future Contingents and Relative Truth', *Philosophical Quarterly* 53, pp. 321–36.
Magidor, O. (2008), 'Another Note on Zeno's Arrow', *Phronesis* 53, pp. 359–72.
Magidor, O. (2011), 'Arguments by Leibniz's Law in Metaphysics', *Philosophy Compass* 6, pp. 180–95.
Marcovich, M. (1967), *Heraclitus*. Mérida, Venezuela: University of the Andes Press.
Markosian, N. (1993), 'How Fast Does Time Pass?' *Philosophy and Phenomenological Research* 53 (4), pp. 829–44.
Markosian, N. (1995), 'The Open Past', *Philosophical Studies* 79, pp. 95–105.
Markosian, N. (2004a), 'A Defence of Presentism', in D. Zimmerman (ed.), *Oxford Studies in Metaphysics Volume 1*. Oxford: Oxford University Press, pp. 47–82.
Markosian, N. (2004b), 'Two Arguments from Sider's Four-Dimensionalism', *Philosophy and Phenomenological Research* 68, pp. 665–73.
Markosian, N. (2013), 'The Truth about the Past and the Future', in F. Correia and A. Lacona (eds), *Around the Tree: Semantic and Metaphysical Issues Concerning Branching and the Open Future*. Dordrecht: Springer, pp. 127–41.
Mason, H. T. (trans.) (1967), *The Leibniz-Arnauld Correspondence*. Manchester: Manchester University Press.
Matson, W. I. (1987), *A New History of Philosophy, Volume I*. New York: Harcourt.
Maudlin, T. (2007), *The Metaphysics Within Physics*. Oxford: Oxford University Press.
Mayo, B. (1962), 'The Open Future', *Mind* 71, pp. 1–14.
McCall, S. (1994), *A Model of the Universe: Space-Time, Probability, and Decision*. Oxford: Oxford University Press.
McKinnon, N. (2003), 'Presentism and Consciousness', *Australasian Journal of Philosophy* 81, pp. 305–23.
McKinnon, N. and J. Bigelow (2012), 'Presentism, and Speaking of the Dead', *Philosophical Studies* 160, pp. 253–63.
McTaggart, J. M. E. (1908), 'The Unreality of Time', *Mind* 17, pp. 457–74.
McTaggart, J. M. E. (1927), *The Nature of Existence,* Vol. II. Cambridge: Cambridge University Press.
Mellor, D. H. (1981), *Real Time*, Cambridge: Cambridge University Press.
Mellor, D. H. (1987), 'Fixed Past, Unfixed Future', in B. Taylor (ed.), *Michael Dummett. Contributions to Philosophy*. Dodrecht: Nijhoff, pp. 168–88.
Mellor, D. H. (1998), *Real Time II*. London: Routledge.
Merleau-Ponty, M. (1962), *Phenomenology of Perception*, C. Smith (trans.). New York: Routledge & Kegan Paul.
Merricks, T. (1995), 'On the Incompatibility of Enduring and Perduring Entities', *Mind* 104, pp. 523–31.
Merricks, T. (2007), *Truth and Ontology*. Oxford: Oxford University Press.
Meyer, U. (2005), 'The Presentist's Dilemma', *Philosophical Studies* 122, pp. 213–25.
Meyer, U. (2009a), 'Times in Tense Logic', *Notre Dame Journal of Formal Logic* 50, pp. 201–19.

Meyer, U. (2009b), '"Now" and "Then" in Tense Logic', *Journal of Philosophical Logic* 38, pp. 229–47.
Meyer, U. (2011), 'Times as Abstractions', in A. Bardon (ed.), *The Future of the Philosophy of Time*. London: Routledge, pp. 41–55.
Miller, I. (1984), *Husserl, Perception and Temporal Awareness*. Cambridge, MA: MIT Press.
Miller, K. (2006a), 'Time Travel and the Open Future', *Disputatio: International Journal of Philosophy* 1, pp. 223–32.
Miller, K. (2006b), 'Travelling in Time: How to Wholly Exist in Two Places at the Same Time', *Canadian Journal of Philosophy* 36, pp. 309–34.
Miller, K. (2013), 'The Growing Block, Presentism, and Eternalism', in H. Dyke and A. Bardon (eds), *A Companion to the Philosophy of Time*. London: Wiley-Blackwell, pp. 345–64.
Minkowski, H. (1908), 'Raum und Zeit'. in Einstein et al. (1952) *The Principle of Relativity*. New York: Dover Publications, pp. 75–91.
Monton, B. (2007), 'Time Travel without Causal Loops', *Philosophical Quarterly* 59, pp. 54–67.
Moody, E. A. (1958), 'Empiricism and Metaphysics in Medieval Philosophy', *Philosophical Review* 67, pp. 145–63.
Moss, S. (2012), 'Four-dimensionalist Theories of Persistence', *Australasian Journal of Philosophy* 90, pp. 671–86.
Nerlich, G. (2004), 'How the Twins do it: STR and the Clock Paradox', *Analysis* 64, pp. 21–9.
Nolan, D. (1997), 'Quantitative Parsimony', *British Journal for the Philosophy of Science* 48, pp. 329–43.
Noonan, H. W. (2013), 'Presentism and Eternalism', *Erkenntnis* 78, pp. 219–27.
Noonan, H. W. (2015), 'The Passage of Time', *Metaphysica* 16(1), pp. 97–102.
Oakeley, H. D. (1946), 'The Philosophy of Time and the Timeless in McTaggart's Nature of Existence', *Proceedings of the Aristotelian Society* 47, pp. 105–128.
Oaklander, L. N. (1991), 'A Defence of the New Tenseless Theory of Time', *Philosophical Quarterly* 41 (162), pp. 26–38.
Oaklander, L. N. (2002), 'Presentism, Ontology and Temporal Experience', in C. Callender (ed.), *Time, Reality and Experience*. Cambridge: Cambridge University Press, pp. 73–90.
Oaklander, L. N. (2003), 'Two Versions of the New B-Theory of Language', in A. Jokic and Q. Smith (eds), *Time, Tense, and Reference*. London: MIT Press, pp. 271–304.
Oaklander, L. N. (ed.) (2008), *The Philosophy of Time* [Six Volumes]. London: Routledge.
Oaklander, L. N. (2010), 'Mctaggart's Paradox and Crisp's Presentism', *Philosophia* 38, pp. 229–41.
Oaklander, L. N. and Q. Smith (eds) (1994), *The New Theory of Time*. London: Yale University Press.
Ockham, W. (1969), *Predestination, God's Foreknowledge, and Future Contingents*, *Second edition*, M. M. Adams and N. Kretzmann (trans.). Indiana: Hackett.
Øhrstrøm, P. and P. Hasle (2011), 'Future Contingents', *Stanford Encyclopedia of Philosophy* (Summer 2011 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/sum2011/entries/future-contingents/>.

Olson, E. T. (2009a), 'The Passage of Time', in R. Le Poidevin, P. Simons, A. McGonigal and R. Cameron (eds), *The Routledge Companion to Metaphysics*. London: Routledge, pp. 440–8.
Olson, E. T. (2009b), 'The Rate of Time's Passage', *Analysis* 69, pp. 3–8.
Owen, G. E. L. (1974), 'Plato and Parmenides on the Timeless Present', in A. Mourelatos (ed.), *The Pre-Socratics*. Garden City: Anchor/Doubleday, pp. 271–92.
Owens, J. (1974), 'The Physical World of Parmenides', in J. R. O'Donnell (ed.), *Essays in Honour of Anton Charles Pegis*. Toronto: Pontifical Institute of Mediaeval Studies, pp. 378–95.
Papa-Grimaldi, A. (1996), 'Why Mathematical Solutions of Zeno's Paradoxes Miss the Point: Zeno's One and Many Relation and Parmenides' Prohibition', *Review of Metaphysics* 50, pp. 299–314.
Pappas, G. (2014), 'Internalist vs. Externalist Conceptions of Epistemic Justification', *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta (ed.), URL = http://plato.stanford.edu/archives/fall2014/entries/justep-intext/ [last accessed 23 February 2015].
Parfit, D. (1971), 'Personal Identity', *Philosophical Review* 80, pp. 3–27.
Parfit, D. (1984), *Reasons and Persons*. Oxford: Oxford University Press.
Parsons, J. (2015), 'A Phenomenological Argument for Stage Theory', *Analysis* 75, pp. 237–42.
Patterson, R. L. (1941), 'Dr. Broad's refutation of McTaggart's Arguments for the Unreality of Time', *Philosophical Review* 50, pp. 602–10.
Pereboom, D. (2001), *Living without Free Will*. Cambridge: Cambridge University Press.
Phillips, I. (2009), 'Rate Abuse: A Reply to Olson', *Analysis* 69 (3), pp. 503–5.
Phillips, I. (2014), 'Experience of and in Time', *Philosophy Compass* 9, pp. 131–44.
Plantinga, A. (1974), *The Nature of Necessity.* Oxford: Oxford University Press.
Plantinga, A. (1983), 'On Existentialism', *Philosophical Studies* 44, pp. 1–20.
Plato (1997), *Parmenides* (trans. R. E. Allen). New Haven: Yale University Press.
Pöppel, E. (2004), 'Lost in Time: A Historical Frame, Elementary Processing Units and the 3-Second Window', *Acta Neurobiologie Experimentalis* 64, pp. 295–301.
Price, H. (1984), 'The Philosophy and Physics of Affecting the Past', *Synthese* 61, pp. 299–323.
Price, H. (1996), *Time's Arrow and Archimedes' Point*. Oxford: Oxford University Press.
Prior, A. N. (1953), 'Three-Valued Logic and Future Contingents', *Philosophical Quarterly* 3, pp. 317–26.
Prior, A. N. (1959), 'Thank Goodness That's Over', *Philosophy* 34 (128), pp. 12–17.
Prior, A. N. (1962), 'Changes in Events and Changes in Things', *The Lindley Lecture.* University of Kansas: Kansas, reprinted in Prior 2003, pp. 7–21.
Prior, A. N. (1967), *Past, Present and Future*. Oxford: Clarendon Press.
Prior, A. N. (1968/2003), *Papers on Time and Tense.* Oxford: Oxford University Press.
Prior, A. N. (1996), 'Some Free Thinking about Time', in B. J. Copeland (ed.), *Logic and Reality: Essays on the Legacy of Arthur Prior*. Oxford: Clarendon Press, pp. 47–51.

Pruss, A. R. (2010), 'Probability and the Open Future View', *Faith and Philosophy* 27, pp. 190–6.
Quine, W. V. O. (1950), 'Identity, Ostension and Hypostasis', *Journal of Philosophy* 47, pp. 621–33.
Quine, W. V. O. (1953), 'On a So-Called Paradox', *Mind* 62, pp. 65–7.
Raven, M. J. (2011a), 'Attesting the Aristotelian Future', *Philosophia* 39, pp. 751–7.
Raven, M. J. (2011b), 'Can Time Pass at the Rate of 1 Second Per Second?' *Australasian Journal of Philosophy* 89, pp. 459–465.
Rea, M. C. (1998), 'Temporal Parts Unmotivated', *Philosophical Review* 107, pp. 225–60.
Rea, M. C. (2003), 'Four-Dimensionalism', in M. Loux and D. Zimmerman (eds), *The Oxford Handbook of Metaphysics*. Oxford: Oxford University Press, pp. 1–59.
Rea, M. C. (2006), 'Presentism and Fatalism', *Australasian Journal of Philosophy* 84, pp. 511–24.
Reichenbach, H. (1947), *Symbolic Logic*. Berkeley: University of California.
Rhoda, A. R. (2010), 'Probability, Truth, and the Openness of the Future', *Faith and Philosophy* 27, pp. 197–204.
Richmond, A. (2003), 'Recent Work: Time Travel', *Philosophical Books* 44, pp. 297–309.
Roark, T. (2004), 'Why Aristotle Says There Is No Time Without Change', *Apeiron* 37, pp. 227–46.
Roark, T. (2011), *Aristotle on Time: A Study of the Physics*. Cambridge: Cambridge University Press.
Robinson, T. M. (1987), *Heraclitus*. Toronto: University of Toronto Press.
Robson, J. (2014), 'A-Time to Die: A Growing Block Account of the Evil of Death', *Philosophia* 42, pp. 911–25.
Rosenkranz, S. (2012), 'In Defence of Ockhamism', *Philosophia* 40, pp. 617–31.
Russell, B. (1903/2010), *Principles of Mathematics*. Oxon: Routledge.
Russell, B. (1905), 'On Denoting', *Mind* 14 (56), pp. 479–93.
Russell, B. (1918), 'The Philosophy of Logical Atomism', in R. C. Marsh (ed.), *Logic and Knowledge: Essays, 1901–1950* (1956). London: Allen & Unwin, pp. 321–45.
Russell, B. (1940), *An Inquiry into Meaning and Truth*. London: George Allen & Unwin.
Russell, B. (1945), *History of Western Philosophy*. London: Routledge.
Russell, B. (1948), *Human Knowledge: Its Scope and Limits*. New York: Simon and Schuster.
Rynasiewicz, R. (1995a), 'By Their Properties, Causes and Effects: Newton's Scholium on Time, Space, Place and Motion. Part I: The Text', *Studies in History and Philosophy of Science* 26, pp. 133–53.
Rynasiewicz, R. (1995b), 'By Their Properties, Causes and Effects: Newton's Scholium on Time, Space, Place and Motion. Part II: The Context', *Studies in History and Philosophy of Science*, 26, pp. 295–321.
Rynasiewicz, R. (2014), 'Newton's Views on Space, Time, and Motion', *Stanford Encyclopedia of Philosophy* (Summer 2014 Edition), E. N. Zalta (ed.), URL = http://plato.stanford.edu/archives/sum2014/entries/newton-stm/> [last accessed 23 February 2015].
Salmon, W. C. (ed.) (2001), *Zeno's Paradoxes*. Indianapolis: Hackett Publishing.
Sanford, D. H. (1968), 'McTaggart on Time', *Philosophy* 43 (166), 371–8.

Saunders, S. (2002), 'How Relativity Contradicts Presentism', *Royal Institute of Philosophy Supplement* 50, pp. 277–92.
Schachner, N. (1933), 'Ancestral Voices', *Astounding Stories* 12, pp. 70–82.
Schaffner, K. F. (1974), 'Einstein Versus Lorentz: Research Programmes and the Logic of Comparative Theory Evaluation', *British Journal for the Philosophy of Science* 25 (1), pp. 45–78.
Schlesinger, G. N. (1980), *Aspects of Time*. Indianapolis: Hackett Publishing.
Schlesinger, G. N. (1983), 'Reconstructing McTaggart's Argument', *Philosophy* 58 (226), pp. 541–3.
Schliesser, E. (2013), 'Newton's Philosophy of Time', in H. Dyke and A. Bardon (eds), *A Companion to the Philosophy of Time*. London: John Wiley and Sons, pp. 87–101.
Schmaltz, T. M. (2008), *Descartes on Causation*. Oxford: Oxford University Press.
Scully, M. O. (2008), 'The Time Dependent Schrodinger Equation Revisited I: Quantum Field and Classical Hamilton-Jacobi Routes to Schrodinger's Wave Equation', *Journal of Physics: Conference Series 99*, pp. 1–5.
Secada, J. E. K. (1990), 'Descartes on Time and Causality', *Philosophical Review* 99, pp. 45–72.
Shoemaker, S. (1969), 'Time without Change', *Journal of Philosophy* 66 (12), pp. 363–81.
Sider, T. (1997), 'A New Grandfather Paradox?', *Philosophy and Phenomenological Research* 57, pp. 139–44.
Sider, T. (2000a), 'All the World's a Stage', *Australasian Journal of Philosophy* 74, pp. 433–53.
Sider, T. (2000b), 'The Stage View and Temporary Intrinsics', *Analysis*, pp. 84–8.
Sider, T. (2001), *Four-Dimensionalism: An Ontology of Persistence and Time.* Oxford: Oxford University Press.
Sider, T. (2005), 'Travelling in A- and B-Time', *The Monist* 88, pp. 329–35.
Sider, T. (2006), 'Quantifiers and Temporal Ontology', *Mind* 115 (457), pp. 75–97.
Sider, T. (2008), 'Temporal Parts', in T. Sider, J. Hawthorne and D. W. Zimmerman (eds), *Contemporary Debates in Metaphysics*. Oxford: Blackwell, pp. 241–62.
Sider, T. (2011), *Writing the Book of the World*. Oxford: Oxford University Press.
Simon, J. (2005), 'Is Time Travel a Problem for the Three-Dimensionalist?', *The Monist* 88, pp. 353–61.
Skirry, J. (ed.) (2005), *Descartes and the Metaphysics of Human Nature*. London: Continuum Press.
Skow, B. (2009), 'Relativity and the Moving Spotlight', *Journal of Philosophy* 106 (12), pp. 666–78.
Skow, B. (2011), 'On the Meaning of the Question "How Fast Does Time Pass?"', *Philosophical Studies* 155, pp. 325–44.
Smart, J. J. C. (1949), 'The River of Time', *Mind* 58 (232), pp. 483–94.
Smart, J. J. C. (1963), *Philosophy and Scientific Realism*. London: Routledge & Kegan Paul.
Smart, J. J. C. (1980), 'Time and Becoming', in P. van Inwagen (ed.), *Time and Cause*. Dordrecht: D. Reidel, pp. 3–15.
Smith, N. J. (1997), 'Bananas Enough for Time Travel?', *British Journal for the Philosophy of Science* 48, pp. 363–89.
Smith, N. J. (2011), 'Inconsistency in the A-Theory', *Philosophical Studies* 156, pp. 231–47.

Smith, N. K. (1902), *Studies in the Cartesian Philosophy*. New York: Russell and Russell.
Smith, Q. (2002), 'Time and Degrees of Existence: A Theory of "Degree Presentism"', *Royal Institute of Philosophy Supplement* 50, pp. 119–36.
Sorabji, R. (1983), *Time, Creation, and the Continuum: Theories in Antiquity and the Early Middle Ages*. Chicago: University of Chicago Press.
Spinoza, B. (1677/2001), *Ethics* (trans. D. Garrett). Ware: Wordsworth.
Stalnaker, R. C. (1976), 'Possible Worlds', *Noûs* 10 (1), pp. 65–75.
Steward, H. (2012), *A Metaphysics for Freedom*. Oxford: Oxford University Press.
Strang, C. (1960), 'Aristotle and the Sea Battle', *Mind* 69, pp. 447–65.
Strawson, G. (1986), *Freedom and Belief*. Oxford: Oxford University Press.
Strawson, G. (2009), *Selves*. Oxford: Oxford University Press.
Strawson, P. F. (1950), 'On Referring', *Mind* 59 (235), pp. 320–44.
Szabó, L. E. (2011). 'Lorentzian Theories vs. Einsteinian Special Relativity – A Logico-empiricist Reconstruction'. In A. Maté, M. Rédei and F. Stadler (eds.), *Vienna Circle and Hungary—Veröffentlichungen des Instituts Wiener Kreis*. Springer: Vienna. (pp. 191–227)
Taylor, A. E. (1928), *A Commentary on Plato's Timaeus*. Oxford: Clarendon Press.
Thomson, J. J. (1983), 'Parthood and Identity Across Time', *Journal of Philosophy* 80, pp. 201–20.
Thomson, J. J. (2001), 'McTaggart on Time', *Noûs* 35 (15), pp. 229–252.
Todd, P. (2016), 'Future Contingents are All False! On Behalf of a Russellian Open Future', *Mind*.
Tooley, M. (1997), *Time, Tense, and Causation*. Oxford: Oxford University Press.
Tooley, M. (2010), 'Farewell to McTaggart's Argument?', *Philosophia* 38, pp. 243–55.
Torre, S. (2011), 'The Open Future', *Philosophy Compass* 6, pp. 360–73.
Turetzky, P. (1998), *Time.* London: Routledge.
Velleman, J. D. and T. Hofweber (2011), 'How to Endure', *Philosophical Quarterly* 61, pp. 37–57.
Vlastos, G. (1965), 'Creation in the *Timaeus*: Is It a Fiction?', in R. E. Allen (ed.), *Studies in Plato's Metaphysics*. London and New York: Routledge & Kegan Paul.
Wasserman, R. (2003), 'The Argument from Temporary Intrinsics', *Australasian Journal of Philosophy* 81, pp. 413–19.
Wetzel, J. (1995), 'Time after Augustine', *Religious Studies* 31, pp. 341–57.
Williams, D. C. (1951), 'The Myth of Passage', *Journal of Philosophy* 48 (15), pp. 457–72.
Williams, J. R. G. (unpublished manuscript), 'Aristotelian Indeterminacy and the Open Future'.
Williamson, T. (1992), 'Vagueness and Ignorance', *Proceedings of the Aristotelian Society* 66, pp. 145–62.
Wilson, N. L. (1955), 'Space, Time, and Individuals', *Journal of Philosophy* 52, pp. 589–98.
Wright, C. (2003), 'Vagueness: A Fifth Column Approach', in J. C. Beall (ed.), *Liars and Heaps*. Oxford: Oxford University Press, pp. 84–105.
Wüthrich, C. (2010), 'No Presentism in Quantum Gravity', in V. Petkov (ed.), *Space, Time, and Spacetime: Physical and Philosophical Implications of Minkowski's Unification of Space and Time*. Berlin: Springer.

Wüthrich, C. (2012), 'Demarcating Presentism', in H. de Regt, S. Okasha and S. Hartmann (eds), *EPSA Philosophy of Science*. Amsterdam: Springer, pp. 441–50.

Zagzebski, L. T. (1991), *The Dilemma of Freedom and Foreknowledge*. Oxford: Oxford University Press.

Zahar, E. (1973), 'Why did Einstein's Programme Supersede Lorentz's?', *British Journal for the Philosophy of Science* 24, pp. 95–123, 223–62.

Zalta, E. N. (1987), 'On the Structural Similarities between Worlds and Times', *Philosophical Studies* 51, pp. 213–39.

Zeyl, D. J. (trans.) (2000), *Plato: Timaeus*. Indianapolis and Cambridge, MA: Hackett Publishing Co.

Zimmerman, D. (1996), 'Persistence and Presentism', *Philosophical Papers* 25, pp. 115–26.

Zimmerman, D. (1998a), 'Temporary Intrinsics and Presentism', in P. van Inwagen and D. Zimmerman (eds), *Metaphysics: The Big Questions*. Oxford: Blackwell, pp. 206–20.

Zimmerman, D. (1998b), 'Temporal Parts and Supervenient Causation: The Incompatibility of Two Humean Doctrines', *Australasian Journal of Philosophy* 76, pp. 265–88.

Zimmerman, D. (2008), 'The Privileged Present: Defending an "A-theory" of Time', in T. Sider, J. Hawthorne and D. Zimmerman (eds), *Contemporary Debates in Metaphysics*. London: Blackwell, pp. 211–25.

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