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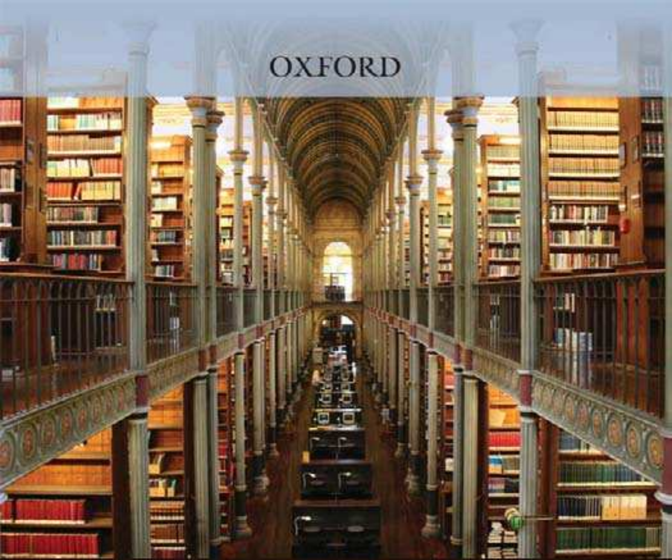

Michael Tooley

Time, Tense, and Causation

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To Sylvia Tooley
and
Rudie Tooley

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Preface and Acknowledgements

Are time and causation related, and if so how? I first became seriously interested in this issue when I was developing an account of the nature of causation. The conclusions that I reached at that time were, first, that it is both possible, and desirable, to offer an account of causation that does not involve any temporal concepts, and, secondly, that, given that there appear to be necessary truths that involve both causal and temporal concepts, the relevant connections between causation and time should be forged via a causal theory of the direction of time.

The resulting picture seemed very appealing. Upon turning, however, from the question of causation to that of the nature of time—and, particularly, to the question of the choice between dynamic and static views of the world—I gradually came to feel that a full account of the relation between time and causation was not provided by a causal theory of the direction of time. The connection was, I felt, a much deeper one, and in the end I concluded, for reasons that will emerge in Chapter 4, that events can be causally related only in a dynamic world. So causation is tied not only to time, but to tense as well.

My intellectual debts here are many, but two in particular deserve special mention. First, a number of articles by Jack Smart, and conversations with him, have increased considerably my appreciation of the difficulties associated both with a tensed account of the nature of time, and with a causal theory of temporal order and direction. Secondly, the sustained defence of a tenseless view of the nature of time that Hugh Mellor sets out in his book *Real Time* convinced me that philosophical attempts to defend tensed approaches to time have been at best highly problematic, and that they have generally failed to come to grips with the most powerful arguments on the other side.

In working on this book, I have profited from conversations with a number of people. My greatest debt in this regard is to Colin Allen, who went through a complete draft of the manuscript in a very thorough fashion, and who offered many incisive comments, criticisms, and suggestions. But I am also very indebted to David Armstrong, George Bealer, William Grey, David Lewis, Graham Oddie, Graham Priest, and the late Francis Snare for valuable discussions of a number of issues, including my overall defence of a tensed account of the nature of time.

I taught a graduate seminar on this material in the Fall Semester, 1994, at the University of Colorado, and I profited from the vigorous challenges to some of my arguments that were mounted by the participants in that seminar.

Among the parts of the book to which I devoted the most time and thought is the one dealing with the challenge posed by the Special Theory of Relativity. Discussions with Brian Ellis, John Clendinnen, Allen Hazen, Stephen Leeds, Adam Morton, and Graham Nerlich were very helpful in regard to this, and my indebtedness is especially great in the case of Graham Nerlich, who talked with me at length about an earlier draft of Chapter 11.

I am also very indebted to the anonymous readers for Oxford University Press. They read the manuscript with great care, and the very helpful criticisms and suggestions that I received from them have enabled me to strengthen the book in a number of ways.

Finally, much of the work on this book was done during my appointment as a Senior Research Fellow, and later as a Senior Fellow, in the Philosophy Program in the Research School of Social Sciences of the Australian National University, and I am very grateful indeed for having had the opportunity to pursue my research on this, and other projects, in a very relaxed and congenial environment, remote from the normal demands of academic life.

Michael Tooley

Boulder

Colorado

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Introduction

The view of time according to which the past and the present are real, but the future is not, is a very natural one. But it is also open to important objections, both philosophical and scientific. Can those objections be answered? I shall attempt to show that they can be, and that, in addition, there are in fact very good reasons for accepting this approach to the nature of time.

The book as a whole is organized as follows. Parts I and II focus, respectively, upon basic ontological and semantical questions connected with the nature of time. Part III is concerned with the analysis of tensed language, and Part IV with the explanation of temporal order and the direction of time. Part V then deals with important objections to tensed accounts in general, and to my own in particular. Finally, Part VI contains a brief summary of the conclusions for which I have argued.

The discussion of basic ontological issues is divided into four chapters. In the first, I begin by considering the difference between tensed and tenseless—or dynamic and static—approaches to time, and I then go on to describe the main alternatives within the tensed camp, including the view that I shall be defending. One thing that emerges is that the tensed view that I am advancing is closer in some respects to tenseless approaches to the nature of time than it is to traditional tensed positions. The reason is related to one of the central points that I shall be making in Chapter 1—namely, that there are two crucial differences between tenseless approaches to the nature of time and *standard* tensed accounts. On the one hand, tenseless approaches to time involve both a static conception of the world and the idea that tensed facts are logically supervenient upon tenseless facts. Traditional tensed approaches, on the other hand, incorporate a dynamic conception of the world, together with the claim that tenseless facts are supervenient upon tensed facts. The tensed view of time that I shall be defending, by contrast, represents an intermediate position, since it combines the idea that the world is dynamic with the thesis that tensed facts are logically supervenient upon what tenseless facts are actual as of different times.

Is such a combination of views coherent? If it is, is there any reason for thinking that it provides a correct account of the nature of time? In what follows, I shall argue that this intermediate approach is coherent, and that it is, in fact, the most promising approach to the nature of time.

Reasons for accepting a given view can take the form either of positive arguments in support of that position, or of objections to alternatives. I shall follow both of these routes. Thus, in Chapters 3 and 4, I set out a positive case for the view that the world is a dynamic one in which tensed facts are logically supervenient upon tenseless ones, while in Chapters 6, 7, and 8 I argue that all of the alternative views are open to decisive objections.

Before I turn to the task of setting out the positive arguments, however, there are some preliminary matters that need to be addressed. These are taken up in Chapter 2, where I focus upon the concept of a state of affairs, the idea of a dynamic world, the contrast between being actual, and being actual as of a time, and the concept of the totality of existence.

With regard to the positive arguments, I begin by considering, in Chapter 3, the 'argument from preventability'. It turns upon the idea that something cannot be a fact as of a given time if there could be a person at that time who had the power to ensure that that fact not obtain, and I try to show how, given this conception of the nature of facts, it seems to follow, first, that what facts there are (tenselessly) depends upon what time it is, and secondly, that, while the past and the present are real, the future is not.

Crucial to the argument from preventability, however, is the claim that it is logically impossible for a cause to be later than its effect, and, while many philosophers certainly hold that this is a necessary truth, the problem is that it does not appear to be a *trivial* analytic truth—akin, say, to the proposition that all bachelors are unmarried. The question, accordingly, is whether it can be demonstrated that backward causation is logically impossible, and if so, how.

I therefore survey the main ways in which philosophers have attempted to establish this claim, and I argue that all of those attempts are problematic. The basic reason is that they usually involve an argument that is directed, not against the possibility of backward causation itself, but, instead, against the possibility of causal loops, and the problem with any such argument is that it seems that one could have backward causation in a world where causal loops were impossible. So standard arguments, even if otherwise satisfactory, do not appear to establish a sufficiently strong conclusion.

The upshot is that the argument from preventability depends upon a premiss that it seems very difficult to establish. But the situation is even less promising than this suggests, for the argument from preventability is also exposed to a second objection, the thrust of which is that the counterfactuals that lie at the heart of that argument are such as can be true even in a static world.

In the light of these two objections, I conclude that the argument from preventability cannot be sustained, at least as an independent argument. The two difficulties from which it suffers point, however, to two other arguments—one turning upon the truth conditions of counterfactuals, and the other turning upon the nature of causation. These are the focus of the discussion in Chapter 4.

Of those two arguments, the more fundamental is the argument from causation. The thrust of this argument is that causation presupposes a dynamic world, and one, moreover, where the past and the present are real, but the future is not. If this conclusion is to be established, however, one cannot appeal to just any approach to the nature of causation: a quite specific account is required. In particular, the account that I shall employ is, first of all, a realist account, rather than a reductionist one. Secondly, it is a singularist account, according to which causal relations between events do not presuppose the existence of causal laws. Thirdly, it involves the claim that causal laws are connected with probabilities in certain ways. It is crucial, therefore, to offer support for this view of the nature of causation, and this I shall attempt to do in a detailed way.

If the argument from causation is right, it turns out that there is a very close relation not only between time and causation—as many philosophers have held—but also between tense and causation: only a dynamic world can contain causally related events. Moreover, the world must be one where the past and the present are real, but the future is not.

Given reasons for believing that the world is a dynamic one, the next main task will be to provide an analysis of the meaning of tensed language. One natural way of formulating such an analysis makes use, however, of a certain semantical notion—namely, that of a proposition's being true *at a time*. Chapter 5, accordingly, is concerned with setting out this idea of truth at a time, and with related semantical issues.

My main objective in that chapter is to defend both the notion of truth at a time, and that of truth *simpliciter*. I therefore begin by arguing, first, that any satisfactory formulation of a tensed view seems to require the concept of truth at a time, and, secondly, that, provided that the idea of a dynamic world is coherent, the idea of a temporally relativized notion of truth is perfectly acceptable. In the case of the latter claim, the basic appeal is to a correspondence theory of truth: if truth is a matter of correspondence with facts, and if what facts there are (tenselessly) is a function of the time in question, then one basic concept of truth—at least for temporal statements—must be that of truth at a time.

Where does this leave the concept of truth *simpliciter*? Most defenders of tensed accounts of the nature of time are inclined to hold, I believe, that the concept of truth *simpliciter* has no role at all to play: that concept would be relevant only if a static view of the world were correct. I shall argue, however, that this position is unsound, and that there are at least three reasons why the concept of truth *simpliciter* is necessary. In the first place, one needs a concept of truth that applies to statements about possible non-temporal entities—numbers, propositions, uninstantiated universals, and so on—and it would seem that the relevant concept will be that of truth *simpliciter,* rather than that of truth at a time. In the second place, the concept of truth *simpliciter* is also needed in the case of propositions expressing logical truths. Finally, it is also essential even in the case of contingent, temporal statements, since, when such statements express certain universally quantified propositions, they may very well be true *simpliciter,* without being true at any time.

The next question that is addressed is that of the correct account of tensed concepts, and this is the focus of the discussion in the next three chapters. To provide the foundations for the account that I wish to offer, I begin, in Chapter 6, by considering a number of issues concerning the relation between tensed concepts and tenseless ones. The basic thrust of the discussion in this chapter is that traditional tensed approaches to the nature of time involve a number of central theses that are open to decisive objections, and that, as a result, these theses must be set aside if there is to be any hope of arriving at an acceptable dynamic account of the nature of time.

One issue involves the status of temporal priority. Can the concept of that relation plausibly be treated as semantically basic, or does it stand in need of analysis? If it does require analysis, what form should that take? In particular, should the concept of temporal priority be analysed in terms of tensed concepts, or in some other way?

With regard to these questions, my central contentions in Chapter 6 are, first, that the relation of temporal priority cannot be analytically basic; and, secondly, that no analysis in terms of tensed concepts is sound. How, then, is the concept of temporal priority to be analysed? The answer is given in a later chapter, where I argue that the correct analysis of temporal priority involves the concept of causation.

A second fundamental issue concerns the question of whether the concepts of the past, the present, and the future are analytically basic. In Chapter 6 the discussion is confined to the concepts of the past and the future, and I attempt to show that both concepts stand in need of analysis, and that a satisfactory and quite straightforward account can be offered. The question of the status of the concept of the present is then taken up in Chapter 7, where I argue that it, too, is analysable in terms of other, more basic concepts.

A third important issue is whether the tenseless existential quantifier can be treated as basic, or whether, on the contrary, it should be analysed in terms of tensed quantifiers. Here I argue that the tenseless existential quantifier is more basic than the corresponding tensed quantifiers. I therefore reject the view—commonly advanced by advocates of tensed accounts of the nature of time—that a statement such as 'Dinosaurs exist (tenselessly)' is to be analysed along the lines of the statement 'Either there were dinosaurs, or there are now dinosaurs, or there will be dinosaurs.'

With this groundwork in place, I turn, in Chapter 7, to the tasks of completing the analysis of basic tensed concepts by setting out an account of the concept of the present, and of providing truth conditions for more complex tensed statements. As regards the former, what I argue is, first, that, given either the concept of truth at a time, or the corresponding ontological concept of being actual as of a given time, a very plausible analysis of the concept of the present can be given, and, secondly, that the concepts of the past and the future can then be analysed in terms of the concept of the present in the manner indicated in Chapter 6. I then go on to discuss the problem of specifying truth conditions for the more complex tensed statements that result when one tensed expression occurs within the scope of another.

In Chapter 4 I set out positive arguments in support of my approach to the nature of time. But, as I indicated earlier, I also want to support that approach by showing that alternatives are exposed to decisive objections. The latter task, which is begun in Chapter 6—where I argue that traditional tensed approaches involve a number of untenable theses—is completed in Chapter 8. There I focus upon alternative accounts of the past, the present, and the future—both tenseless approaches, and a wide variety of tensed views that differ both with regard to whether the past, the present, and the future are all real, and with respect to whether there are one or more intrinsic properties that serve to mark a significant difference among past, present, and future states of affairs. All of these alternative accounts are, I argue, unacceptable.

The accounts that I offer, in Chapters 6 and 7, of the concepts of the past, the present, and the future all presuppose the claim, which is defended in Chapter 6, that temporal priority is not to be analysed in terms of tensed concepts. This leaves one with the question of what account is to be given. Can the concept of temporal priority be analysed in some other way? Or is it to be viewed as analytically basic?

This issue is addressed in Chapter 9, where I offer reasons for thinking, first, that temporal priority cannot be analytically basic, and, secondly, that the concept of causation must enter into its analysis. One of the main lines of argument offered there turns upon the claim that there appear to be necessary connections between temporal relations and causal relations. If that is right, the question arises as to whether the reason is that the analysis of causal relations involves temporal relations, or vice versa. The account of causation that is set out in Chapter 4, however, does not involve any reference to temporal relations. Consequently, if that account is at least roughly along the right lines, and if there is a necessary connection between time and causation, then it would seem that the explanation of that connection must be that temporal priority is analysable, and that the analysis involves the relation of causation.

Given this conclusion, the idea of a causal theory of time is a very natural one. But can *all* temporal relations be analysed in causal terms? I argue that, while a causal analysis can be given in the case of temporal priority, it is not possible for all temporal relations. In particular, I attempt to show that quantitative temporal relations cannot be analysed in causal terms.

A large number of objections have been directed against causal theories of time, and so the question arises as to whether some of these may not tell, as well, against the causal account that I am advancing of temporal priority. The account that I offer, however, is unusual in a certain respect, in that it involves combining a causal account of temporal priority with an absolute view of space and time, and I argue that, mainly because of this feature, my account does not fall prey to the standard objections to causal theories of time.

Given the analysis of temporal priority set out in Chapter 9, my account of the nature of time is virtually complete. I therefore turn, in the next two chapters, to the task of defending that account against various objections. This is a crucial undertaking, since it is in large measure because tensed accounts of the nature of time are exposed to very serious objections, both philosophical and scientific, that many philosophers have concluded that no tensed approach can possibly be correct.

In Chapter 10 the focus is upon philosophical objections of an a priori sort that have been directed against tensed approaches to the nature of time. Such objections include the second part of McTaggart's famous argument for the unreality of time, together with more recent arguments advanced by Williams, Quine, Smart, Mellor, and others. I attempt to show, in a detailed way, that the present approach provides answers to all of those objections.

If the central arguments that I have offered are basically sound, then the view that, while the past and the present are real, the future is not, should be very appealing, since I have argued that this account of the nature of time is a coherent one, that there are good reasons for accepting it, and that, when it is combined with the right auxiliary elements, it is not exposed to any serious philosophical objections of an a priori sort. I have also argued that alternative approaches are open to very serious objections. But there is one rather dark cloud on the horizon: namely, the possibility that, while this theory of time may be the front runner in purely philosophical terms, it ceases to be plausible when one considers what our best scientific theories tell us about the world of space and time. In particular, the worry is that, since this view of the nature of time commits one to absolute simultaneity, it is rendered implausible by the Special Theory of Relativity.

This difficulty is clearly a very serious one. When a philosophical view is on a collision course with a very well-confirmed scientific theory, the prospects for the former do not seem especially bright. As a consequence, a number of philosophers who would otherwise be attracted to this general metaphysical view of the nature of time have concluded that, given the scientific standing of the Special Theory of Relativity, some modification in the philosophical theory is needed, if there is to be any hope of having a tenable position. The question is then whether there is any plausible modification that will preserve enough of what seems to lie at the heart of this account of the nature of time.

My own feeling is that too much has to be given up if one follows this route. In Chapter 11, accordingly, where this problem is discussed, I take a different tack. There I argue, first, that the Special Theory of Relativity can be modified to produce an alternative theory that does entail the existence of absolute simultaneity, and which thus does not conflict with the view that the past and the present are real, but the future is not; and, secondly, that the modified theory is preferable to the Special Theory of Relativity, on grounds of greater explanatory power, and for other reasons as well.

Finally, in Chapter 12, I offer a brief summary of the central features of my approach, and of what I take to be its main advantages. Among the points that I emphasize there is the central role played by causation, and how that gives rise to an account of the nature of time that is in many respects intermediate between tenseless accounts and traditional tensed approaches.

Part I Causation, Time, and Ontology

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1 The Nature of Time: Alternative Accounts and Basic Issues

In this chapter, after briefly describing some alternative accounts of the nature of time, I shall raise three fundamental issues that bear upon the question of what the correct account is. The first concerns the choice between dynamic and static conceptions of the nature of the world; the second, the logical relations between tensed propositions and tenseless ones; and the third, the question of the relation between indeterminism and alternative views of the nature of time. Given the framework thus provided, I shall conclude by describing how the approach to the nature of time that I shall be defending differs from other approaches.

1.1 Alternative Views of the Nature of Time

Among non-philosophers, certain beliefs concerning the nature of time seem to be quite widely accepted. One is the belief that there is a fundamental difference between the past and the future—an idea often expressed in terms of the claim that, while the past is fixed and settled, the future is open, and not yet determined. Thus the world is, on this view, characterized by a deep asymmetry that, rather than being merely an asymmetry with respect to the patterns exhibited by events in time, is, instead, a feature of time itself.

A secondly commonly accepted idea is that time, in addition to being asymmetric, is characterized by an intrinsic direction. Time flows, and, as it does, enduring entities such as ourselves move forward in time, while events that have taken place recede ever further into the past.

Can such views be sustained? Philosophical opinion is sharply divided on this issue. On the one hand, many philosophers—and probably the majority working in this area—accept a tenseless, or static conception of the nature of time. Such philosophers hold that, although there may be asymmetries with respect to the patterns of events in time, there is no deep asymmetry intrinsic to time itself. *A fortiori,* it is a mistake to think that time flows. Many other philosophers, however, reject this view, maintaining, on the contrary, that time does flow, that time does have an intrinsic direction, and that there are significant ontological differences between the past, the present, and the future.

But what account can be given of such purported ontological differences? Advocates of tensed views are far from unanimous concerning this matter. Sometimes it is held that the crucial difference is that between existing and not existing. Thus one version of this position—known as presentism—draws a sharp line between the present, on the one hand, and both the past and the future, on the other, maintaining that, while the present is real, the past and the future are not. Another, somewhat more moderate approach claims that, although both the past and the present are real, the future is not.

Not all tensed approaches, however, hold that the relevant differences are a matter of what is real. Some agree with tenseless approaches in holding that the past, the present, and the future are all equally real. They maintain, however, that there are nevertheless significant ontological differences between the past, the present, and the future, in the form of one or more special, tensed properties that events either acquire, or lose, or both, with the passage of time.

On one version of this last view, there is a property of presentness, which events initially lack, then acquire for a moment, and then lose forever. On another, there are three tensed properties—those of pastness, presentness, and futurity. All events initially have the property of futurity, then lose it at the same instant that they acquire the property of presentness. They then immediately lose that property, and acquire the property of pastness, which they then retain forever.

Advocates of tenseless or static views of time reject all such claims. They contend that the past, present, and future do not differ with regard to their reality. Nor are there any special properties associated with the concepts of pastness, presentness, and futurity. How, then, are those concepts to be understood? The answer offered is that they are to be explained in terms of tenseless temporal concepts plus indexicals. Temporal talk about now and then is, on this view, very similar to spatial talk about here and there. Just as there is no ontological difference *per se* between things that are here and things that are there, so there is no intrinsic ontological difference between things that exist now and things that exist at other times. Similarly, just as there is no property in virtue of which something is here rather than there, so there is no property in virtue of which an event is occurring in the present, rather than in the past, or in the future. In both cases, such statements are true or false simply because of some relation—in the one case spatial, and in the other, temporal—between two entities, one of which is picked out by an indexical or demonstrative term.

My basic goal in this book, as I indicated earlier, is to defend a tensed account of the nature of time, and, specifically, one according to which, while the past and present are real, the future is not. Before turning to that task, however, I need to explain certain features of the approach to time that I am defending, since, while the general tensed view in question has a long philosophical history, the version that I am advancing differs sharply, in certain fundamental ways, from traditional formulations. The remainder of this chapter, accordingly, will be devoted to making those differences clear—differences which I believe are crucial if a tensed account of the nature of time is to be defensible.

1.2 Dynamic Versus Static Conceptions of the Nature of the World

I shall begin with the distinction between static and dynamic conceptions of the world, for it seems to me that the most fundamental question in the philosophy of time is whether a static or a dynamic conception of the world is correct.

What is the difference between static and dynamic conceptions of the world? The natural way to explain the difference, I think, is in terms of two competing concepts of change. First, there is the concept of change associated with a static conception of the world, and according to which for an object to change is simply for it to have different properties at different times. So, if a glass is warm at one time, having been cool at an earlier time, then it has undergone change. And as with objects, so with the world as a whole: for the world to change, in this first sense, is simply for it to have different properties at different times.

Advocates of a dynamic conception of the world reject this concept of change. Sometimes, for example, it is argued that it is unclear why the fact that earlier and later stages of an object have different properties should be, in itself, a reason for describing an object as having undergone change, whereas the fact that different spatial parts of an object, at a given time, have different properties is not.[1] It is difficult, however, to take this dissatisfaction seriously until some alternative is at least roughly in focus. So what other concept of change is there?

The alternative associated with tensed approaches is that an object changes if and only if there is a change over time in the totality of the monadic states of affairs[2] involving the object. Similarly for the world as a whole—although here one can drop the restriction to monadic states of affairs. Thus the world as a whole changes, in this second sense, only if the totality of temporal facts, or states of affairs, is different at different times.

But how can the totality of states of affairs be different at different times? The answer is that this will be possible only if, in the case of temporal facts or states of affairs, facts are, fundamentally, *temporally relative,* so that the basic notion is not that of states of affairs being actual *simpliciter,* but that of states of affairs existing, or being actual, *as of* a particular time. And given this temporally relative conception of facts, or states of affairs, there will presumably be nothing problematic about the idea that the totality of facts that are actual as of one time may be different from the totality of facts that are actual as of some other time.

But what about the concept of being actual as of a particular time? Is that concept itself coherent? This is obviously a crucial question, and I shall begin to address it in the next chapter, where I shall attempt to make plausible the view that the concept of being actual as of a time is no more problematic than the concept of being actual *simpliciter.* The suspicion that the former concept is ultimately incoherent rests, however, to a substantial degree, upon

1 J. M. E. McTaggart, *The Nature of Existence,* ii (Cambridge: Cambridge University Press, 1927,) 13.

2 The restriction to monadic states of affairs is necessary to exclude so-called 'Cambridge' change, where an object's relations to another object alters because of a change in the other object, and not because of a change in the object itself.

specific arguments—such as McTaggart's famous argument for the unreality of time—and I shall be able to deal with those arguments only after I have set out my own positive account of the nature of time.

If the idea of being actual as of a particular time is coherent, one is still faced with the question of what reason there is, if any, for thinking that that concept applies to our world. What grounds are there for holding that the actual world is one where states of affairs are not merely actual *simpliciter,* but actual as of particular times, and where what facts there are depends upon what time it is?

One way of attempting to argue for the view that the idea of being actual *simpliciter* is not sufficient, and that one needs the idea of being actual as of a time, is this. If a temporally indexed idea of actuality applies to our world, then it may well be the case that the only way of giving a consistent description of our world is from one temporal perspective or another. But if, on the contrary, it is only the idea of being actual *simpliciter* that applies to our world, then it must be possible to give a complete and consistent description of our world that is not a description from the perspective of any particular time. But this, it might then be claimed, is not possible: the world can be described only from one temporal perspective or another.[3] Most advocates of a tensed approach to time would say, for example, that, if an event, E, takes place at time t, then it is a fact, as of time t, that E lies in the present, and not a fact that E lies in the past, whereas at any time after t, it is a fact that E lies in the past, and no longer a fact that E lies in the present, and thus they would conclude that there can be no complete description of the world that is not a description from some particular temporal perspective, since, on pain of contradiction, no consistent description of the world can contain all the facts that obtain at different times, since, to do that, it would have to include both the fact that E is present and the fact that E is past.

This attempt to justify the claim that the concept of being actual as of a time must apply to our world seems to me unsound, since, as will emerge later, I believe that the totality of facts that there are as of two or more different times will never involve any incompatible

[3] Michael Dummett, 'A Defence of McTaggart's Proof of the Unreality of Time', *Philosophical Review;* 69 (1960,) 497–504, repr. in Michael Dummett, *Truth and Other Enigmas* (Cambridge, Mass.: Harvard University Press, 1978,) 351–7. See esp. pp. 356–7.

states of affairs, and thus that there can be a complete and consistent description of the world that is not a description from any particular temporal perspective. Nevertheless, I certainly wish to maintain that the concept of being actual as of a time is essential, and that our world is one where what facts there are depends upon what time it is. I need to offer, then, some alternative line of argument in support of this view, and Chapters 3 and 4 will be devoted to that task.

To sum up, then, the difference between a static conception of the world and a dynamic one comes to this. According to a static conception, what states of affairs there are does not depend upon what time it is. Change, consequently, cannot be a matter of a change, over time, in what states of affairs exist. It must be a matter simply of the possession, by an object, or by the world as a whole, of different intrinsic properties at different times.

According to a dynamic conception of the world, by contrast, what states of affairs exist does depend upon what time it is. As a consequence, the totality of monadic states of affairs which exist as of one time, and which involve a given object, may differ from the totality that exists as of some other time, and it is precisely such a difference that constitutes change in an object, rather than merely the possession by an object of different properties at different times. Similarly, change in the world as a whole is a matter of a difference in the totality of states of affairs that exist as of different times, and not merely a matter of the possession of different properties by different temporal slices of the world.

1.3 Tensed Facts Versus Tenseless Facts, and the Question of Supervenience

The fundamental thing that separates tensed and tenseless accounts of the nature of time is, I shall be claiming, the acceptance, or rejection, of a dynamic conception of the world. The distinction between tensed and tenseless accounts is usually drawn, however, in quite a different way. In this section I shall describe that alternative approach, and then consider how those two ways of distinguishing between tensed and tenseless accounts are related.

The usual approach to distinguishing between tensed and tenseless approaches to time is in terms of certain claims concerning the relation between two classes of temporal concepts—namely, tensed and tenseless temporal concepts. So we need to begin with the latter distinction. First, then, tensed concepts. For our purposes here, it will suffice to say that tensed concepts indicate how an event is temporally related to the present. Included, therefore, are the very basic notions of the past, the present, and the future, but also relational concepts, such as that of being further in the past, and quantitative concepts, such as those of having happened five years ago, or of lying three minutes in the future. Tenseless temporal concepts, on the other hand, specify temporal relations between events, and do so without any reference to the present. Included among such tenseless temporal concepts are the central ones of simultaneity and temporal priority, but also other qualitative ones, such as that of temporal betweenness, plus quantitative ones, such as those of being five years earlier, or of being three minutes later.

Given the distinction between tensed and tenseless temporal concepts, the usual way of distinguishing between tensed and tenseless accounts of the nature of time is in terms of certain theses about the relative priority, first, of those two types of concepts, and, secondly, of the corresponding facts described by means of those concepts. Thus, those who advocate a tenseless view of the nature of time maintain that the truth conditions of sentences involving tensed concepts can be given by means of sentences containing only tenseless temporal concepts. Accordingly, once all tenseless facts are fixed, all tensed facts are also settled. There are, therefore, no irreducible tensed facts. All tensed facts are logically super- venient upon tenseless facts.

Suppose, for example, that someone utters the sentence, ‘Event *E* took place five minutes ago’, or has the corresponding thought. What is it that makes that utterance, or thought, true? According to a tenseless approach to time, the utterance or thought in question is true if and only if it stands to event *E* in the tenseless temporal relation of being five minutes later, and false otherwise. Nothing beyond that tenseless state of affairs is relevant to the truth of the utterance or thought.

A very different view of the relation between tensed and tenseless temporal concepts is advanced by advocates of traditional tensed approaches to the nature of time. They maintain that, so far from its being the case that one can set out tenseless truth conditions for tensed utterances, tenseless sentences themselves can be understood only in terms of tensed sentences. As a consequence, it is tenseless facts that are logically supervenient upon tensed facts, rather than the other way around.

Consider, for example, the tenseless sentence 'There are (tenselessly) dinosaurs.' What is it that makes this sentence true? Advocates of traditional tensed approaches to time hold that this sentence can be analysed in terms of the tensed sentence 'Either there were dinosaurs, or there are now dinosaurs, or there will be dinosaurs.' If this is right, then what makes it the case that there are (tenselessly) dinosaurs is either the tensed fact that dinosaurs existed, or the tensed fact that dinosaurs now exist, or the tensed fact that dinosaurs will exist.

In short, tensed and tenseless approaches to the nature of time typically disagree concerning the relative semantical priority of tensed and tenseless concepts, and, correspondingly, concerning the relative ontological priority of tensed and tenseless facts. But how is this difference related to that between static versus dynamic conceptions of the world? And which of these differences is more fundamental?

It would generally be thought, I believe, that these two ways of drawing the distinction between tensed and tenseless accounts of the nature of time come to the same thing, for I think that most philosophers would hold both that tensed concepts can be semantically basic only if the world is a dynamic one, and that tenseless concepts can be semantically basic only if the world is a static one.

The first of these claims certainly seems very plausible. Suppose that *E* is some instantaneous event that is now taking place, and consider two utterances of the tensed sentence '*E* lies in the present', one made now, and one in five minutes' time. If the world is a static one, then the first utterance must be true, and the second false. If tensed utterances have tenseless truth conditions, this poses no problem, since there is no reason why a static world cannot contain the tenseless facts that render the first utterance true, and the second false: the first utterance will be true because it is simultaneous with event *E,* while the second utterance will be false because it is not simultaneous with *E*. But what if tensed utterances, rather than having tenseless truth conditions, express irreducible tensed propositions? Then it would seem that the two utterances of '*E* lies in the present' will express the same proposition.

But this means that in a static world, where the totality of facts never changes, either both utterances would have to be true, or both would have to be false. This, however, is unacceptable. Consequently, if tensed concepts are to be semantically basic, the world cannot be a static one.

But what about the second claim? If tenseless temporal concepts, such as temporal priority, are semantically basic, does it follow that the world is a static one? It is hard to see why it does. In order for the world to be a dynamic one, all that is required is that the facts that are actual as of one time differ from the facts that are actual as of some other time. There is no need for that difference to be a difference with respect to irreducible tensed facts. It may simply be a matter of a change, over time, with respect to what tenseless states of affairs have become actual. If this is right, however, then there can be a world where events are temporally ordered, but where, since there are no irreducible tensed facts, temporal priority cannot be analysed in tensed terms.

Consider, for example, the view of time according to which, while the past and the present are real, the future is not, and suppose that such a view is true of our own world. Then the states of affairs that are actual as of the year 1990 do not include any that involve purple sheep, whereas, given appropriate advances in genetic engineering, the states of affairs that are actual as of the year 2000 might very well do so. But such a difference is one that, on the face of it, can be described without using any tensed terms, since it is simply a matter of there being a spatiotemporal region in which various non-temporal properties, such as that of being purple, are instantiated, and which is actual as of the year 2000, but not as of the year 1990. The assumption that tenseless temporal concepts are semantically basic appears to be perfectly compatible, therefore, with the possibility that the world is a dynamic one.

The situation, in short, is this. The metaphysical hypothesis that the world is a static one does entail that there are no irreducible tensed facts, and therefore that tensed concepts cannot be semantically basic. But, on the other hand, the hypothesis that the world is a dynamic one does not entail that tenseless temporal concepts cannot be semantically basic. Indeed, as we shall see later, not only is a dynamic world perfectly compatible with the view that tenseless temporal concepts are semantically basic; it is also compatible with the thesis that tensed concepts, rather than being semantically basic, are analysable in terms of tenseless temporal concepts, together with the general concept of a dynamic world. This means, in turn, that a dynamic world need not involve any special, irreducible tensed properties—such as those of presentness, pastness, and futurity—in order for tensed sentences to be true: it may simply be a world where what tenseless states of affairs are actual is different at different times.

This conclusion is important for two reasons. In the first place, it shows that it is a mistake to characterize tensed approaches to the nature of time in terms of the thesis that tenseless temporal concepts must be analysable in tensed terms, or in terms of the thesis that tensed concepts are semantically basic, or in terms of the thesis that there are irreducible tensed properties. What is crucial to a tensed approach to time is simply the proposition that the world is dynamic, rather than static.

In the second place, it shows that there is an important alternative besides tenseless approaches to the nature of time and *traditional* tensed approaches. One can agree with traditional tensed approaches that the world is dynamic, while rejecting the claims that tenseless temporal concepts must be analysable in tensed terms, that there are irreducible tensed properties, and that tensed concepts are semantically basic.

The realization that there is this third alternative seems to me crucial, since, on the one hand, as I shall attempt to show in Chapter 4, there seem to be very strong arguments in favour of a dynamic view of the world, and, on the other, arguments that are set out in Chapters 6 and 8, along with some of the standard objections to tensed views discussed in Chapter 10, seem to constitute a decisive refutation of the claims, first, that tenseless facts are logically supervenient upon tensed facts; secondly, that there are special, irreducible tensed properties; and, thirdly, that tensed concepts are semantically basic. If this is right, then only the intermediate alternative can constitute a satisfactory approach to the nature of time.

1.4 Indeterminism and the Openness of the Future

A third issue that needs to be considered—though it is less fundamental than those discussed in the preceding two sections—is that of the relation between indeterminism and a dynamic view of the world. Is the absence of determinism a sufficient condition for the world's being a dynamic one? Is it a necessary condition? Is it both necessary and sufficient? Or is it neither?

This issue of the relation between indeterminism and a tensed view of time arises very naturally, particularly if one focuses upon the question of how the past and the future could differ in some significant way, and if, in response, one opts for the view that the difference is that the future, unlike the past, is open. For then the question arises as to what it means for the future to be open, and one very natural response is to connect openness with indeterminism: the future is open because, assuming that the world is not deterministic, there must always be, at any time, a number of distinct possibilities with regard to what future events will actually take place.

A number of philosophers have, accordingly, set out tensed accounts of the nature of time in which an appeal to indeterminism plays a central role. It will be helpful here, I think, to consider in particular the accounts advanced by Hans Reichenbach and Storrs McCall, both because they represent the two main options, and because they involve quite different views concerning the nature of an indeterministic, dynamic world.

1.4.1 Indeterminism and Reichenbach's Approach to Time

Reichenbach's view of time, as set out in his essay 'Les Fondements logique de la mécanique des quanta',[4] involves the idea that, while the past and the present are real, and consist of determinate events, in the case of the future there are only various possibilities, with associated probabilities, that events with certain determinate properties will occur. The present is, accordingly, the point at which mere possibilities become actual.

This picture is obviously a rather natural one, given the indeterminism of quantum physics. But what did Reichenbach take the logical relations between physical indeterminism and a tensed view of the world to be? The answer is not entirely clear, but it appears that Reichenbach may have held, first of all, both that there is some strong notion of becoming that is essential to a tensed view of time,

[4] Hans Reichenbach, 'Les Fondements logique de la mécanique des quanta', *Annales de l'Institut Henri Poincaré,* 13 (1953,) 140–58.

and that that notion is one that can be satisfactorily explicated *only* in terms of the indeterminism of physics. Thus he says: 'The concept of "becoming" acquires significance in physics: the present, which separates the future from the past, is the moment at which that which was undetermined becomes determined, and "becoming" has the same meaning as "becoming determined".'[5]

Secondly, Reichenbach also appears to have thought that the above conception of time is a necessary consequence of quantum indeterminism. His line of reasoning seems to have been that, if future events are not determined, then they cannot be determinate, and, if they are not determinate, then the world must contain real change, given that the present is the point at which previously indeterminate events become determinate. The indeterminism of quantum physics entails, then, a dynamic view of the nature of time.

The idea that indeterminism necessitates the adoption of a tensed view of time has been criticized by a number of philosophers, the basic objection being that a static world can perfectly well contain indeterministic laws, and can do so regardless of what account is to be given of the nature of indeterministic laws. If a reductionist view of laws of nature is correct—according to which what laws there are is logically supervenient upon the total history of the world—then the world's containing indeterministic laws is simply a matter of certain statistical relations between events of different types belonging to different temporal stages. The existence of such relations between classes of events provides, however, no ground for concluding that events themselves are, until the time at which they occur, indeterminate with respect to their properties. So, given a reductionist view of laws, the existence of indeterministic laws does not seem to entail that future events are in any way indeterminate. Nor does the situation seem to be any different if, as I have argued elsewhere,[6] laws of nature, rather than being logically supervenient upon the history of the world, involve relations among universals. Since the properties standing in

[5] Hans Reichenbach, quoted by Adolf Grünbaum, *Philosophical Problems of Space and Time,* 2nd edn. (Dordrecht: D. Reidel, 1973,) 320.

[6] The main objections to a reductionist view of laws in general are set out in my article 'Causation: Reductionism versus Realism', *Philosophy & Phenomenological Research,* suppl. 50 (1990,) 215–36. A more detailed discussion of objections that apply specifically to the case of indeterministic laws can be found in *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) ch. 4.

the relevant second-order relations will be perfectly determinate properties, the existence of indeterministic laws will not entail that future events are indeterminate in any respect. Therefore, regardless of whether one is a reductionist or a realist with regard to laws of nature, the existence of indeterministic laws does not appear to entail the existence of any indeterminacy with respect to the properties of future events.[7]

What about the suggestion that indeterminism is necessary for a tensed view of time? Reichenbach's reason for accepting this latter idea appears to have been that he thought that the only way that one can make sense of the strong notion of becoming that is central to any dynamic view of time is by identifying the concept of becoming with the concept of an event's becoming determined. So he seems to have thought that there was no hope of explaining becoming in terms of a thing becoming actual, or in terms of an event coming into existence. But if the latter concepts do not make any sense, it is hard to see how the concept of becoming determined can do the job either. This becomes clear, I think, once one asks what events are determined, at some time *t,* in an indeterministic world. According to Reichenbach's view of time, events that happen at time *t,* or at some earlier time, are determined at time *t.* But what makes it the case that earlier events are determined at time *t,* whereas later events are not? Why is the determination of events at a time asymmetric with respect to later versus earlier events? If one could say that earlier events are already actual as of time *t,* whereas later events are not, then one would have an explanation of the asymmetry with respect to what events are determined at a time. If, however, such an answer is not available, then it is hard to see how any rationale can be offered for holding that, in an indeterministic universe, past events are determined, but future events are not.

On the other hand, if one can make sense of the notion of possibilities being actualized, or of events coming into existence, then there is no need to appeal to the concept of becoming determined. In an indeterministic world, before time *t,* there are a

7 Compare the criticisms of Reichenbach advanced by Grünbaum in *Philosophical Problems of Space and Time,* 321–4, and in his article 'The Meaning of Time', in Eugene Freeman and Wilfrid Sellars (eds.), *Basic Issues in the Philosophy of Time* (LaSalle, Ill.: Open Court, 1971), 195–228, at p. 223, and also the discussion by Storrs McCall in his article 'Objective Time Flow', *Philosophy of Science,* 43 (1976,) 337–62, at pp. 338–9.

number of possibilities concerning how the world will be at time *t*. When it is time *t,* those possibilities are narrowed to one, and the state of the world at time *t* is then fixed. In a deterministic world, by contrast, there is always, at every time, just the one possibility concerning how the world will be at time *t,* and so there is not, at time *t,* any narrowing of the relevant possibilities. But this difference is not crucial if one can make sense of the concept of an event coming into existence, or of possibilities being actualized. For although, in a deterministic universe, there is always only the one possibility with regard to the state of the world at time *t,* in such a world, no less than in indeterministic ones, a change takes place at time *t*: a certain possibility becomes actual; a certain state of affairs comes into existence.

In short, the concept of an event becoming determined does not help one to explain what is involved in a dynamic world unless one can invoke the idea of an event coming into existence, or of something becoming actual. But, given the latter notions, it is irrelevant whether the world is deterministic or indeterministic.

1.4.2 Indeterminism and Storrs Mccall's Model of the Universe

A rather different account of the nature of time, but one which shares with Reichenbach's approach the thesis that indeterminism is essential for a tensed view, is that developed by Storrs McCall, first in his article ‘Objective Time Flow’, and more recently, and in more detail, in his book *A Model of the Universe.*[8] According to this view, the world at any time has a treelike structure, with the history of the world up to the present represented by the trunk of the tree, and all future possibilities represented by branches. Given this model, if one compares the world as it is at time *s* with the world as it is at a later time *t,* the trunk that represents the past and the present at time *s* will be a proper part of the trunk that represents the past and the present at time *t,* whereas the branches of the tree at time *t* will be a proper part of the branches of the tree at time *s.* On McCall's model, then, the passage of time involves the dropping-off of all those branches that represent the possibilities that

[8] Storrs McCall, *A Model of the Universe* (Oxford: Oxford University Press, 1994,) esp. chs. 1 and 2.

were not in fact realized, while the branch which remains, and which represents the single possibility for the time in question which was, in fact, realized, becomes the latest part of the trunk of the tree.

How does McCall's model differ from Reichenbach's? The answer is that, while, for Reichenbach, future possibilities do not exist in the same sense that past and present facts exist, for McCall, on the other hand, possible future states of affairs are ontologically on a par with past and present ones. Just as David Lewis is a realist with regard to possible worlds, maintaining that other possible worlds are made of the same ontological stuff as the world we inhabit, so McCall is a realist with regard to future possibilities, holding that future possibilities are made of the same ontological stuff as past and present actualities.[9]

According to Reichenbach's model, then, future states of affairs do not exist, while, according to McCall's model, they do. The future is nevertheless indeterminate, since all of the future possibilities that will not turn out to be part of the actual future history of the world also exist, and there is nothing that marks off the path through the tree that will be the actual course of events from the many alternative possibilities that will not be 'realized'.

Given McCall's model of a dynamic universe, indeterminism is certainly essential, for, in a deterministic world, there would be only the one possibility for any given point in time, and so there would be no branches representing unrealized possibilities that could drop off with the passage of time. The world at any time would consist of a single unbranching structure. Part of that structure would consist of past and present states of affairs, while the rest would consist of the one possible future history of the world. But, given McCall's realism with regard to possibilities, there would be no ontological difference between the part of the tree that consisted of past and present facts and the part that consisted of the future history of the world. As a consequence, in a deterministic world, given McCall's model, there is no difference between the way the world is at one time and the way it is at any other time. A deterministic world will be, in short, a static world, rather than a dynamic one.

[9] For an early statement of McCall's realism concerning possibilities, see his 'Counterfactuals Based on Real Possible Worlds', *Noûs,* 18 (1984,) 463–77, at p. 466. A much fuller discussion can be found in *A Model of the Universe,* 194–9.

So indeterminism is essential for a dynamic world, given McCall's model. But, if it is possible to make sense of McCall's model of a dynamic world, then it must also be possible to make sense of the very different model proposed by C. D. Broad[10] and others. On McCall's model, the universe changes over time through the deletion of branches, while, on Broad's model, the universe changes through the addition of new states of affairs, and surely it cannot be the case that, while the former is possible, the latter is not.

But, if one adopts Broad's model, indeterminism becomes irrelevant, for then a deterministic world will be one where there is only one possibility concerning the way the world is at any given time *t,* but, up until time *t,* there will not be any actual state of affairs that corresponds to that single possibility for the way the world is at that time. A completely deterministic world can, therefore, be a dynamic world. Broad's model of a dynamic world thus has the advantage that, while it is conceptually no more complicated than McCall's, it is more widely applicable, and enables one to capture the intuition that even a deterministic world can be one where states of affairs come into existence. But, in addition, Broad's model is ontologically much simpler than McCall's. In the case of an indeterministic world, what exists as of any given time, according to Broad's model, consists of past and present states of affairs, whereas, on McCall's model, if a world contains laws of the sort that physicists believe characterize our own world, the universe as it is as of any given time will contain uncountably many branchings for each future instant, and every point on every one of those branches will likewise involve uncountably many branchings.

There are, therefore, at least two reasons for preferring Broad's model to McCall's. But perhaps there are other considerations that point in the opposite direction? McCall certainly thinks so, and in *A Model of the Universe* he argues that his branched account is more successful than competing theories of time in providing solutions to a number of very difficult philosophical problems. McCall's account deserves, accordingly, more careful examination. This is best left, however, for later.[11]

10 C. D. Broad, *Scientific Thought* (London: Routledge & Kegan Paul, 1923,) 53–84.

11 McCall's view is discussed in Sect. 8.7.

To sum up. How is indeterminism related to a tensed view of time? In this section I have argued that indeterminism is neither a necessary condition nor a sufficient condition for the existence of a dynamic world. It is not necessary, because, if one considers a dynamic, indeterministic world, two things are happening with the passage of time. First, every present moment is the point at which many possibilities concerning the state of the world are reduced to a single possibility. Secondly, the single possibility that remains is, at the same moment, actualized, either by the coming into existence of new states of affairs, as on Broad's model, or by the deletion of states of affairs, as on McCall's model. If McCall's model is adopted, such actualization does presuppose an indeterministic universe. But, as we have seen, there are reasons for preferring Broad's model, and its adoption means that the actualization of possibilities can occur in deterministic universes as well as in indeterministic ones. Accordingly, since the actualization of new states of affairs suffices to make the world a dynamic one, rather than a static one, indeterminism cannot be necessary for a tensed view of time.

Nor is indeterminism sufficient for the existence of a dynamic world. Regardless of whether one adopts a realist or a reductionist view of laws of nature, there is no reason why a static world cannot contain indeterministic laws.

1.5 Some Divergences from Other Tensed Views of the Nature of Time

The tensed approach to time that I shall be defending involves the claim that, while the past and present are real, the future is not. The central idea underlying this view is that the passage of time involves events, or states of affairs, becoming actual, with the present—the boundary between the past and the future—being the point at which that happens. This is, I believe, a very natural way of thinking about time, and it is also a view with a long philosophical history, going back at least to Aristotle and his famous discussion of the sea fight tomorrow. Aristotle maintained that, although it was true—and indeed necessarily so—that either there would be a sea battle tomorrow or there would not be one, it was neither true nor false that there would be a sea battle tomorrow, and, similarly, neither true nor false that there would not be one.[12] Subsequently, the view that the future is unreal was advocated, in the Middle Ages, by Thomas Aquinas and Peter de Rivo,[13] among others; in the nineteenth century, by Charles Pierce;[14] and in the present century by a number of philosophers, including, perhaps most notably, C. D. Broad.[15]

But, while my general approach to the nature of time falls within this long tradition, it diverges from that tradition—and indeed, from all traditional tensed approaches to the nature of time—in a number of significant respects, and with regard to which it is often much closer to tenseless views than to tensed ones. The two reasons for this involve the accounts that I wish to offer concerning, first, the relation between tensed and tenseless concepts and facts, and, secondly, the connection between causation and time.

1.5.1 Tenseless Concepts and Facts as More Basic Than Tensed Ones

Earlier, in Sections 1.2 and 1.3, I emphasized that tenseless approaches to time differ from traditional tensed ones in two important respects: first, with regard to whether the world is static or dynamic; secondly, with regard to the relation between tensed concepts and facts, and tenseless ones. My own approach to the nature of time shares with traditional tensed approaches the view that the world is dynamic, rather than static. Moreover, and because of this, I agree that certain concepts, which are rejected by advocates of tenseless approaches to time—namely, the concept of a state of affairs being actual as of a time, and the corresponding semantical concept of a proposition being true at a time—are not only perfectly intelligible, but absolutely fundamental. But the situation is very different when one turns from those concepts—which are essential to the very idea of a dynamic world—to specifically tensed concepts and facts. As regards the latter, my approach agrees instead with tenseless accounts in

12 Aristotle, *De interpretatione,* ch. 9, sects. 18a–19b.

13 See Arthur N. Prior, *Past, Present and Future* (Oxford: Oxford University Press, 1967,) 121–2.

14 Charles S. Pierce, *Collected Papers of Charles Sanders Pierce,* ed. Charles Hartshorne and Paul Weiss (Cambridge, Mass.: Harvard University Press, 1931,) v. 459; vi. 368.

15 Broad, *Scientific Thought,* 53–84.

maintaining that tenseless concepts and facts are more basic than tensed ones.

This divergence from traditional tensed approaches means that I shall be rejecting a number of crucial subsidiary claims almost invariably advanced by those who accept tensed views of the nature of time. Especially important in this regard are the following five theses. First, there is the claim that tenseless temporal concepts are to be analysed in terms of tensed ones—a claim that implies not only that concepts such as simultaneity and temporal priority cannot be treated as semantically basic, but also that they cannot, for example, be analysed in causal terms. They must, instead, be analysed in terms of tensed concepts, such as those of past, present, and future.

Secondly, there is the thesis that the concepts of past, present, and future are semantically basic ones, incapable of being analysed in terms of other concepts. Or at least, that this is so for what would seem to be the most central tensed concept—namely, the concept of the present.

Thirdly, there is the contention that, contrary to what is claimed by advocates of tenseless views of the nature of time, familiar tensed statements do not, as such, involve indexicals, and therefore that a given tensed sentence, rather than expressing different propositions when uttered on different occasions, always expresses the same proposition, whenever it is uttered.

Fourthly, there is the claim that the idea of a conceptually basic, tenseless, existential quantifier that ranges over all entities, spatiotemporal and otherwise, must be rejected. The fundamental quantifiers, in the case of things that exist in time, are tensed quantifiers, and the concept of the existence of a spatiotemporal entity, if it is not the concept of something existing *now;* must be analysed disjunctively in terms of the concepts of existing in the past, existing in the present, and existing in the future.

Finally, there is the contention that, since a tensed view of time presupposes a dynamic conception of the world, according to which what facts there are depends upon what time it is, the classical semantical concept of truth *simpliciter* must be abandoned in favour of the temporally indexed concept of truth at a time.

None of these additional theses is, I shall argue, essential to a tensed view of the nature of time. But because they have been so frequently advanced by advocates of tensed views, it is very natural to view them as part and parcel of such a position. This is, I believe, unfortunate. In the first place, and as I shall be arguing later, each of these theses, on its own, is open to strong objections. In the second place, and even more important, the incorporation of any of these theses into a tensed position means that the resulting position is exposed to *very* strong objections that it does not have the resources to answer. Thus in Chapter 10, for example, we shall see that it is not at all clear that any tensed view that incorporates the first of the above theses can respond, in a satisfactory fashion, to McTaggart's famous argument.

The tensed view that I shall be defending differs from standard tensed views in rejecting all five of the above claims. Thus I shall be arguing, first, that tenseless temporal concepts cannot be analysed in terms of tensed ones. Secondly, that tensed temporal concepts cannot be treated as basic and unanalysable. Thirdly, that, although *some* tensed statements do not involve indexicals, this is not true of tensed statements in general; and that, in particular, advocates of tenseless accounts of the nature of time are right in thinking that *ordinary* tensed statements do involve indexicals. Fourthly, that there is a basic existential quantifier which is not analysable in tensed terms, and which ranges over all existents, temporal or otherwise. And finally, that, although the acceptance of a dynamic model of the world certainly entails that the concept of truth at a time is both legitimate and important, it does not entail the further conclusion that the classical concept of truth *simpliciter* must be jettisoned. Although some dynamic models of the world, as I noted earlier, do have this consequence, because they entail that no consistent state of affairs can possibly contain, as parts, all the states of affairs that exist at different times, the model that I shall be defending, by contrast, implies that all of the facts that exist, at some time or other, are perfectly consistent with one another, and, if this is right, it means that both the concept of truth at a time and that of truth *simpliciter* are perfectly legitimate concepts.

1.5.2 Time and the Role of Causation

The other main respect in which the tensed approach to be defended here differs from traditional ones concerns the role assigned to causation: in traditional tensed approaches, causation seems to play no part at all; according to the present approach, however, causation lies at the very heart of time.

How is causation involved in the nature of time? The answer is perhaps best set out in terms of two claims that vary greatly in strength, that are supported by very different arguments, and that, rather than standing or falling together, are logically independent. The first, and more moderate claim is connected with my rejection of the view that tenseless temporal concepts are analysable in tensed terms, since, given this rejection, the question arises as to what account is to be given of tenseless temporal concepts. Is some other analysis to be offered? Or are at least some of those concepts to be treated as basic? The answer that I favour involves an idea that is quite familiar in connection with tenseless views of the nature of time, but which is rarely combined with tensed accounts—the idea, namely, that the direction of time is to be *defined* in terms of the direction of causation.

The second, and more radical claim postulates a connection not merely between time and causation, but between tense and causation. Basic to this second claim is the contention that, given a satisfactory account of causation, it turns out to be a necessary truth that causes bring their effects into existence. So events can be causally related only in a dynamic world.

The approach to time that I shall be defending here involves, therefore, conjoining a dynamic view of the world, first, with the thesis that tenseless concepts and facts are more basic than tensed ones, and that, in particular, tensed truths are logically supervenient upon what tenseless facts are actual as of different times, and, secondly, with the view that causation is basic both to temporal order and to the passage of time. The incorporation of the latter two elements into a dynamic model of the world results in a tensed approach that is quite unusual, involving as it does a number of elements normally associated with tenseless accounts. Some philosophers—and perhaps especially those who embrace a tensed approach to time—may well feel that the marriage of these elements is ill-advised. But I hope to show that, on the contrary, it is a very happy one.

To sum up. The conception of time according to which the present lies at the cutting edge of reality, with the world growing through the addition of new facts, is, I believe, a very natural one, and it has been embraced by a number of philosophers. At the same time, however, it is exposed to very serious objections. What I have suggested in this chapter, however, is that those difficulties may arise, not out of a dynamic view of the world itself, nor out of the specific version according to which, while the past and present are real, the future is not, but, instead, out of certain unsound subsidiary theses that have been traditionally thought to be essential to such an approach to the nature of time. In what follows, I shall try to show that, when this general approach to time is modified in the ways I have indicated, the result is a theory which can be supported by very strong arguments, and which does not fall prey to any of the objections typically directed against tensed accounts of the nature of time.

2 Actuality and Actuality as of a Time

The account of the nature of time that I am defending here involves the claims, first, that the world is dynamic, rather than static; secondly, that the present is the point at which states of affairs come into existence; and, thirdly, that, once a state of affairs is actual, it remains part of reality from that point on. So the past and the present are real, but the future is not.

The task of developing a positive case in support for these claims will be the focus of Chapters 3 and 4, where I shall consider three arguments that might be offered for the thesis that the world is dynamic, in the way just described. Before I turn to those arguments, however, there are two preliminary matters that need to be addressed, concerned, respectively, with the concept of a state of affairs, and with the concept of a dynamic world. Central to the latter will be a consideration of the idea of the totality of existence, and of the contrast between being actual, and being actual as of a time.

2.1 Facts, States of Affairs, and Truth-Makers

2.1.1 Facts as States of Affairs

Philosophers use the term ‘fact’ in at least two very different ways. Sometimes it is used to refer to propositional entities, where the latter may be thought of either as mind-dependent entities, or as denizens of a third world. Facts, on that usage, are simply true propositions. Often, however, the term ‘fact’ is used to refer, not to a true proposition, but, instead, to whatever it is in the world that is the truth-maker for a true proposition. It is the latter usage that I shall be following here.

To talk simply of truth-makers for true propositions does not, however, take one very far. It is important to say something, first, about the structure of truth-makers, and, secondly, about the way that the structure of a truth-maker does or does not correspond to the structure of a proposition which it renders true.

The view of facts that I want to advance, then, is as follows. First, facts are to be identified with states of affairs, where the latter consist of entities, of various sorts, having or not having properties, and standing, or not standing, in relations.

Secondly, properties and relations are to be viewed as universals, where the latter, rather than being conceptual entities, or meanings of terms, are features of reality that account for objective sameness in the world. Thus two things share the same property only if they are genuinely identical in some respect. They do not share the same property simply in virtue of falling under the same concept, or under the same term. Two things may be green, for example, without being the same shade of green, and in that case they are not identical with respect to greenness. As a consequence, while one can speak of the *concept* of greenness, there is, on the view being adopted here, no *property* of greenness.

This view of properties and relations has certain consequences that it is important to note. One has just been mentioned: there is no one-to-one correspondence between concepts and related properties. Another is that there are no negative properties. That is to say, if *P* is some property, there is no property that is necessarily possessed by all and only those things that lack property *P*. Finally, given the existence of two properties, *P* and *Q*, there need not be any corresponding disjunctive property—that is, any property that is necessarily possessed by everything that has either property *P* or property *Q*.[16]

Thirdly, what states of affairs there can be is constrained in important ways by these facts about universals. Thus it follows, for example, that there are no disjunctive states of affairs: *a* having property *P* may be a state of affairs, and, similarly, *a* having property *Q*, but *a* either having property *P* or having property *Q* cannot, in itself, be a state of affairs.

As a consequence, the relation between true propositions and facts is, on this view, more complex than on some alternative theories:

[16] For a detailed discussion and defence of the existence of universals, and of the view of universals just sketched, see David M. Armstrong, *Universals and Scientific Realism* (2 vols.; Cambridge: Cambridge University Press, 1978.)

while any true proposition is, of course, true in virtue of what states of affairs there are, there is no simple, *one-to-one correspondence* between facts and true propositions. But although this means that the present account is less straightforward, it also means that any suggestion that facts are simply hypostatizations of true propositions, or of true sentences, has markedly less plausibility.

Fourthly, the mereological whole formed from any two states of affairs is itself a state of affairs. This means that states of affairs may be either simple or complex. The main significance of this third point, however, is that it implies, on the view of time that I am defending, that there is (tenselessly) a state of affairs that contains every simple state of affairs as a proper part. There is a state of affairs that is the sum total of existence.

Finally, basic states of affairs are, in my view, of three main types, depending upon the sorts of entities involved. Some simple states of affairs consist of (first-order) *particulars* having (or not having) properties, or standing (or not standing) in relations. Others consist of *properties, or relations,* of whatever level, having (or not having) higher-order properties, or standing (or not standing) in higher- order relations. Finally, some states of affairs consist of a *state of affairs* having (or not having) properties, or of two or more states of affairs standing (or not standing) in some relation.

Provided that the existence of universals is accepted, the postulation of basic states of affairs of the first type needs no comment. But what is the justification for postulating basic states of affairs of the other two types? In the case of those of the second sort, the justification is that they are needed for laws of nature, since, as I have argued elsewhere,[17] laws are to be identified, not with Humean regularities involving particulars, but with genuine relations among universals.

As regards basic states of affairs of the third sort, they are needed, I believe, for two reasons. First, a dynamic world is one where not only basic particulars, but also states of affairs, have the property of coming into existence at a time. Secondly, causal relations involve relations between states of affairs.

[17] Michael Tooley, *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) chs. 2 and 3.

The second consideration is certainly not uncontroversial: many philosophers would hold that causal relations between states of affairs are logically supervenient upon laws of nature together with the properties of, and relations among, first-order particulars. If the latter view is right, then one does not need to postulate *basic* states of affairs consisting of states of affairs standing in causal relations to one another. But, as I shall be arguing in Chapter 4, the view that causal relations are reducible to laws plus the non-causal properties of, and relations between, particulars is exposed to very serious objections, and it seems very likely, as a consequence, that one must adopt a non-reductionist view of causal relations. If this is right, then basic states of affairs consisting of relations between simpler states of affairs must also be part of one's ontology.

2.1.2 Truth Conditions and States of Affairs

The ontology just described can, I think, be supported by arguments that render it quite plausible. What matters in the present context, however, is not the details of the account, but the following two general ideas: first, that true propositions must have truth- makers; and, secondly, that truth-makers are entities that possess a structure. For if these two claims are correct, then any explanation of the meaning of a sentence capable of having a truth-value should include, or at least imply, a description of the types of individuals that would have to exist if the sentence were true, and of the properties such individuals would have to have, or of the relations into which they would have to enter.

Tenseless approaches to the nature of time have no problem meeting this constraint, and the same is true of many tensed approaches. But not all. Some tensed accounts, as we shall see, talk very freely about the grammar of tensed sentences, and about the types of metaphysical pictures which they claim are *incorrect,* but they fail to provide any positive account of what states of affairs must exist if a given tensed sentence is to be true. This, I maintain, is unsatisfactory. No contingent sentence can be true (or true at a time) without having a truth-maker that either exists tenselessly, or exists at some appropriate time, and no truth-maker can be devoid of structure. Any acceptable account of the meanings of tensed sentences must, therefore, describe the types of states of affairs that can serve as truth-makers.

2.2 The Idea of a Dynamic World

In a dynamic world, the distinction between states of affairs that are real, or that exist, or that are actual, and those that are not, is insufficient: given that what states of affairs exist, or are real, or are actual may be different at different times, one also needs the concept of existing, or of being actual, *as of* a given time.

How, then, is the latter concept to be explained? A number of defenders of tenseless accounts of the nature of time have suggested, in effect, that no satisfactory account can be given of the concept of being actual as of a given time, that the concept is probably unintelligible, and that, therefore, the whole idea of a dynamic account of the nature of time must be rejected.[18] The best response to this objection would be to provide an analysis of the concept of being actual as of a given time. It seems to me very doubtful, however, that that can be done. What I shall do in this section, accordingly, is to argue that there is nothing objectionable about the view that the concept of being actual as of a given time must be taken as primitive, and as incapable of being analysed.

2.2.1 Reality, Existence, Actuality

What is it for dinosaurs to be real, to exist, to be actual? Various answers have been proposed, but the best starting-point, I suggest, is a distinction drawn by Robert Adams between *possibilist* ac- counts and *actualist* accounts.[19] The former start from an ontology that contains the totality of logically possible worlds, view the actual world as one possible world among others, and then attempt to explain what it means to say of that world that it is the actual world. Actualist accounts, by contrast, hold that nothing exists outside the actual world, and thus that either talk about possible worlds is merely a heuristic device for thinking about modal questions, or else possible worlds do exist, but are simply logical constructions out of items found in the actual world—such as sentences, or propositions, or certain sets of individuals and properties,

[18] A forceful formulation of this view can be found in J. J. C. Smart, 'The Reality of the Future', *Philosophia,* 10 (1981,) 141–50.

[19] Robert Merrihew Adams, 'Theories of Actuality', *Noûs,* 8 (1974,) 211–31. See pp. 224–5.

or thoughts in a divine mind, etc. (Adams speaks here of 'hard actualism' versus 'soft actualism'.)

If one adopts a possibilist approach, there is an interesting argument—formulated by Adams—which shows that actuality either is not a contingent property of a certain possible world, but a necessary one, or else, rather than being an absolute property of a world, it is merely a property that something has relative to a world. The argument begins with the assumption that 'possible worlds are completely determinate; and therefore, for all possible worlds, *w* and *w*', and every interpretation of the notion of actuality, the proposition that *w* is actual is either true or false in *w*''.[20] Given this assumption, there are two possibilities. One is that there is some world, *w,* such it is true in *every* world that *w* is actual. But then it is not a contingent fact, but a necessary one, that *w* is the actual world. The other possibility is that it is true in some worlds that *w* is actual, but not in others. The only sensible option here, however, is that it is true in each world that that world is actual. So according to world *w, w* is actual, whereas according to world *w*', it is instead *w*' that is actual, and so on for every world. But then actuality is not a property that any world has absolutely: it is a property that a world has only relative to itself.

If actuality is a necessary property of one world, then other worlds are not logically possible. It would seem, then, that, if one opts for a possibilist account, one will have to hold that actuality is not an absolute property of a world. This is the view adopted by David Lewis, who holds that the term 'actual', rather than picking out a genuine property that one world has, and others lack, functions simply as an indexical term that picks out the world that one inhabits oneself.[21]

The idea that actuality is not an absolute property of a world does not seem especially appealing, and when formulated in a concrete way—such as Lewis's indexical account—is open to specific objections.[22] The main point, however, is that relatively few philosophers are modal realists, and so very few advocates of a tenseless account of the nature of time would advance a possibilist account of what it is to exist, or to be actual.

20 Robert Merrihew Adams, 222.

21 David Lewis, 'Anselm and Actuality', *Noûs,* 4 (1970,) 175–88.

22 See e.g. Adams, 'Theories of Actuality', 214–20.

What if one adopts an actualist approach, holding that there are no possible worlds, or they are merely logical constructions out of things in the actual world? One possibility is the 'true-story' theory of actuality, according to which " 'In the actual world, *p*" is to be analyzed as "The proposition that (*p*) is true' ".[23] But this account immediately gives rise to the questions, first, whether one cannot offer an analysis of the concept of truth, and, secondly, whether such an analysis will not render the true-story account of actuality circular. In response, Adams contends that it is 'very natural for a soft actualist' to view the concept of truth 'if not as primitive, at least as prior to the notion of actuality'.[24] But what he offers in defence of this claim is simply a criticism of the view that truth is to be analysed in terms of truth in a possible world. The crucial objection, however, comes from within the actualist camp: namely, that being true is not an intrinsic property of propositions—or at least, of contingent ones—but a matter of a relation to something outside of the proposition, and how can that external something be characterized other than as what is actual? So there would seem to be good reason for holding that the true-story theory of actuality is implicitly circular.

What actualist alternatives are there to the true-story account? One is simply to take the notion of existence, or actuality, as primitive—an approach that seems to me preferable to the true- story account, since whether something is actual does not, unlike the case of a proposition's being true, seem to be a matter of a relationship to something else. One would always prefer, of course, not to have to take a concept as basic and unanalysable. In the present case, however, it is not easy to see what other alternatives there are.

2.2.2 Actuality as of a Time

An advocate of a static view of the world certainly needs the notion of actuality, or existence. But then, if no satisfactory analysis can be offered of that concept, where does that leave the objection that the difficulty of supplying an analysis of the concept of being actual as of a given time provides grounds for rejecting the whole idea of a dynamic world? Initially, it might seem that the objection is

[23] Ibid. 225.

[24] Ibid. 226–7.

robbed of all of its force: one cannot provide an analysis of the concept of being actual as of a time, but neither can one provide an analysis of the concept of existence or actuality *simpliciter,* and so the idea of a dynamic world is no more problematic than that of a static world. But the situation is not quite that simple, since the advocate of a dynamic approach to time needs both the concept of actuality as of a given time, and the concept of existence *simpliciter*.

Why is this so? Why is not the concept of actuality as of a given time sufficient? There are two reasons. First, states of affairs are actual as of a given time because of events that occur either at that time, or at some other appropriate time. One needs to be able to make sense, however, of metaphysical hypotheses concerning the existence of entities that are naturally viewed as not having temporal location—such as numbers, propositions, uninstantiated universals, or a complete world of Platonic forms. To do so, it would seem that one needs a notion of existence that involves no relation to time.

Secondly, besides being able to speak of what is actual as of the present moment, one needs also to be able to make sense of propositions about what was actual, and about what will be actual, and, more generally, about the totality of what is actual at some time or other. In short, one needs to be able to offer an account of the concept of a total, dynamic world, as contrasted with the history of a dynamic world up to some point in time.

Suppose that we ignore, for the moment, the existence of non- temporal entities. Can one offer an analysis of what it is to be an actual, temporal entity or state of affairs in terms of the idea of being actual as of a time? The natural ways of trying to do so would be by a definition along the lines of either

X is an actual, temporal entity or state of affairs means the same as
X is a part of the mereological whole that is composed of every state of affairs that is actual as of some time t or other or, alternatively,
X is an actual, temporal state of affairs means the same as
X is a member of the set whose members are all and only states of affairs that are actual as of some time t or other.

One of these definitions might provide a satisfactory way of analysing what it is to be an actual temporal state of affairs in terms of the idea of actuality as of a time *if* every moment of time were actual as of every other moment, and there certainly are dynamic views according to which past, present, and future events and times are all actual as of every time. But the above definition cannot accomplish the desired reduction if one is defending a dynamic view according to which only the past and the present are real, since the times that one is quantifying over in the above definitions cannot be restricted to the past and the present if one is to succeed in capturing the notion of the totality of actual, temporal states of affairs: the temporal quantifier must range over absolutely all times.

The immediate upshot is that on any dynamic view of the world that holds that not all temporal states of affairs are actual as of all times—such as the view that I shall be defending here—one can give an account of the idea of a whole, dynamic world only if one employs both the concept of being actual as of a time and the concept of the totality of existence—both temporal and non- temporal. On some other dynamic views, this is not the case. Nevertheless, even if one adopts a dynamic view according to which all events are actual as of all times, one will still need to treat the notion of the totality of existence as primitive, unless one is prepared to argue that the existence of non-temporal entities is logically impossible. Consequently, it seems that, on *any* dynamic view of the world, there are two concepts that need to be taken as primitive.

How does the situation stand if one opts instead for a static world? Once again, one needs the very general idea of existence, thought of as including both temporal entities and states of affairs together with any non-temporal entities and states of affairs that there may be. But, given that notion, one can define the concept of a complete static world as simply the mereological union—or alternatively, the set—of all existing temporal states of affairs. That will still leave one with the task of explaining what a temporal state of affairs is. But if, as I shall argue in Chapter 9, one can defend a causal theory of temporal order and direction, the advocate of a static view of time will not have to introduce any additional primitives at this point. It appears, then, that the advocate of a tenseless approach to the nature of time needs only a single primitive notion.

The conclusion, therefore, is that the conceptual framework that is needed for the formulation of a dynamic approach to time is slightly more complex than what is needed in the case of a tenseless approach, and this is a reason, other things being equal, for preferring the latter sort of approach. But this advantage is a rather mild one, and in what follows I shall attempt to show that there are other, much more serious considerations that tell in favour of a dynamic account of the nature of time.

3 Temporally Relative Facts and the Argument from Preventability

In this chapter and the next I shall turn to the task of offering positive support for the claim that the world is a dynamic one in which the past and the present are real, as of the present moment, but the future is not. The focus in this chapter will be upon the first of three arguments that might be offered in support of this claim—the argument from preventability—and the structure of the discussion is as follows. I shall begin by setting out the argument from preventability, and show how it leads to the conclusion that, while the past and present are real as of the present moment, the future is not. Then I shall consider two very strong objections to the argument. The first turns upon the claim that certain crucial premisses of the argument—namely, that it is logically impossible for a cause and its effect to be simultaneous, or for a cause to succeed its effect—cannot be established without appealing to a tensed view of time, thus rendering the argument circular. The thrust of the second objection is that the account of temporally relative facts upon which the argument from preventability is based is such that the proposition that different states of affairs are actual as of different times could perfectly well be true even in a static world, so that the argument from preventability, even if otherwise sound, cannot show that the world is a dynamic one. Finally, I shall turn to the question of alternative lines of argument, and I shall suggest that the very difficulties that appear to undercut the argument from preventability themselves point towards two other, much more promising arguments.

3.1 The Argument from Preventability

The argument from preventability turns upon the idea that something cannot be a fact as of a given time if it is logically possible for there to be a person who would have the power at that time to ensure that the state of affairs in question not obtain—an idea that has, I believe, considerable appeal. But, although this argument is very natural and tempting, there are two very serious objections to it, to which the argument itself, as it stands, has no satisfactory responses. My conclusion, therefore, will be that the argument from preventability cannot be sustained, at least as an independent argument.

Why, then, should one consider this argument? The answer is that the two central challenges that can be directed against it point immediately to two deeper issues. Reflection upon those issues leads, in turn, to two more fundamental arguments—one based upon the truth conditions of subjunctive conditionals, and the other, and more basic, upon the nature of causation. These two alternative arguments capture, I believe, the intuitions that underlie the argument from preventability. In Chapter 4, accordingly, I shall turn to the task of setting out those alternative arguments.

3.1.1 Preventability and the Concept of Time-Dependent Facts

In 1980 it was a fact that Einstein had, several years earlier, revolutionized physics. Was it also a fact, in 1980, that a nuclear war would not take place in 1986? It was certainly a fact, in 1987, that a nuclear war had not taken place in 1986, and many philosophers would say that, in view of this, it was also a fact in 1980 that a nuclear war would not take place in 1986—though most would quickly add that talk about what is a fact at a given time is very misleading, since it suggests that facts are time-dependent, whereas all that one really has are facts *simpliciter*.

Consider, however, the following line of thought. In the first place, one understands what it is for it to be within someone's power at one time, but not at some other time, to determine whether a given proposition is true or false. Prior to the end of 1986, for example, there were individuals, or groups of individuals, who had it in their power to make it the case that a nuclear war took place in 1986. Now, however, that is not within anyone's power. Secondly, if someone has, at time *t*, the power to prevent its being the case that *p*, then it seems natural to say that it cannot be a fact, at time t, that p obtains. What can be prevented at a given time is not yet a fact at that time. So, while it is now a fact that no nuclear war took place in 1986, it was not a fact in 1980 that no nuclear war would take place in 1986.

What analysis is to be offered of the concept of time-dependent facts, of states of affairs being actual as of a given time? The thrust of the discussion in the previous chapter was that this concept may very well have to be taken as primitive. But if it is true that, if there is someone who has, at time t, the power to make it the case that p not be true, then it cannot be, at that time, a fact that p, might it not be possible to construct an analysis based upon that conceptual connection? A natural way of attempting to do so is by appealing to the further intuition that whether or not it is a fact that p at time t should not depend upon whether there merely *happens* not to be anyone who has the power at time t to prevent its being the case that p, and thus that, even if there is no actual person with the power at time t to ensure that p does not obtain, if there *could* have been such a person, then it is not, at time t, a fact that p.

But how should the 'could' be construed here? In particular, is it nomological possibility that is in question, or mere logical possibility? The answer is that, if one is to have a concept of time- dependent facts that will allow a deterministic world to be a dynamic world, then one must formulate the analysis in terms of logical possibility, rather than in terms of nomological possibility. The resulting analysis, accordingly, might be expressed as follows:

> It is a fact that p at time t>

means the same as

> p, and it is logically impossible for there to exist anyone who would have been able, at time t, to prevent its being the case that p.

This suggested analysis of the concept of time-dependent facts is, I think, a very natural one. Unfortunately, I think that we shall see, in the end, that this analysis is not really satisfactory.

3.1.2 The Argument from Preventability and the Time-Dependence of Facts

First, however, let us consider how the argument might run, given the above analysis of the concept of time-dependent facts. Consider a world that contains at least two states of affairs, S_1 and S_2, existing at times t_1 and t_2, respectively, and where t_1 is earlier than t_2. Then, given the assumption that the existence of a free and omnipotent person is logically possible, there could have been a person who existed who would have been able at time t_1 to prevent the existence of state of affairs S_2 at time t_2. So the existence of that state of affairs is not a fact at time t_1. But, on the other hand, provided that it is logically impossible for a cause to be simultaneous with its effect, even an omnipotent person would not be able, at time t_2, to prevent the existence of state of affairs S_2 at time t_2, so the existence of S_2 at t_2 is a fact at time t_2. Accordingly, any world that contains states of affairs that exist at different times is necessarily a world where what facts there are is different at different times.

This formulation of the argument for the conclusion that facts are temporally relative depends upon the assumption that it is logically impossible for a cause to be simultaneous with its effect. But the argument can also be developed in terms of an alternative assumption—namely, that it is logically impossible for a cause to be later than its effect—since, given the latter proposition, one can then argue as follows. Either it is logically impossible for a cause to be simultaneous with its effect or it is not. If it is, then the argument proceeds as before. If it is not, then a free and omnipotent being could prevent, at time t_1, the existence of state of affairs S_1 at time t_1, and so the existence of that state of affairs could not be a fact at time t_1. But, provided that a cause cannot be later than its effect, such a being could not, at time t_2, prevent the existence of state of affairs S_1 at time t_1, and so the existence of that state of affairs would be a fact at time t_2. So, either way, what facts there are (tenselessly) must be different at different times.

If one is willing to ignore worlds that contain only two temporal instants, this conclusion can also be established by a slightly simpler argument. Thus, suppose that the world contains three distinct times t_1, t_2, and t_3, where t_1 is earlier than t_2, and t_2 is earlier than t_3, and where S is a state of affairs that exists at time t_2. At time t_1, an omnipotent being could have ensured that S not exist at time t_2, whereas at time t_3—provided that a cause cannot be later than its effect—it is logically impossible to prevent the existence of S at time t_2. So the existence of state of affairs S is a fact at time t_3, but not at time t_1.

Given the above account of time-dependent facts, it is, in short, a straightforward matter to offer an argument in support of the thesis that what facts there are (tenselessly) must differ from one time to another. But a stronger conclusion is also warranted. Since the states of affairs in question may perfectly well be tenseless ones, the above arguments also support the conclusion that what *tenseless* facts there are (tenselessly) must be different at different times.

3.1.3 Preventability, and Past, Present, and Future Facts

What are the implications of the argument from preventability with respect to the existence of past, present, and future facts? Since the argument from preventability shows that what facts there are as of time *t* cannot include any facts that involve the existence of later states of affairs, it supports the claim that there are no future facts. But what about past facts? Here it might initially seem that the argument leaves it an open question whether the past is real, since, in the initial formulation of the argument that was offered in the previous section, I appealed to the assumption that a cause could not be simultaneous with its effect, and it might be thought that, by accepting that assumption, while rejecting the thesis that a cause cannot be later than its effect, one could, consistently with the argument from preventability, hold that the only facts that there are as of any time *t* consist of states of affairs that exist *at* time *t*. Upon reflection, however, it is clear that this is not a plausible position, since, if one holds that backward causation is logically possible, it is hard to see how one can plausibly deny that simultaneous causation is logically possible. The reason is that, if backward causation is logically possible, then surely it should be possible to have a chain in which an event, E_1, causes a later event, E_2, which in turn causes an earlier event, E_3. But then, if such a chain is possible, why should it not also be possible for events E_1 and E_3 to occur at the same time? In short, if backward causation is logically possible, it seems very plausible to hold that it must also be logically possible for one event to cause, at least indirectly, an event that is simultaneous with it. Accordingly, it would seem that acceptance of the argument from preventability cannot plausibly be combined with a denial of the existence of past facts.

Finally, what about present facts? To show that present facts are real, using the argument from preventability, one will need to establish that a cause and its effect cannot be simultaneous, and one natural way of doing that is by trying to find a sound argument against the possibility of backward causation, and then making appropriate modifications. (Most of the arguments against backward causation mentioned in the next section can be thus modified.)

To sum up, what does the argument from preventability purport to establish? First, if the initial part of the argument is sound, it entails the unreality of the future, and thereby refutes all views, both tensed and tenseless, which hold that the past, the present, and the future are all equally real. Secondly, if the claim that causes cannot succeed their effects can also be established, the argument from preventability will then show that past facts are real, and so it would be a decisive objection to presentism—the thesis that only the present is real. Finally, if one can also establish that a cause cannot be simultaneous with its effect, the argument from preventability will also support the conclusion that the present is real. Accordingly, the only tenable position on the nature of time would be the tensed view according to which the past and the present are real, but the future is not.

3.2 The Question of Backward Causation

As set out above, the argument from preventability involves either the assumption that it is logically impossible for a cause and its effect to be simultaneous, or the assumption that it is logically impossible for a cause to be later than its effect. In the preceding section, however, we saw that the former assumption is plausible only if the latter is also. If this is right, then the argument from preventability can be sound only if it is logically impossible for an effect to be earlier than its cause.

How might one attempt to show that it is logically impossible for an effect to precede its cause? In this section I shall briefly describe six important arguments that have been offered. The first appeals to the idea that causation involves the bringing of effects into existence; the second, to a connection between causation and control; the third, to the possibility, given backward causation, of bringing about contradictions; the fourth, to the problem posed by the possibility of undercutting causal chains; the fifth, to the view that causes must render their effects more likely; and the sixth, to the idea that the existence of causal laws involves a ‘transmission’ of probabilities from causes to effects.

Many of these arguments possess, I believe, a certain initial plausibility. I shall contend, however, that none of them provides satisfactory support for the crucial premisses needed in the argument from preventability.

3.2.1 Causes as Bringing Effects into Existence

Arguments for the claim that an effect cannot precede its cause can be divided into those that either presuppose, or directly support, a dynamic view of time, and those that are neutral between dynamic and static views. One example of the former sort appeals to the ideas, first, that the concept of causation is that of the *bringing into existence* of one event by another; secondly, that the bringing into existence of an effect by its cause means that, on the one hand, as of the time of the cause's occurrence, the effect does not exist, whereas, on the other hand, as of the time of the effect's occur- rence, the cause does exist; and, thirdly, that, if one event is either earlier than, or simultaneous with, another event, then the former does exist as of the time of the latter.

Given such an account of causation, existence, and time, it certainly follows that a cause cannot be either later than, or simultaneous with, any of its effects, since in either case, and contrary to the requirement just mentioned, the effect would exist as of the time of the cause's occurrence. But this way of attempting to support the crucial premisses in the argument from preventability is clearly unsatisfactory. In the first place, if the above line of argument is correct, there is no need for the argument from preventability. In the second place, in the absence of an argument for the above account of the concept of causation, the claim that causation involves what might be called ‘tensed succession’ simply begs the question against a tenseless view of time.

3.2.2 Causation and Potential Control

The preceding argument incorporates a dynamic conception of time in a completely explicit fashion. This second argument, by contrast, initially appears to be neutral with respect to tensed versus tenseless views of the nature of time. I shall contend, however, that the argument in question quickly collapses unless a tensed view of time is invoked.

The starting-point for this second argument is that there is an analytical connection between the concepts of causation and control: causes are necessarily such as could, in principle, be used to control the occurrences of events that they cause; they are, in principle, effective means of bringing events of the relevant sort into existence. Given that this is so, consider the hypothesis that backward causation is possible. In particular, consider the idea that an event of type C at location s_2 at time t_2 would be causally sufficient to bring about an event of type E at location s_1 at an earlier time t_1. Once t_1 is past, one could in principle know whether an event of type E had occurred at location s_1 at a time t_1. But then it can be argued that, regardless of whether an event of type E has or has not occurred, bringing about an event of type C at location s_2 at time t_2 cannot be an effective means of bringing it about that an event of type E occurred at location s_1 at time t_1. For if an event of type E has not occurred, then it will be impossible to bring it about that it has occurred by bringing about an event of type C, whereas, on the other hand, if an event of type E has occurred, then the later production of an event of type C is unnecessary, and therefore cannot be an effective means of bringing about an event of type E at the earlier time t_1. So, either way, the production of an event of type C at a later time t_2 cannot be an effective way of producing an event of type E at an earlier time t_1.[25]

Both of the crucial claims just made can, however, be challenged. First, consider the claim that, if no event of type E occurs at time t_1, then bringing about an event of type C at a later time t_2 cannot be an effective means of bringing about an event of type E at the earlier time. It is true that, if no event of type E occurs at location s_1 at time t_1, then it is nomologically impossible for an event of type C to occur at location s_2 at the later time t_2. But how does this entail that production of an event of type C is not an effective means of producing an event of type E? For might it not be true that, if there

[25] For formulations of this argument, see e.g. Antony Flew, 'Can an Effect Precede its Cause?', *Proceedings of the Aristotelian Society,* suppl. 28 (1954,) 45–62, esp. pp. 57–8, and Max Black, 'Why Cannot an Effect Precede its Cause?', *Analysis,* 16 (1955–6,) 49–58, esp. p. 58.

were to be an event of type C at location s_2 at time t_2, there *would* have been an event of type E at location s_1 at time t_1? And, if that counterfactual were true, would not the production of events of type C at later times be an effective means of producing events of type E at earlier times?

Similarly, suppose that an event of type E has occurred at location s_1 at time t_1. How does it follow that the later production of an event of type C cannot be an effective means of bringing about the occurrence of the earlier event of type E? For might it not be true that, if there *were not* an event of type C at location s_2 at time t_2, there *would not* have been an event of type E at location s_1 at time t_1? And, if that counterfactual were true, would not that be a reason for holding that the production of events of type C at later times is an effective means of producing events of type E at earlier times?

The response, in short, is that it has not been shown in the above argument that certain crucial counterfactuals are false—counter- factuals whose truth would support the claim that bringing about events of type C at later times *is* an effective means of bringing about events of type E at earlier times.

Can the argument be supplemented to meet this objection? One possibility is to appeal to the idea that 'backtracking' is not to be allowed in the case of standard counterfactuals—that is, in evaluating a counterfactual of the form 'If C were the case, then E would be the case', one keeps fixed all states of affairs up to the time of event C—since, if this procedure is followed, and one is in a world where an event of type E occurred at time t_1, and an event of type C at a later time t_2, then it will not be true that, if an event of type C had not occurred at time $t_{2,}$ then an event of type E would not have occurred at the earlier time t_1.

The problem with this response is that it can be argued that, in interpreting standard counterfactuals, the correct principle concerning which events can be changed should be formulated in *causal* terms, rather than *temporal* ones. In particular, in evaluating a counterfactual of the form 'If C were the case, then E would be the case, it is not necessarily inadmissible not to keep fixed all of the states of affairs that are temporally prior to event C. What is essential, rather, is that change be confined to events that are not causally prior to C. In short, it is not *temporal* backtracking *per se* that must be excluded, but *causal* backtracking.

In the absence of backward causation these may come, of course, to the same thing, but, if one assumes, for example, that time travel into the past is possible, they often will not, and in such cases it is causal backtracking, not temporal backtracking, that must be excluded in evaluating counterfactuals, since surely one wants to say that, had Dr Who not been wearing a red scarf when he stepped into Tardis in ad 2050, then neither would he when he emerged thirty years earlier, in ad 2020.

This latter claim might be disputed, but only, I think, by arguing that, in evaluating a counterfactual, the events that should, so far as possible, be kept fixed are those that are *objectively fixed,* as of the time of the state of affairs referred to in the antecedent. Then, in the case of the counterfactual 'If Dr Who had not been wearing a red scarf when he stepped into Tardis in ad 2050, neither would he have had one when he emerged in ad 2020', the events that are to be kept fixed will be those that—aside from Dr Who's wearing a red scarf—are objectively fixed as of the relevant time in ad 2050, and, it might be contended, these will include Dr Who's having a red scarf when he emerges from Tardis in ad 2020. So the counter- factual in question will be false: even if Dr Who had not been wearing a red scarf when he entered Tardis in ad 2050, he would still have had one when he emerged in ad 2020.

But, if the advocate of the argument from causation and potential control adopts this line of defence, then he or she is no longer advancing an argument that is neutral with regard to the nature of time: a tensed view is being presupposed, and one that entails that the future, unlike the past, is not fixed. Accordingly, regardless of the merits of this attempt to rule out backward causation, it cannot be used in the context of the argument from preventability to show that a cause must precede its effect.

3.2.3 Four Neutral Arguments Against Backward Causation

The other four arguments that I shall consider are neutral between tensed and tenseless accounts of the nature of time, so any of them, if sound, could be employed in support of the argument from preventability. I shall argue, however, that all of them run afoul of a certain objection concerning the relation between backward causation and causal loops.

3.2.3.1 Backward Causation and the Bringing-About of Contradictions

The first of these arguments appeals to the idea that, if backward causation were logically possible, then it would be possible to make contradictions true. This argument is illustrated, for example, by the time travel case discussed by David Lewis:

> Consider Tim. He detests his grandfather, whose success in the munitions trade built the family fortune that paid for Tim's time machine. Tim would like nothing so much as to kill 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 of his daily walk to the munitions works; 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 . . .[26]

It is natural to suppose that it would, in such a situation, be possible for Tim to kill Grandfather. But the course of history leading up to the existence of Tim does not contain any state of affairs which is Grandfather's being killed in 1921. So, if Tim succeeds in killing Grandfather, then it is both true, and not true, that Grandfather is killed in 1921. It would seem, therefore, that, if backward causation were possible, then it would also be possible for contradictions to be true. Consequently, backward causation must be impossible.

3.2.3.2 Backward Causation and the 'Undercutting' Of Causal Chains

Another familiar argument for the view that backward causation is logically impossible is the 'bilking' argument, advanced by Antony Flew, Max Black, and others,[27] and which might be put as follows. Consider the hypothesis that later events, of type *L*, are causally necessary for earlier events, of type *E*. Confronted with such a causal hypothesis, Flew argues, one should not be satisfied with the role of a passive observer; one should not merely stand by to see

[26] David Lewis, 'The Paradoxes of Time Travel', *American Philosophical Quarterly,* 13 (1976,) 145–52. at p. 149.

[27] See e.g. Flew, 'Can an Effect Precede its Cause?', and Black, 'Why Cannot an Effect Precede its Cause?'

whether, as it happens, earlier events of type *E* are always followed by later events of type *L*. Rather, one should subject such a causal hypothesis to vigorous experimental investigation. And one way of doing that is to wait until an event of type *E* occurs, and then try to prevent the occurrence of any appropriately related event of type *L*. If one does this, there are two possible outcomes. On the one hand, one may sometimes succeed. If so, the hypothesis has been falsified: events of type *L* are not causally necessary for events of type *E*. On the other hand, suppose that, when an earlier event of type *E* has occurred, one never succeeds in preventing the occur- rence of an appropriately related later event of type *L*. Then the question to ask is what makes it *impossible,* given an earlier occur- rence of an event of type *E,* to prevent the occurrence of an event of type *L*? The only satisfactory answer, Flew and others seem to say,[28] is that the causal antecedents of later events of type *L* are not in fact independent of earlier events of type *E,* so that, rather than events of type *L* being causally necessary for events of type *E,* the latter are causally sufficient for the former. The unbreakable correlation is to be explained via forward causation, rather than backward causation. So there could never be a situation in which belief in backward causation would be justified.[29]

3.2.3.3 Causation and Increase in Probability

One of the most carefully developed arguments for the claim that backward causation is logically impossible is that advanced by Hugh Mellor in his book *Real Time*.[30] As Mellor points out, his argument is an extension of Michael Dummett's discussion in the latter's 'Bringing about the Past'.[31] Mellor's argument also resembles, with its central focus upon the experimental evaluation of causal claims, the argument considered in the preceding section. But, as we shall see, Mellor's argument involves the introduction of other crucial elements—and the result is a much more tightly constructed and circumspect argument.

[28] See e.g. Antony Flew, 'Effects before their Causes?—Addenda and Corrigenda', *Analysis,* 16 (1955–6,) 104–10, esp. p. 107.

[29] Critical discussion of this argument can be found in Michael Scriven, 'Randomness and the Causal Order', *Analysis,* 17 (1956–7,) 5–9.

[30] D. H. Mellor, *Real Time* (Cambridge: Cambridge University Press, 1981), ch. 10.

[31] Michael Dummett, 'Bringing about the Past', *Philosophical Review,* 73 (1964,) 338–59, repr. in Michael Dummett, *Truth and Other Enigmas* (Cambridge, Mass.: Harvard University Press, 1978,) 333–50.

Mellor's argument has two main parts. First, he argues that backward causation entails the existence of causal loops. Secondly, he attempts to show that causal loops are logically impossible. If both claims are correct, then backward causation is logically impossible.

Let us consider, then, the first step. Why could there not be a world that contained backward causation, but no causal loops? Mellor appeals, at this point, to a view that he advanced in an earlier chapter, to the effect that events always have spatiotemporally contiguous effects.[32] Given this premiss, if a later event L causes an earlier event E, then E will necessarily have later effects in its immediate neighbourhood, and those events in turn will have later effects, until eventually E gives rise to events that occur at the same time as event L. Even if this is so, however, it would not by itself seem to entail that E is among the causal antecedents of L. But perhaps there are ways in which this gap can be bridged. Alternatively, perhaps Mellor really wants to defend a weaker thesis than what I have attributed to him—to the effect that backward causation, even if it need not entail the actual existence of causal loops, must at least entail that causal loops are physically possible. This more modest claim, together with the proposition that causal loops are logically impossible, will still entail the impossibility of any backward causation, and the more modest claim could be defended by appealing to the idea that, if all events must have spatiotemporally contiguous effects, then there could always be circumstances that would result in a forward causal chain that would intersect the backward causal chain in question, thereby resulting in a causal loop.

Let us turn, then, to the second part of Mellor's argument. Why are causal loops conceptually problematic? Mellor's argument here appeals to a claim concerning the relation between causation and probability—to wit, that ‘causes have *inter alia* to make their effects more likely than in the circumstances they would otherwise have been’.[33] Given this assumption, his argument runs as follows. Imagine a world that is supposed to contain backward causation. In particular, suppose that striking of matches can, in appropriate circumstances, cause earlier ignition of fires. Suppose further that such fires do give rise to later effects in their immediate vicinity,

[32] Mellor, *Real Time,* 123.

[33] Ibid. 178.

which in turn give rise to later effects, and so on, so that causal loops involving the backward causal chains are possible. It would then be in principle possible not only to perceive the fires that ignite, but to do so prior to the later acts of striking matches, and one could then use that information to control when matches are and are not struck. In particular, Mellor suggests that one can set up the following test: 'We can see by t_1 which fires ignited at t_0 and which did not: assume about equal numbers of each. We now ask half the self-styled igniters of each group to put matches to their fires at t_2 and the rest to refrain. They try to comply (or we should have no test), we note at t_2 whether they do, and then we assess the results.'[34]

What are the possible outcomes? One is that there is a positive correlation between the striking of matches and the earlier lighting of fires because some of the igniters disobeyed the instructions. Given that result, the natural idea, as Mellor points out, is to rerun the experiment, offering more glorious rewards to igniters who obey, and more exciting punishments to those who do not. But what if a correlation continues to exist, despite all efforts to improve the behaviour of the igniters? Then, Mellor says, the appropriate conclusion to draw is that there is a causal connection between the striking of matches and the earlier ignition of fires, but it is not one that runs in the backward direction: 'Somehow fires igniting at t_0 make their igniters more likely to apply matches at t_2 than unlit fires do. People's activities at t_2 are somehow constrained, albeit only statistically, by what happens to fires at t_0.'[35]

A second possible outcome is that there is a positive correlation between the later striking of matches and earlier ignitions, and this is so even though all of the igniters in both groups obey their instructions. But how could there be a correlation in that case? The only possibility is that mistakes were initially made concerning which fires were lit, and which were not. But it would seem that it should be possible to reduce such mistakes to a very low level by the use of a sufficient number of accurate perceivers and recording devices.[36] So it would seem that one could also exclude this second possible outcome.

[34] Mellor, 178.

[35] Ibid. 178–9.

[36] Mellor advances, at this point, a more complicated response that involves consideration of the nature of perception, and its relation to prediction.

But the only other possibility is that the earlier perceptions of whether fires have lit are accurate, and that the igniters obey their instructions—in which case the result must be that the ignition of fires does not exhibit any positive correlation with later strikings of matches. It then follows, in virtue of the relation between causation and increase in probability, that strikings of matches cannot cause earlier fires to ignite. Backward causation is, accordingly, impossible.

3.2.3.4 A Formal Approach: Causation and the 'Transmission' Of Probabilities from Cause to Effect

The final approach to the question of backward causation that I want to mention involves the attempt to formulate postulates that can plausibly be viewed as expressing conceptual truths about causation, and that will entail that causal loops are logically impossible.

Merely finding postulates that have such consequences is not, of course, especially difficult. Thus, for example, if the postulates include ones asserting that causation is irreflexive and transitive, then it follows immediately that causal loops are impossible. But the very immediacy of the entailment means that such postulates are question-begging with respect to whether causal loops are possible. What is needed are postulates that will recommend themselves both to those who think that causal loops are possible, and to those who do not, but which in fact entail—in a relatively deep, and unobvious way—the impossibility of causal loops.

Let me now try to motivate a set of postulates that will satisfy these conditions. The postulates that I shall set out are concerned with causal laws, rather than with the relation of causation itself. This is not, of course, any limitation if one holds, as most philosophers do, that causal relations are logically supervenient upon laws plus the non-causal properties of, and relations among, things. But what if, instead, one embraces a singularist conception of causation, and holds that events can be causally related without that being an instance of any causal law at all? Then it might well seem mistaken to start out from postulates that deal with causal laws, rather than with causation. Elsewhere I have argued, however, that this is not so.[37] First of all, it certainly seems possible to hold that

[37] Michael Tooley, 'The Nature of Causation: A Singularist Account', *Canadian Journal of Philosophy*, suppl. 16 (1990,) 271–322.

the concept of the relation of causation is to be analysed in terms of the concept of causal laws, without being compelled thereby to reject a singularist approach to causation. The reason is that one can characterize causation as that relation such that, *if* it enters into laws, those laws must necessarily be causal laws—and where the latter are characterized by the postulates to be set out below. Secondly, it seems to me that there are strong reasons for holding, first, that causation is not an observable relation; secondly, that no reductionist account of causation can be satisfactory; and, thirdly, that no theory that does not refer to causal laws can serve to characterize uniquely the relation of causation. If these three theses are correct, then there would seem to be no alternative to an approach that characterizes causal relations indirectly in terms of causal laws.

Let us ask, then, what it is that makes something a *causal* law. Reflection upon certain simplified situations suggests, I believe, a very plausible answer. Imagine, for example, the following possible world. It contains two radioactive elements, *P* and *Q,* that, in every sort of situation but one, exhibit half-lives of five minutes and ten minutes respectively. However, in one special sort of environment—characterized by some property *R*—an atom of type *P* undergoes radioactive decay *when and only when* one of type *Q* also decays. Now, given such facts, a natural hypothesis would be that the events in question are causally connected. Either (1) the decay of an atom of type *P* is, in the presence of property *R,* both causally sufficient and causally necessary for the decay of an atom of type *Q,* or (2) the decay of an atom of type *Q,* in the presence of property *R,* is both causally sufficient and causally necessary for the decay of an atom of type *P,* or (3) there is some property *S* which is, given property *R,* causally sufficient and causally necessary both for the decay of an atom of type *P* and for the decay of one of type *Q*. But which of these causal connections obtains? Given only the above information, there is no reason for preferring one causal hypothesis to the others. But suppose that the following is also the case: in the presence of property *R,* both element *P* and element *Q* have half- lives of five minutes. Then surely one has good grounds for thinking that, given the presence of property *R,* it is the decay of an atom of type *P* that is both causally sufficient and causally necessary for the decay of an atom of type *Q,* rather than vice versa, and rather than there being some other property that is involved. Conversely, if it turned out that, in the special situation, both elements had half- lives of ten minutes, one would have good grounds for concluding instead that it was the decay of an atom of type *Q* that, given the presence of property *R*, was both causally sufficient and causally necessary for the decay of an atom of type *P*.

In the former case, the observed facts suggest that atoms of type *P* have the same probability of decaying in a given time period in the special situation that they have in all other situations, while atoms of type *Q* do not. On the contrary, atoms of type *Q* appear to have, in the special situation, precisely the same probability of decay as atoms of type *P*. So the probability of decay has, so to speak, been transferred from atoms of type *P* to atoms of type *Q*. It is this, I suggest, that makes it natural to say, in that case, that it is the decay of atoms of type *P* that is, in the presence of property *R*, both causally sufficient and causally necessary for the decay of atoms of type *Q*. The direction of causation coincides, therefore, with the direction of transmission of probabilities.

The basic idea, accordingly, is to characterize causal laws in terms of the transmission of probabilities. Talk about the 'transmission of probabilities' is, of course, a metaphor, and one needs to show that that metaphor can be cashed out in precise terms. How can this be done?

In order to set out in a perspicuous fashion the postulates that provide, I believe, the answer to this question, it will be helpful to introduce a few symbols. First, I shall use the expression '$P \Rightarrow Q$' to say that it is a causal law that the possession of property *P* is causally sufficient to bring about the possession of property *Q*. Secondly, I need to refer to relations of logical probability. To do this, I shall use the expression '$\text{Prob}(Px, E) = k$', where this is to be interpreted as saying that the logical probability that *x* has property *P*, given only evidence *E*, is equal to *k*. Finally, I need to refer to information of a certain restricted sort—specifically, information that either is tautological, or that concerns only what causal laws there are. I shall use the term '*C*' for that purpose.

Given the above notation, one natural formulation of the desired postulates for causal laws is this:

(C_1): $\text{Prob}(Px, P \Rightarrow Q \;\&\; C) = \text{Prob}(Px, C)$
(C_2): $\text{Prob}(Qx, P \Rightarrow Q \;\&\; C) = \text{Prob}(Px, C) + \text{Prob}(\sim Px, C) \times \text{Prob}(Qx, \sim Px \;\&\; P \Rightarrow Q \;\&\; C)$

(C_3): Prob$(Qx, \sim Px \ \& \ P \Rightarrow Q \ \& \ C)$ = Prob$(Qx, \sim Px \ \& \ C)$
(C_4): Prob$(Qx, P \Rightarrow Q \ \& \ C)$ = Prob(Px, C) + Prob$(\sim Px, C) \times$ Prob$(Qx, \sim Px \ \& \ C)$.

These postulates are essentially somewhat simplified versions of ones that I set out elsewhere in developing a supervenience account of causation.[38] There I discussed, in a fairly detailed way, the line of thinking that leads to the specific postulates in question.[39] So perhaps it will suffice here simply to note the central considerations.

Postulate (C_1) states that, if the prior probability that some individual will have property *P,* given only information that is restricted to logical truths and statements of causal laws, has a certain value, then the posterior probability of that individual's having property *P,* given the additional information that the possession of property *P* causally gives rise to the possession of property *Q,* must have precisely the same value. Postulate (C_1) therefore asserts, in effect, that the posterior probability of a state of affairs of a given type is, in the situation described, not a function of the prior probability of any state of affairs of a type to which states of affairs of the first type causally give rise.

Postulates (C_2), (C_3), and (C_4) deal with the posterior probability of a state of affairs, given information to the effect that it is a state of affairs of a type that is causally brought about by states of affairs of some other type, together with prior information that is restricted in the way indicated above. The first of these three postulates asserts that, given the additional information that the possession of property *P* causally gives rise to the possession of property *Q,* the posterior probability that some individual has property *Q* is, in the way indicated, a function of the prior probability that that individual has property *P.*

Postulate (C_2) does not, however, express that dependence in the clearest way, since it involves, on the right-hand side, a probability that is also conditional upon the information that the possession of property *P* gives rise to the possession of property *Q.* It is for this reason that postulate (C_3) is part of the theory, for it makes it

[38] It is also possible to set out corresponding postulates for probabilistic causal laws, but they are unnecessary in the present context. (For details concerning the probabilistic analogues, see my *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) 291–6.)

[39] Ibid. 256–62.

possible to derive a statement in which the relevant posterior probability is expressed in terms of prior probabilities alone.

Postulate (C_3) asserts that, if the prior probability that some individual will have property *Q*, given only information that is either tautologous, or else restricted to statements of causal laws, has a certain value, then the posterior probability of that individual's having property *Q*—given the additional information both that the possession of property *P* causally gives rise to the possession of property *Q*, and that the individual does *not* have property *P*—must have precisely the same value as the prior probability. (C_3), together with (C_2), then entails (C_4), which does express the posterior probability that an individual will have property *Q* in a way that involves only prior probabilities.

The crucial content of the above theory of causal laws is expressed, accordingly, by postulates (C_1) and (C_4), since (C_1) expresses the fact that the logical probability that a given state of affairs will obtain, given information about the types of states of affairs that *are caused by* states of affairs of that type, does not differ from the prior probability, upon evidence of a certain restricted sort, that the state of affairs in question will obtain. Its posterior logical probability cannot, therefore, be a function of the prior logical probabilities of states to which it causally gives rise. But by contrast, as is indicated by postulate (C_4), the posterior logical probability of a given state of affairs is a function of the prior logical probability of any state of affairs of such a type that states of affairs of that type *causally give rise to* states of affairs of the first type. The relation between posterior probabilities and prior probabilities is, in short, different for causes than for effects.

Do the above postulates capture the intuition that there is a relation between causation and the direction of transmission of probabilities? I believe that they do. For if one applies them to the example above, it turns out that, if the radioactive decay of an atom of type *P* in the presence of property *R* is both causally necessary and causally sufficient for the decay of an atom of type *Q*, then postulate (C_1) entails that the posterior probability of an atom of type *P*'s decaying in a given period of time is equal to the prior probability of that sort of event, whereas postulate (C_4) entails that the posterior probability of an atom of type *Q*'s decaying in a given period of time, rather than being equal to the prior probability of that sort of event, is equal instead to the prior probability of an atom of type *P*'s decaying. So the postulates generate the correct probability values.

One way of motivating, therefore, the adoption of postulates (C_1) through (C_4) is by appealing to the intuition, elicited by examples such as that used above, that there is a connection between the direction of causation and what I have referred to as the direction of transmission of probabilities. But the case for the above postulates does not rest upon that intuition alone: there are at least three other grounds of support that can be offered. The first is that reductionist accounts of the direction of causation are open to decisive objections—objections that an account based on postulates (C_1) through (C_4) totally avoids. The second is that those postulates—or, rather, slightly strengthened versions of them—generate the formal properties of causal relations. The third is that the above postulates also serve to explain how beliefs about causal relations can be justified.[40]

Do the above postulates have any implications with respect to the possibility of causal loops? The answer is that quite strong conclusions can be derived from them. First, causal loops where each event is causally sufficient for the next event in the loop are logically impossible. Secondly, the same is true with respect to loops in which each event is causally necessary for the next event. Thirdly, let us say that one event is causally prior to another if and only if it is either causally sufficient, or causally necessary, for the other. Then it is logically impossible to have loops in which each event is causally prior to the next event.

These results, moreover, are not obvious or trivial consequences of the postulates: the derivations are in fact rather complicated.[41] So the postulates cannot be described as begging the question with respect to the possibility of causal loops. Nevertheless, someone who thought that causal loops of one or more of the sorts just mentioned were in fact possible would—assuming the derivations are soundprobably want to run the arguments in the opposite direction, and conclude that at least one of the postulates must be

[40] For a defence of the first claim, see my 'Causation: Reductionism versus Realism', *Philosophy & Phenomenological Research,* suppl. 50 (1990,) 215–36. Arguments in support of the second and third claims can be found in *Causation,* 278–87 and 296–303, respectively.

[41] The relevant proofs are set out in *Causation,* 275–87, 328–35.

mistaken. However, given that the postulates do seem to capture plausible intuitions concerning the relation between causation and probability, and that they can be supported in the other ways mentioned above, it would seem unlikely that there is *nothing* in postulates (C_1) through (C_4). If so, then the crucial question would seem to be whether there is any way of weakening that set of postulates to get an alternative set that will have the same merits, but which will not entail the impossibility of certain sorts of causal loops. If that could be done, then the present argument would be completely undercut.

Suppose that no such weakening exists, that no set of postulates that does not entail the impossibility of causal loops can generate the right consequences concerning the relation between causation and probability, and provide both a non-reductionist account of the direction of causation, and an explanation of the possibility of causal knowledge. Where would that leave one? The answer is that one would still be left with the question of whether backward causation is possible—unless it is true, as Mellor and others have maintained, that backward causation entails at least the possibility of causal loops. In the next section, however, we shall see that there are reasons for holding that backward causation does not entail the possibility of causal loops. So, even if one can show that causal loops are impossible by appealing to postulates (C_1) through (C_4), that will not suffice to establish the impossibility of backward causation.

3.2.4 The Basic Difficulty: Backward Causation Without Causal Loops

The four arguments just considered are all directed to showing, in the first instance, that causal loops are impossible. The question therefore arises as to whether one can move on to the further conclusion that backward causation is impossible. To do so, one will somehow have to prove that backward causation entails the possibility of causal loops. But can that be done?

Given certain views concerning the independence of causation and time, such a line of argument would be impossible. In particular, suppose that the direction of time was not based upon the direction of causation. Then among the worlds that would have to be regarded as possible, until proven otherwise, would be worlds that contained backward causation, but where forward causation was not only completely absent, but impossible. So there would be possible worlds containing backward causation, but without even the possibility of causal loops, and the above line of argument would therefore collapse.

Some writers have been aware of this point. Hugh Mellor, in particular, emphasizes the role that is played in his own argument by a causal account of the direction of time. But many other philosophers have failed to consider the possibility of a world that contains only backward causation, even when it seems that they do not accept a causal analysis of the direction of time.

I shall not appeal, however, to the idea of a world that contains only backward causation. Like Mellor, I believe that causation fixes the direction of time, and thus that it is not really possible for there to be a world containing only backward causation. What I shall need to argue, accordingly, is that there can be worlds where, in spite of the presence of both backward and forward causation, causal loops are impossible.

Consider, then, the following world. It consists of two spatial regions segregated from each other by a wall with some remarkable properties. First, the wall has always existed. Secondly, it is indestructible, and so it will exist at every future time. Thirdly, there is no way of getting around the wall, so that something can travel from the one region of space to the other only by going through the wall. Finally, the wall's properties differ depending upon the direction through the wall: in one direction, no causal processes at all can be transmitted from the one region to the other, while, in the opposite direction, light waves, but nothing else, can pass through the wall.

Suppose now that you are living on the side of the wall that can receive light waves from the other side, but from which no causal influence at all can be transmitted back in the opposite direction. On your side of the wall, life is very similar to the actual world. But on the other side, things are somewhat different. For example, next to you, on the other side, is a golf course. As you look across, you see a golf ball, lying on a green. But then, though there are no readily observable forces acting upon the ball, it starts to roll, at first slowly, and then more rapidly. It then hops, landing exactly in an indentation on the green, out of which it leaps at a much higher velocity. You notice that, remarkably, the indentation that was there has now completely disappeared. Following the flight of the ball, you notice it moving towards a golfer who appears to be swinging a club in reverse. As the ball moves towards the ground, you also notice that a loose piece of turf, that had been lying there, leaps in the air, and the turf, the golf ball, and the clubhead all arrive at the same location at about the same time. The piece of turf winds up fitting exactly into a divot hole that had been there in front of the golfer, while the ball comes to a complete halt as it makes contact with the backward-moving clubface.

A remarkable series of events. But in the world we are imagining, these sorts of events take place all the time on the other side of the wall: it is as if all causal processes were running in the opposite direction from what they are on this side of the wall. So let us assume now that things are just as they appear to be. Causal processes on the other side run in the opposite direction from those on this side.

We have, then, a world with oppositely directed causal processes, but where causal loops are not even possible. Seeing the golf course, and the peculiar behaviour of the ball on the green, you may very well be able to predict what the golfer standing down the fairway is going to do. But if you attempt to subject the apparent causal connection to any experimental test, you will necessarily fail, since no causal processes can pass from your side to the other. Experimenters on the other side, of course, will have no trouble subjecting the relevant causal hypothesis to an experimental test, and in finding, thereby, that golfers on their side, by swinging a golf club, can indeed control—at least to some extent—the flight of a golf ball.

In this first type of world, events belonging to oppositely directed causal chains on different sides of the wall can be causally connected. The golfer's swing causes the ball to be on the green, which then causes your perceptual experiences, which, in turn, cause your later memories. Then, a few seconds later, the golfer's swing causes your perceptual experiences of it, and those experiences together with your earlier memory produce a memory that encompasses both the swing and the outcome. So in a certain sense one has events that form a causally interrelated loop. But the sort of causal interrelatedness is harmless, and does not constitute a causal loop, since, as one goes around the loop, the connecting relation at one point, rather than being that of causation, is instead the inverse relation of being caused by.

The second type of world, by contrast, is one where the oppositely directed causal processes are not causally connected in this way—nor, indeed, in any way at all. This second possibility can be arrived at by a two-step modification of the segregated world. The first modification involves imagining that there are different types of fundamental particles on different sides of the wall, whose natures are such that there would be no direct causal interaction between them even if the wall were not present. So now it cannot be the case that light is being transmitted through the wall in one direction. What must be happening is that light of the type found on the other side interacts with the wall, and produces a causal process in the wall, which leads in turn to the emission of light of another type on this side of the wall. The existence of the wall would then be necessary for any causal interaction between things on different sides of the wall.

The second modification then consists of removing the wall. The two parts of the resulting world will then be causally isolated from one another. They will, however, still be spatially related. Thus, though you will no longer be able to see the ball lying on the green in the sub-world made up of different types of particles, that state of affairs will be spatially related to events in your sub-world, and some of those events may very well cause events that will be spatially related to the golfer's swing. So one can have oppositely directed causal processes entering into loops of the following sort: C_1 causes E_1; E_1 is spatially related to C_2; C_2 causes E_2; E_2 is spatially related to C_1. Indeed, given that there is now no wall to keep the two sub-worlds apart, we might as well imagine that, rather than occupying different regions of space, they overlap completely. Then one could have oppositely directed causal processes entering into loops of the following sort: C_1 causes E_1; E_1 and C_2 occur in precisely the same spatiotemporal location; C_2 causes E_2; E_2 and C_1 occur in precisely the same spatiotemporal location.

In short, it seems possible for there to be oppositely directed causal processes in worlds where causal loops are impossible. This may happen either because oppositely directed causal processes, though spatially related, cannot be causally connected, or because, though oppositely directed causal processes can be causally connected, there are restrictions upon the possible causal connections that are built into the world, and that preclude causal loops.

Do we have here a decisive objection to any attempt to rule out backward causation by means of an argument that presupposes a connection between backward causation and the possibility of causal loops? I think that would be to overstate the matter, since there are ways in which one might attempt to show that worlds of the sort to which I have just appealed are not in fact really possible. In particular, one might try to argue that spatiotemporal relations need to be analysed in causal terms, and, if that could be established, then the present objection might well be undermined.

But how promising is such a response? It seems to me that the prospects are not bright, since, if one considers what is undoubtedly the most impressive attempt to analyse spatiotemporal relations in causal terms—namely, Alfred A. Robb's axiomatic development of the space-time of the Special Theory of Relativity[42]—a problem emerges that seems likely to plague all such attempts. The starting- point of the difficulty is that there seems to be no reason why *actual* causal relations among events will necessarily suffice to fix the total structure of space-time. Because of this fact, Robb's own account is formulated not in terms of actual causal relations between events, but in terms of causal connectibility. The concept of causal connectibility, however, presumably has to be analysed in terms of counterfactuals, and so one is faced with the question of the truth-makers for the relevant subjunctive conditionals: what makes it true that, although event *A* is not causally connected to event *B,* there could have been a causal process connecting those events, or, at least, connecting alternative events in the same spatiotemporal locations? It is hard to see what answer there can be, other than one that appeals not only to relevant laws of nature, and to the intrinsic properties of the events in question, but also to the spatiotemporal relation between those events. This answer is not available, however, if one holds that spatiotemporal relations are themselves to be analysed in terms of actual and possible causal relations.

The problem, in short, is that the most natural way of attempting to answer the argument developed in this section seems to require

[42] Alfred A. Robb, *A Theory of Time and Space* (Cambridge: Cambridge University Press, 1914.)

subjunctive conditional statements for which, on pain of circularity, no categorical truth-makers can be supplied. Perhaps this obstacle can be overcome. Or perhaps there is some alternative way of attempting to show that worlds of the sort described above are not really possible. But until a promising proposal appears on the horizon, I think that the conclusion must be that backward causation need not entail the possibility of causal loops, and thus that any attempt to rule out backward causation which claims that there is such an entailment must necessarily fail.

3.3 A Second Objection to the Argument from Preventability

If the argument from preventability is to provide a reason for accepting a dynamic view of time, one needs to be able to establish that a cause cannot be later than its effect, and to do so by means of an argument that does not itself presuppose a tensed approach to time. The discussion in the previous section strongly suggests, however, that the 'neutral' arguments—as they stand—do not establish that an effect cannot precede its cause, for they do not show that oppositely directed causal processes are impossible.

The preceding problem is not, however, the only obstacle that the argument from preventability faces. Another objection, which appears even more troubling, is as follows. First, consider the structure of the argument from preventability. It starts out from a certain account of what it is for something to be a fact at a given time—namely, that *p*'s being a fact at time *t* is a matter of its being logically impossible for there to exist anyone who would have been able, at time *t,* to prevent its being the case that *p*. It is then argued that this account entails that what facts there are is different at different times, and so it is concluded that the world must be a dynamic one.

What is one to say about the final step in this argument? It is easy to let it slip by unnoticed. After all, a dynamic world is just a world where what facts there are is different at different times. But a certain account has been given of what it is for something to be a fact at a given time, and one needs to ask whether, given that analysis, the inference remains acceptable.

But when this is done, is it not clear that the inference is not acceptable? What is being said is that, if *p*'s being the case is preventable at time t_1, but not at time t_2, then the world is a dynamic one. Preventability, however, is being explained in terms of certain subjunctive conditionals, and, given that explanation, an advocate of a static view of the world may very well agree that *p*'s being the case is preventable at time t_1, but not at time t_2, without agreeing that it follows from this that the world is a dynamic one, since it can be argued, first, that any standard account of the truth conditions of subjunctive conditionals will provide satisfactory truth conditions for the preventability conditionals in question, and, secondly, that standard accounts are all formulated entirely in terms of states of affairs in a static world.[43]

Can the argument from preventability escape this criticism? The only possibility would be if it could be argued that every standard account of the truth conditions of subjunctive conditionals either is inadequate, or implicitly presupposes dynamic worlds. In the case of the possible-worlds approach, developed by Robert Stalnaker, and by David Lewis,[44] the claim would have to be that such accounts are inadequate, since such accounts are explicitly formulated in terms of static worlds. As such approaches are exposed to strong objections, it may well be possible to sustain that claim. But what about approaches in which causation plays a central role, such as that set out by Frank Jackson?[45] As such accounts appear not to be exposed to really serious objections, it would seem that what one will have to argue is instead that such accounts implicitly presuppose dynamic worlds. But how could that be done? The only possibility, it would seem, would be to show that causal connections themselves presuppose a dynamic world, and thus that no subjunctive conditionals whose truth-makers involve causal connections, or causal laws, could be true in a static world.

If both of these claims could be made good, the second objection to the argument from preventability would be undercut. But not in such a way as to restore the original argument, since if a defence of

43 Or a number of static worlds, if one adopts David Lewis's modal realism, and his account of the truth conditions of subjunctive conditionals.

44 See e.g. Robert Stalnaker, 'A Theory of Counterfactuals', in Nicholas Rescher (ed.), *Studies in Logical Theory* (Oxford: Blackwell, 1968,) and David Lewis, *Counterfactuals* (Cambridge, Mass.: Harvard University Press, 1973.)

45 Frank Jackson, 'A Causal Theory of Counterfactuals', *Australasian Journal of Philosophy*, 55 (1977,) 3–21.

the argument from preventability turns out to presuppose the thesis that events can be causally related only in a dynamic world, then the rest of the argument from preventability is rendered unnecessary.

3.4 Alternative Lines of Argument?

What will happen later causally depends upon what happens now, whereas what has happened in the past does not. Furthermore, and as a consequence, the future would be different if the present were different, whereas the past would not. These two facts play a central role, it seems to me, in generating the belief that, while the past is fixed, the future is open—or at least, not yet actual.

It is therefore natural to try to develop an argument that will move from the premiss that the future and the past differ with respect to their counterfactual dependence upon the present, to the conclusion that the world must be a dynamic one—that is, a world where what facts there are depends upon what time it is. But we have seen that the resulting argument from preventability faces at least two serious obstacles. First, it presupposes that one can prove that an effect cannot precede its cause, and that one can do this in a way that is neutral with respect to the issue of a static world versus a dynamic world. We have seen, however, that such a proof is very problematic. Secondly, the argument from preventability also seems to presuppose that subjunctive conditional statements cannot be true in a static world, and it is hard to see how that can be so, unless it is impossible for states of affairs in a static world to stand in causal relations to one another.

As a consequence, the argument from preventability, at least viewed as an independent argument, appears very problematic. I now want to suggest, however, that the difficulties it faces point towards two other, more promising arguments. First of all, suppose that the first objection to the argument from preventability is sound—namely, that there is no ontologically neutral proof of the impossibility of backward causation. What conclusion should one draw? In particular, should one conclude that backward causation is logically possible? Perhaps. But many philosophers, I think, would be very hesitant to draw this conclusion. Yet what is the alternative? The only possibility, it would seem, is a proof of the impossibility of oppositely directed causal processes that uses, as a premiss, the assumption that the world is a dynamic one. But how could that count as a proof of the impossibility of backward causation? An answer is suggested by the upshot of the second objection to the argument from preventability: if states of affairs can be causally related only in a dynamic world, then an argument for the impossibility of backward causation can make use of the premiss that the world is a dynamic one and still be a satisfactory proof of the impossibility of backward causation.

The second difficulty for the argument from preventability involved the question of whether the relevant conditionals could only be true in a dynamic world. Given that standard accounts of the truth conditions of subjunctive conditionals appear to entail that this is not so, one might very well simply dismiss the argument from preventability as unsound. But, given that, intuitively, the preventability conditionals appear to express an asymmetry that characterizes at least some dynamic worlds, an alternative possibility is that standard accounts of the truth conditions of counterfactuals are either unsatisfactory, or else are not really compatible with a static world.

In short, what I am suggesting is that the central difficulties confronting the argument from preventability point towards two issues that it is crucial to examine. First, if it is not possible to establish that backward causation is logically impossible in an ontologically neutral way, is there any alternative, other than arguing that events can be causally related only in a dynamic world? Secondly, can one really offer a satisfactory account of the truth conditions of counterfactuals without implicitly presupposing an ontology involving a dynamic world? These issues, in turn, suggest two alternative ways in which one might attempt to argue in support of the existence of a dynamic world—arguments that I shall set out, and defend, in the next chapter.

4 Facts, Causation, and Time

We have seen that the argument from preventability, appealing though it may initially seem, is open to at least two serious objections. As it stands, therefore, it does not provide a satisfactory defence of a dynamic view of the world. Is it possible to do better? My goal in this chapter is to argue that it is.

How, then, is a dynamic account of the nature of time to be defended? The approach that I shall offer here consists of two related arguments, each suggested by the problems encountered by the argument from preventability. The first, and the less fundamental, focuses upon the problem of, first, setting out adequate truth conditions for counterfactuals, and then, secondly, of offering a satisfactory rationale for those truth conditions. I shall attempt to show that a satisfactory solution to this problem requires reference to a dynamic world.

The second, and the more central argument turns upon the nature of causation, and the thrust of it is that events can be causally related only in a dynamic world. The argument rests upon three claims concerning causation. The first is that a realist approach to causation is correct: causal relations between events are not logically supervenient upon the non-causal properties of, and relations between, events, nor even upon those states of affairs together with causal laws. The second is that a singularist account of causation is correct: causal relations do not presuppose laws, either probabilistic or non-probabilistic. The third is that causal laws are to be characterized as laws that satisfy certain postulates—namely, those set out earlier in Chapter 3.

The argument based upon those claims, if sound, not only establishes that a dynamic account of the nature of time is correct; it also rules out all of the familiar competitors, both tensed and tenseless, to the view that the past and the present are real, and the future is not. On the other hand, it is not entirely clear that the argument does entail the latter view. At the very least, however, any world in which there can be causal laws must be a very close approximation to a world where the past and the present are real, and the future is not.

The arguments set out here also have implications with respect to the unresolved question of the possibility of backward causation. As that issue is crucial for any tensed account of the nature of time, I shall conclude by briefly returning to that topic.

4.1 The Truth Conditions of Counterfactuals and the Direction of Counterfactual Dependence

What makes it true that, if *A* were the case, *B* would be the case? The question is a difficult one, and some complex accounts have been offered.[46] Here, however, it will suffice to divide the answers up into, first, those accounts in which either the concept of temporal priority or the concept of causal priority plays an essential role, and, secondly, those accounts where this is not so, and where truth conditions are formulated instead simply in terms of some relation of comparative similarity between possible worlds.

One thing that must be delivered by any adequate approach to the analysis of counterfactuals is a satisfactory account of the direction of counterfactual dependence. Thus, we typically view later events as counterfactually dependent upon earlier events, rather than vice versa. For example, consider a situation where there is a match that is dry, in the presence of sufficient oxygen, etc., that could be struck, but is not. We accept the counterfactual claim that, if the match had been struck, it would have lit, but not the claim that, if the match had been struck, it would either not have been dry, or not have been in the presence of sufficient oxygen, etc.

How is this fact about the direction of counterfactual dependence to be explained? According to accounts of the first sort, the truth conditions for counterfactuals involve a reference either to temporal priority, or else to causal priority, and this generates the desired direction for counterfactual dependence. Consider, for example, an account that appeals to temporal priority. What makes it

[46] For one of the most thorough discussions, see Igal Kvart, *A Theory of Counter- factuals* (Indianapolis: Hackett Publishing Company, 1986).

true that, if *A* were the case at time *t,* then *B* would be the case at some later time *t*′? The answer given is that whether this counter- factual is true is determined as follows. Consider all of the possible worlds in which *A* is true at time *t,* and that, first, differ as little as possible from the actual world with respect to what is the case both *before and at time t,* and, secondly, contain the same laws as the actual world, at least from time *t* onwards. Then the counterfactual that, if *A* were the case at time *t,* then *B* would be the case at a later time *t*′ is true if and only if *B* is true at a later time *t*′ in all of those possible worlds.

The crucial feature of this sort of account is that the possible worlds to be considered are ones that differ as little as possible from the actual one with regard to what happens at time *t,* and at earlier times. As a consequence, the true counterfactual concerning the match is the one that says that, if the match had been struck, it would have ignited, rather than the one that says that, if the match had been struck, it would not have been dry, or in the presence of sufficient oxygen, etc., for the latter counterfactual requires worlds that differ more from the actual world at time *t,* or at earlier times, than the former counterfactual. So an approach that assigns a role to temporal priority does deliver the desired direction of counter- factual dependence.

Or rather, it does so if backward causation is impossible. If, on the contrary, Tim can travel back in time and attempt to kill Grandfather, then one wants to say that later events are not always counterfactually dependent upon earlier ones—so, if Tim had not stored nuclear weapons in his time machine before setting off, he would not have had access to any when, in 1921, he attempted to kill Grandfather.

The natural response, if one thinks that backward causation is logically possible, is to shift from an account formulated in terms of temporal priority to one formulated in terms of causal priority. The idea will then be that whether it is true that, if *A* were the case at time *t, B* would be the case at some later time *t*′ will be a matter of what takes place in possible worlds where *A* is the case at time *t* and that, first, diverge as little as possible from the actual world with respect to events that are causally prior to events at time *t,* and, secondly, contain the same laws as the actual world, at least in the case of processes that are causally posterior to time *t.* The result will then be an account that entails that later events will be counterfactually dependent upon earlier events, except in cases involving backward causation.

What about the second sort of account? According to that analysis of counterfactuals, the proposition that, if *A* were the case, then *B* would be the case is true if and only if some worlds in which both *A* and *B* are true are closer to the actual world than any world in which *A* is true, but *B* false. But does this capture the counterfactual dependence of later events upon earlier ones? The following, familiar example seems to suggest that it does not. Nixon could have pressed the button, initiating a nuclear war. What would have happened if he had? The answer is that the world would have been very different. But is this so if one accepts an account of counterfactuals that is in terms of similarity of possible worlds, and that does not bring in either temporal priority or causal priority? It might well seem that, for example, a world where Nixon pushed the button, but that did not lead to a nuclear war, because of, say, a break in a wire, would be closer to our world than one where Nixon pushed the button, there was no subsequent malfunction, and a nuclear holocaust ensued.

This objection has been carefully discussed by David Lewis,[47] and his response to it is roughly as follows. To begin with, worlds may be similar and different in various respects, and there is no one way of weighting those different aspects to arrive at an overall judgement of comparative similarity: different weightings may be appropriate in different contexts. The question that one needs to ask, accordingly, is not whether the present account of counterfactuals, when combined with certain intuitive judgements of similarity, generates satisfactory truth conditions, but whether there is some way of weighting different aspects in arriving at an overall judgement of the comparative similarity of worlds that will do the job. Lewis claims that there is, and the recipe that he suggests is as follows. First, there would seem to be two factors that are relevant to judgements as to how similar two worlds are. One is the extent to which their histories agree throughout stretches of time. The other is the extent to which the generalizations that express laws in one world are true in the other world. Secondly, in the case of each of these two factors, a distinction needs to be made. With regard to the first factor, we need to distinguish between an exact match

47 David Lewis, 'Counterfactual Dependence and Time's Arrow', *Noûs,* 13 (1979,) 455–76.

through a stretch of time, and a merely partial match. With regard to the second factor, we need to distinguish the case where a generalization that expresses a law in one world is violated in a single, small, localized way in the other world, and the case where there are massive, widespread violations. Finally, having drawn these distinctions, we can say that the factors that make for comparative similarity, ranging from the most important to the least important, are as follows: (1) the absence of large-scale violations in one world of generalizations that express laws in the other world; (2) exact match of the histories of the two worlds throughout a stretch of time; (3) the absence of small, localized violations in one world of generalizations that express laws in the other world; (4) partial match of the histories of the two worlds throughout a stretch of time.

Given this account of the relevant factors, and how they should be weighted, the Nixon case appears to turn out right. For consider a world where Nixon pushes the button, but there is no war, because of a small break in a wire. Here we would have a small violation of generalizations that express laws in our world, and, if we thereby achieved a complete match of the future history of that world with the relevant future history of the actual world, then it would follow that, if Nixon had pushed the button, no nuclear war would have taken place. But we will not have an exact match of future histories, since, though Nixon's pressing the button in the other world does not give rise to a nuclear war, it does initiate many less conspicuous causal chains that give rise to events that do not occur in the actual world. There will, in short, be only a partial match, and the above recipe tells us that a partial match does not contribute as much to the similarity of two worlds as does the absence of violations of generalizations that express laws in one world.

But what about a world where not only does Nixon's pushing the button not result in a nuclear war, but where it leaves no traces? There is no transference of heat from Nixon's finger to the button; light waves miraculously alter their direction and location to what would have been the case had Nixon not pushed the button; and, in general, all the many small effects of Nixon's action are somehow cancelled. Now we will have an exact match of the future history of the world we are considering with that of the actual world. But it is not achieved by means of a small violation of a generalization that expresses a law in our world; it requires, rather, many violations, and the above account of the weight to be assigned to different factors tells us that even an exact match of histories is not worth the cost of such widespread violations.

The upshot is that it would seem to be true, given Lewis's recipe for measuring similarity of worlds, that, if Nixon had pressed the button, then there would have been a nuclear war. And, if the account works here, why not in general? In which case, it would seem that the comparative-similarity-of-worlds approach does capture the counterfactual dependence of later events upon earlier ones.

It is not, of course, sufficient that later events be counterfactually dependent upon earlier ones: it must also be the case that the converse does not hold, that earlier events are not counterfactually dependent upon later ones. So we need to ask, for example, whether it is true or not, given the present account, that, if Nixon had pressed the button, then all of past history would have been different in certain ways. The answer is that this would not be true, and the reason is that only a small violation of generalizations that express laws in the actual world would be required to have a complete match of the past history of a relevant possible world with the past history of the actual world. And an exact match is worth the cost of a small violation in one world of generalizations that express laws in the other world.

But why is it that we can achieve an exact match of past histories at the cost of only a small violation, whereas an exact match of future histories requires a large violation? The reason is that, in our world, events almost always generate multiple diverging causal chains, whereas events are only rarely the result of multiple converging causal chains. As a consequence, only a small violation of generalizations that express laws can, so to speak, preserve earlier history, whereas a large-scale violation, destroying all of the many causal chains, is necessary to preserve later history.

As a consequence, the comparative-similarity-of-worlds approach to counterfactuals, given Lewis's proposal concerning the weighting of factors in the determination of comparative similarity, appears, at least initially, to capture the asymmetry of counterfactual dependence. But does it really do so? I believe not. In attempting to capture the asymmetry without appealing to either temporal priority or causal priority, Lewis has to appeal to what is merely a *contingent* fact about our world—namely, that causal forks are almost invariably open towards the future, rather than towards the past. Events typically have multiple effects, but rarely have multiple causes: witness the frequency of outgoing spherical wave fronts, produced, for example, by sources of light, in contrast to that of incoming wave fronts. But, given that this is a contingent fact, what about worlds where it is not so? What about a world where events typically had multiple causes, but never had multiple effects? On the present account, it would follow that earlier events were counterfactually dependent upon later ones, rather than vice versa—which is surely unacceptable. Or what about a world where events were causally related, but never had either multiple causes or multiple effects? The present account would entail that in such a world later events would not be counterfactually dependent upon earlier events, nor vice versa, since, according to Lewis's proposals for comparative similarity, a perfect match of particular facts throughout a stretch of time counts for more than the absence of a small miracle. And this conclusion is surely also unacceptable.

Lewis's response to this objection is that neither of the worlds just described is logically possible. Why? The reason is that, first, the direction of causation is by definition determined by the direction in which open nomological forks are oriented, and, secondly, the direction of time is, in turn, fixed by the direction of the majority of causal processes. So the first sort of world—where nomological forks are open towards the past, rather than towards the future—is logically impossible, since the direction in which they are pointed *is* the direction of causation, and that in turn is the direction of time. So one has, once again, a world where events typically have multiple effects, but rarely or never have multiple causes.

What about the second sort of world? It too is logically impossible. Since causal processes cannot exist without having a direction, it follows, if the direction of causation is given by the direction of open forks, that a world devoid of forks is a world devoid of causation. So it will not be a world where there is any asymmetry of counterfactual dependence.

Lewis's defence of the comparative-similarity-of-worlds approach to counterfactuals presupposes, in short, a reductionist approach to causation—and, specifically, one where the direction of causation is given by certain patterns exhibited by events. In the next section, however, I shall be arguing that any reductionist approach to causation—and, in particular, to the direction of causation—is exposed to decisive objections. If those criticisms are right, we have good grounds for concluding that any comparative-similarity-of-worlds approach to counterfactuals that does not also bring in either temporal priority or causal priority cannot successfully capture the asymmetry of counterfactual dependence.

Let us turn, then, to the other approach to counterfactuals, and ask whether accounts that incorporate reference either to temporal priority or to causal priority can provide a satisfactory approach to the asymmetry of counterfactual dependence. Initially, the prospects might seem very promising, since such accounts certainly generate the correct truth-values for counterfactuals in worlds where events have multiple causes, rather than multiple effects, and in worlds where events have neither multiple causes nor multiple effects. But is it enough simply to generate the desired truth-values? Does one not need, in addition, some explanation of why those truth-values are the right ones? Counterfactuals supply answers to questions concerning what would have been the case if the world had been different in certain ways, and surely it must be possible to offer some account of *why* the answers that we intuitively take to be the correct ones are in fact correct, or at least justified. Merely to provide an account that results in an assignment of truth-values that we intuitively take to be the right ones does not do this.

The problem here becomes especially vivid, I think, if one considers counterfactuals that are concerned, not with how the world would have been different if some event had occurred, or some temporally locatable state of affairs had obtained, but with how things would be different if the world contained another law. Consider, for example, the following, very simple world—a partial picture of which is given in Fig. 4.1. First, it contains events of only three types—*P*, *Q*, and *R*—no two of which can exist in the same location. Secondly, there are only two laws: events of type *P* caus- ally give rise to later events of type *Q*, and events of type *Q* causally give rise to later events of type *P*. So there are no laws involving events of type *R*. Thirdly, events of all three types sometimes occur without having any cause. Fourthly, events of types *P* and *Q* have occurred uncaused on a number of occasions. So, in virtue of the

Fig. 4.1

World *W*

Locations	Times: 1		2		3		4		5		6		7		
(1)					*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(2)	*R*		*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(3)	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(4)					*R*		*Q*	→	*P*	→	*Q*	→	*P*	→	etc.
(5)			*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.

Fig. 4.2

World W_1

Locations	Times: 1		2		3		4		5		6		7		
(1)					*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(2)	*R*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(3)	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(4)					*R*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(5)			*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.

Fig. 4.3

World W_2

Locations	Times: 1		2		3		4		5		6		7		
(1)					*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(2)	*R*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(3)	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.
(4)							*Q*	→	*P*	→	*Q*	→	*P*	→	etc.
(5)			*P*	→	*Q*	→	*P*	→	*Q*	→	*P*	→	*Q*	→	etc.

two laws that the world contains, there are a number of causal chains in which events of type *P* alternate with events of type *Q*, and which have an initial event, but which are unending in the forward direction. Fifthly, there are only two events of type *R*. One occurs before an event of type *P* that is an initial event in a *P*–*Q* causal chain, while the second occurs before an event of type *Q* that is an initial event in a *Q*–*P* causal chain. Finally, let us assume that the temporal distance between the two events of type *R*, and the corresponding events of types *P* and *Q*, respectively, which follow the events of type *R,* but which are not caused by it, is precisely *d* units.

Given such a world, how would things be different if there were an additional law to the effect that events of type *R* causally give rise, at a temporal distance of precisely *d* units, to events of type *P*? The two possible worlds that need to be considered are described in Figs 4.2 and 4.3. In both world W_1 and world W_2 the event of type *R* that occurs at location (2) is now causally connected with the later *P–Q* causal chain, in virtue of the fact that the temporal distance between the corresponding events of types *R* and *P* in world *W* is precisely equal to the relevant temporal gap involved in the law that has been added. But W_1 and W_2 differ with regard to what happens to the event of type *R* at location (4) in the original world. In world W_1 there is still an event of type *R* at location (4), which gives rise to another *P–Q* causal chain that replaces the previous *Q–P* causal chain that existed at location (4) in world *W.* In world W_2, by contrast, there is still a *Q–P* causal chain at location (4), but no longer any event of type *R* at that location.

Which of these worlds correctly represents the way things would be if a law that events of type *R* causally give rise, at a temporal distance *d,* to events of type *P* were added to the original world? If the comparative-similarity-of-worlds approach to counterfactuals were correct, the answer would be W_2, rather than W_1, since the only difference between W_2 and the original world, *W,* with regard to what events take place is that there is one event of type *R* that occurs in *W* but not in W_2, whereas, while W_1 agrees with *W* with respect to that event of type *R,* it disagrees with *W* in that an infinite number of events of types *P* and *Q* that occur in *W* have been replaced, respectively, by events of types *Q* and *P.* So W_2 is much closer to the original world than W_1 is, and this is true not merely on the account of similarity proposed by Lewis, but on any sensible measure of the comparative similarity of worlds.

What if one adopts instead an approach to counterfactuals that assigns an essential role to either temporal priority or causal priority? When one is dealing with a counterfactual whose antecedent is about an event with a certain specified temporal location, the basic idea is to keep things as similar as possible to the actual world up to, and including, that moment in time, and then to allow the world at later times to be determined, as far as possible, by the relevant causal laws. In the counterfactual we are now considering, however, the antecedent, rather than referring to an event at some specified time, refers instead to a new law, so the question arises as to how this general approach to counterfactuals is to be applied in such a case. A natural answer is that, when no time is mentioned in the antecedent, one should try to match the past histories until one is forced to diverge. In the present case, that will mean that W_1 is the relevant world, since it diverges from world W only at time 4, whereas world W_2 diverges earlier—at time 3.

The latter answer is surely the correct one. But what is the underlying rationale? Why should one attempt to match the *earlier* history of the original world W until one is forced to diverge from it? What is the reason for this particular temporal bias? Why not try to match the *later* history of the original world, until one is forced to diverge from it? Or why not have no temporal bias at all, and adopt instead the comparative-similarity-of-worlds approach, in which the relevant world is the one—among those in which the new law obtains—that diverges as little as possible from the original world?

What rationale can be offered? In approaching this issue, let us begin by assuming that the world is not a dynamic world, but a static one—so that all events, past, present, and future, are equally real. Consider now the view that it is world W_1, not W_2, that correctly specifies how things would be if it were a law that events of type R causally give rise to events of type P. In world W there are two events of type R, neither of which causes an event of type P. One of those two events happens to be followed by an event of type P at the right temporal distance, so that for that first event of type R all that needs to be done in constructing the desired possible world is to connect that event causally with the succeeding event of type P. But the other event of type R is not so fortunately situated, being followed instead by an event of type Q. As a consequence, one must either eliminate the event of type R, or else eliminate an infinite causal chain of the Q–P variety, and introduce in its place an infinite causal chain of the P–Q variety. In each case, the alternative possible worlds involve the absence of something that is actual in the original world, the difference being that the divergence in the case of W_2 involves the elimination of one event, while the divergence in the case of W_1 involves eliminating an infinite number of events, and then introducing an infinite number of events that did not exist in the original world. In saying that W_1 is the right world, then, one is opting for much greater divergence from the original world than if W_2 were the right world. So one is not merely exhibiting a certain temporal bias for which no justification has been offered. One is also selecting the alternative world that is much more dissimilar from the original world. This, too, surely requires justification. But if all events—past, present, and future—are equally real, it is very hard to see how any justification can possibly be offered.

Let us now assume instead that our worlds are dynamic ones. We imagine altering world *W* by adding the law that events of type *R* causally give rise, at an appropriate temporal distance, to events of type *P*. The new dynamic world begins to develop, gradually growing by the accretion of new states of affairs—the underlying idea being that nothing is to be changed unless a change is necessitated by the totality of the laws that govern the development of the world. No change from the original world is required—aside from introducing a causal relation between the event of type *R* at location (2) and the succeeding event of type *P*—until we reach the event of type *R* at location (4) and time 3. The law that has been added then entails, given that event of type *R,* that there must be an event of type *P* at location (4) at time 4. So that event must be added to the world. The nomological incompatibility of events of types *P* and *Q* then entails that the event of type *Q* must be eliminated from that spatiotemporal location. The other two laws, together with that nomological incompatibility, will then entail the step by step replacement, at location (4), of events of type *P* by events of type *Q,* and vice versa.

The idea, in short, is that, if all events—past, present, and future—are equally actual, then there is no way that one can justify the massive divergence from the original world that appears to be required by appealing to the presence of the earlier event of type *R,* whereas, if the world is a dynamic one—and, specifically, one where past and present events are actual, but future events are not—then the required divergence can be satisfactorily explained, since then there is a time when the event of type *R* is real, but nothing later than it is, and the actuality of the event of type *R* at that moment, together with the new law, necessitates how the future must be.

To sum up. There are two main approaches to the task of formulating truth conditions for counterfactuals. The one rests simply upon the idea of comparative similarity of worlds, whereas the other makes essential use either of the concept of temporal priority, or of that of causal priority. In the case of the former, there is a relatively clear rationale that can be offered for the proposed truth conditions, since it is rather natural to think that the way to answer the question of how the world would be different if certain things were the case is by considering the worlds in which those things are the case, and that are closest to the actual world. This rationale, moreover, is perfectly compatible with the world's being a static one. This approach to counterfactuals, however, fails to deliver the correct truth-values in a variety of cases, and it must therefore be rejected.

The second approach, on the other hand, does generate the correct truth-values, but it does so by a method with a built-in bias for which it offers no justification. Moreover, when the issue of justification is pursued, it becomes clear that it is not possible to offer a justification of the second approach if one assumes that the world is static, rather than dynamic.

The overall conclusion, accordingly, is that the only satisfactory account of the truth conditions of counterfactuals is one that presupposes that the world is a dynamic one. So, if there is good reason for thinking that counterfactuals, as we actually employ them, are sometimes true, that is also a good reason for concluding that the world is a dynamic one.

4.2 The Nature of Causation: I. Realism

The main argument that I wish to develop in this chapter turns upon the question of how certain postulates concerning causal laws—namely, those set out in Section 3.2—can possibly be true. It is crucial to show, accordingly, that there is good reason to accept the postulates in question. One way of doing this is to argue, as I did earlier, that there is a very plausible intuition concerning the relation between causal laws and probabilities that those postulates capture. But my argument here will obviously be strengthened if I can offer other reasons for accepting those postulates, and, of the additional reasons that might be advanced, the most important is that the postulates do provide an analysis of the direction of causation. For that consideration to have any force, however, it must be shown that reductionist approaches to causation are untenable—since reductionist approaches offer alternative, and in many cases simpler accounts of the direction of causation.

Another reason why I need to defend a realist approach to causation is to make good an earlier promissory note—for, in arguing against the account of the direction of counterfactual dependence that Lewis offers, I appealed at a crucial point to the claim that no reductionist account of causation can be sustained.

In this section, accordingly, I shall begin by briefly explaining the distinction between realist and reductionist approaches to causation, and then go on to offer three objections to reductionist accounts. The first two turn upon the problem of the direction of causation; the third consists of a counterexample to the supervenience claims that lie at the heart of reductionist approaches.

First, then, the distinction between realism and reductionism with respect to causal relations. Reductionism comes in two forms, depending upon what the reduction base is claimed to be:

I. Strong Reductionism with Respect to Causal Relations
Any two worlds that agree with respect to all of the non-causal properties of, and relations between, particular events or states of affairs must also agree with respect to all of the causal relations between states of affairs. Causal relations are, in short, logically supervenient upon non-causal properties and relations.

II. Weak Reductionism with Respect to Causal Relations
Any two worlds that agree both with respect to all of the non-causal properties of, and relations between, particular events or states of affairs, and with respect to all causal laws, must also agree with respect to all of the causal relations between states of affairs.

Realism with regard to causal relations, then, consists in the rejection of these two reductionist theses.

4.2.1 Direction of Causation Objections to Reductionism

I shall set out two arguments which focus upon the direction of causation. The thrust of the first is that there are possible causal worlds to which reductionist accounts of the direction of causation do not apply, while that of the second is that there are other possible causal worlds for which reductionist accounts yield incorrect answers with respect to the direction of causal processes.

4.2.1.1 Causation and Simple Worlds

Our world is a complex one, with a number of features that might be invoked as the basis of a reductionist account of the direction of causation. First of all, it is a world where the direction of increase in entropy is the same in the vast majority of isolated or quasi- isolated systems. Secondly, the temporal direction in which order is propagated—such as by the circular waves that result when a stone strikes a pond, or by the spherical wave fronts associated with a point source of light—is invariably the same. Thirdly, consider the causal forks that are involved when two events have either a common cause, or a common effect. A fork may be described as open if it does not involve both a common cause and a common effect. Then it is a fact about our world that all, or virtually all, open forks are open in the same direction—namely, towards the future.[48]

Can such features provide a satisfactory account of the direction of causation? One objection arises out of possible causal worlds that are much simpler than our own. Consider, for example, a world that consists of a single particle, and in which there are no force fields. Such a world would still involve causation, since the identity over time of the particle depends on causal relations between its temporal parts. Alternatively, consider a world where Newton's laws of motion are true, but where the only forces are contact forces, and which consists of two objects, connected by a rod, that rotate endlessly about one another. Each object will undergo acceleration of a constant magnitude, due to the force exerted on it by the connecting rod, so the world is certainly a causal one. But both of these worlds are utterly devoid of changes of entropy, of propagation of order, and of open forks. Hence there

[48] For the first, see Hans Reichenbach, *The Direction of Time* (Berkeley and Los Angeles: University of California Press, 1956), 117–43, and Adolf Grünbaum, *Philosophical Problems of Space and Time,* 2nd edn. (Dordrecht: D. Reidel, 1973), 254–64. For the second, see Karl Popper, 'The Arrow of Time', *Nature,* 177 (1956), 538. For the third, see Reichenbach, *Direction of Time,* 161–3, and Wesley C. Salmon, 'Why Ask "Why?"?', *Proceedings and Addresses of the American Philosophical Association,* 51/6 (1978,) 683–705, at p. 696.

is no hope of basing an account of the direction of causation upon any of those features.

What account can a reductionist give, then, of the direction of causation in the case of such worlds? The answer is that there is only one possibility, since, given that the simple world just described is completely symmetrical in time, events themselves do not exhibit any structure that serves to distinguish between the direction from cause to effect and the inverse one from effect to cause. So, if the direction of causation is to be reduced to anything else, it can only be to the direction of time. But then, one will have to be a realist with respect to the latter. There will be no possibility of reducing the direction of time to any structure present in the arrangement of events in time.

But what if a reductionist, to escape the present argument, does appeal to the direction of time? Then one can ask what it is that gives time its direction, given that it is not constituted by patterns exhibited by events in time. If one were a realist with regard to causation, one could hold that the direction of time is given by the direction of causation. But in the present context, the latter view would land the reductionist in a circle. One option would be to hold that directionality is an intrinsic feature of the earlier-than relation. But can this view be sustained? That it is an intrinsic feature of a relation that it is asymmetric is perhaps acceptable—though I am inclined to think that it is preferable if all necessary truths, with the exception of a posteriori necessary truths, if any, can be treated as analytic, and this entails, I believe, that it can never be an ultimate, inexplicable fact about a relation that it is asymmetric. The main point here, however, is that, even if one treats it as fact, not susceptible of any further explanation, that the earlier-than relation is necessarily asymmetric, that does not provide one with any account of *the* direction of time, of why it is that the direction of time is the direction from earlier events to later, rather than vice versa.

A second option at this point is to adopt a dynamic view of time, and to characterize the direction of time in terms of differences with regard to what facts there are. In Section 6.1 I shall be arguing that such an account of the direction of time is not satisfactory. But, in the context of the central argument that I am setting out in this chapter, it does not really matter whether or not that is so, since, if the direction of causation is to be analysed in terms of the direction of time, and the latter is to be explained in terms of a dynamic conception of time, then it follows that there is a shorter route to the result I am attempting to establish—that is, to the view that events can be causally related only in a dynamic world.

4.2.1.2 Inverted Worlds and the Direction of Causation

It is the year 4004 bc. A Laplacean-style deity is about to create a world rather similar to ours, but one where Newtonian physics is true. Having selected the year ad 2000 as a good time for Armageddon, the deity works out what the world will be like at that point, down to the last detail. He then creates two spatially unrelated worlds: the one just mentioned, together with another whose initial state is a flipped-over version of the state of the first world immediately prior to Armageddon—that is, the two states agree exactly, except that the velocities of the particles in the one are exactly opposite to those in the other.

Consider, now, any two complete temporal slices of the first world, *A* and *B,* where *A* is earlier than *B*. Since the worlds are Newtonian ones, and since the laws of Newtonian physics are invariant with respect to time reversal, the world that starts off from the reversed, ad 2000 type state will go through corresponding states, *B** and *A*,* where these are flipped-over versions of *B* and *A* respectively, and where *B** is earlier than *A**. So, while the one world goes from a 4004 bc, Garden of Eden state to an ad 2000, pre-Armageddon state, the other world will move from a reversed, pre-Armageddon type state to a reversed, Garden of Eden type state.

In the first world, the direction of causation will coincide with such things as the direction of increase in entropy, the direction of the propagation of order in non-entropically irreversible processes, and the direction defined by most open forks. But in the second world, although the direction of causation runs from the initial state created by the deity—that is, the flipped-over ad 2000 type state—through to the flipped-over 4004 bc type state, the direction in which entropy increases, the direction in which order is propagated, and the direction defined by open forks will all be the opposite one. So, if any of the latter were used to define the direction of causation, that would generate the wrong result in the case of the second world.

As with the ‘simple-universes’ argument, it is open to a reductionist to respond by holding that the direction of causation is to be defined in terms of the direction of time. But here, as before, this response is available only if one is prepared to adopt a realist view of the direction of time, since any reductionist account of the latter in terms of the structure exhibited by events in time cannot possibly generate the right results in both cases for two worlds that are 'inverted twins'—such as the two worlds just described.

4.2.2 Underdetermination Objections to Reductionism

The second main type of objection to reductionism with respect to causal relations involves what may be referred to as problems of underdetermination. What objections of this second kind attempt to establish is that there can be worlds that agree with respect to, first, all of the non-causal properties of, and relations between, events, secondly, all causal laws, and, thirdly, the direction of causation, but which disagree with respect to some of the causal relations between corresponding events.

Elsewhere, I have set out four objections of this general sort,[49] but one of those arguments should suffice to give one a good idea of the sorts of considerations upon which such underdetermination objections to reductionism typically rest.

4.2.2.1 The Argument from the Possibility of Indeterministic Laws

A world with at least some basic probabilistic laws is necessarily an indeterministic world, so the present argument could equally well employ the assumption that probabilistic laws are logically possible. But there can be indeterministic laws that are not probabilistic. For example, it might be a law that an instance of property *P* will give rise *either* to an instance of property *Q or* to an instance of property *R,* without its being the case that there is any number *k* such that it is a law that an instance of property *P* will give rise, with probability *k,* to an instance of property *Q*. Accordingly, since indeterministic laws need not be probabilistic, and since the concept of a probabilistic law has been thought by some to be more problematic than that of a non-probabilistic law, it seems preferable to start from the slightly more modest assumption.

[49] Michael Tooley, 'Causation: Reductionism versus Realism', *Philosophy & Phenomenological Research,* suppl. 50 (1990,) 215–36.

Given that probabilistic laws are indeterministic, and that quantum physics seems to lend strong support to the idea that the basic laws of nature may well be probabilistic, the assumption that indeterministic causal laws are logically possible is surely very plausible. Let us consider, then, a world with only the following two basic causal laws—both of which, though not probabilistic, are indeterministic:

For any object *x*, *x*'s having property *P* for a temporal interval of length $\Delta\, t$ either causes *x* to acquire property *Q*, or else causes *x* to acquire property *R*, but does not do both;

For any object *x*, *x*'s having property *S* for a temporal interval of length $\Delta\, t$ either causes *x* to acquire property *Q*, or else causes *x* to acquire property *R*, but does not do both.

Suppose now that *a* is an object in such a world, that *a* has property *P*, but not property *S*, throughout some interval of length $\Delta\, t$, and then acquires property *Q*, but not property *R*. In view of the first of the above laws, *a*'s acquisition of property *Q* must have been caused by its possession of property *P*. Similarly, if *a* had property *S*, but not property *P*, throughout some interval of length $\Delta\, t$, and then acquired property *Q*, but not property *R*, then, in view of the second law, *a*'s acquisition of property *Q* must have been caused by its possession of property *S*. But what if *a* had acquired properties *P* and *S* at the same time, and had retained both throughout an interval of length $\Delta\, t$? If *a* then acquired only property *Q*, there would be no problem: it would simply be a case of causal overdetermination. Similarly, if it acquired only property *R*. But what if the situation were as follows:

Time *t* through time $(t + \Delta\, t)$			Time $(t + \Delta\, t)$
Pa and *Sa*			*Qa* and *Ra*

Here, *a* has acquired *both* property *Q and* property *R*, and, as a result, there are two possibilities concerning the relevant causal relations:

Possibility 1		Possibility 2
Pa causes *Qa*, and *Sa* causes *Ra*		*Pa* causes *Ra*, and *Sa* causes *Qa*

One is therefore confronted with the question of what the actual causal relations are. Was it the possession of property *P*, for the appropriate interval, that caused the acquisition of property *Q*, and the possession of *S* that caused the acquisition of *R*? Or was it, instead, the other way around? Given a reductionist view, however, no answer is possible, for the causal laws in question, together with the non-causal properties of the object, and its non-causal relations to other objects, plus facts about the direction of causation in all potential causal processes, do not entail that it was one way rather than the other.

What might a reductionist say to this argument? One response would be that, where an object acquires property *P* and property *S* at the same time, and then, after the relevant interval, acquires both property *Q* and property *R,* there are *no* causal relations at all involved. But given that, for example, the first of the above laws can obtain only if the possession of property *P always* causes an event that is of one of two sorts, this response would seem to entail that indeterministic laws of the above sort are not really logically possible—a claim that surely needs to be supported by some independent argument. Moreover, given that the present argument can easily be formulated in terms of probabilistic laws, the latter would also have to be rejected as incoherent.

Another response would be that, although there are causal relations in the situation, they are not quite as determinate as one might initially assume. The idea here would be that, in the crucial situation where the object has both *P* and *S,* and then acquires both *Q* and *R,* it is not the case either that the possession of *P* for the relevant interval causes the acquisition of *Q,* or that it causes the acquisition of *R.* What is true, rather, is simply that the possession of property *P* for the relevant interval causes the state of affairs which involves either the acquisition of property *Q,* or the acquisition of property *R.*

But this response is also very dubious, since it appears to involve a confusion between, on the one hand, certain non-linguistic, non-conceptual entities which are the relata of causal relations—namely, states of affairs—and, on the other, certain linguistic expressions that may be used to designate states of affairs. Thus, in referring to states of affairs, one may certainly use disjunctive expressions to pick them out—such as the expression 'the state of affairs that involves either *a*'s acquisition of property *Q,* or *a*'s acquisition of property *R*'. But, while states of affairs can be referred to in that way, it makes no sense to speak of states of affairs as themselves disjunctive in nature. The only states of affairs that can be picked out by the disjunctive expression in question are, first, the state of affairs that consists of *d*'s acquiring property *Q*, and, secondly, the state of affairs that consists of *d*'s acquiring property *R*. Accordingly, if the situation described above is to involve causal relations falling under the relevant laws, it must be the case either that the possession of property *P* for the relevant interval caused the acquisition of property *Q*, or that it caused the acquisition of property *R*, and similarly for property *S*.

4.2.3 Realism or Reductionism?

Reductionist approaches to causation have dominated the field. How is that to be explained? At least three reasons come to mind. The first is that most philosophers who have been realists with regard to causation have been so because they thought that the relation of causation was observable. But that is a position that has never had much appeal, and for good reason, for, as we shall see in the next section, there is a very strong argument against the view that one can be directly acquainted with the relation of causation.

But if causation is not immediately observable, then to be a realist with regard to causation one needs a satisfactory realist account of the meaning of theoretical terms. A second reason, then, why reductionist approaches to causation have held sway is that it is only relatively recently that realist accounts of theoretical terms have been available.

In many other areas, however, the shift from reductionist to realist approaches has been swift indeed, once it was realized that a realist interpretation of theoretical terms was a viable option. Why has no comparable shift taken place in the case of causation? The answer, I suggest, is that some of the key postulates that are needed for a complete theory of causation have not been easy to find, and, in the absence of a complete theory, a realist approach to causation must remain at best a hope.

The arguments set out above, however—along with other arguments—constitute, I believe, a very powerful prima-facie case against reductionism. In addition, I think that it is now possible to specify the postulates that are needed for a satisfactory theory of causation. If that is right, then realism must surely be the preferred alternative in the philosophy of causation.

4.3 The Nature of Causation: II. A Singularist Approach

To adopt a singularist view of causal relations is to hold that it is logically possible for two events to be causally related without that relation being an instance of any law, either basic or derived. This in turn suggests, and would seem to support, a more radical conclusion—namely, that it must be possible for events to be causally related even in a world that contains no laws at all.

Realists with regard to causation have traditionally been singularists as well, for the following reason. First, realists have usually held that causal relations are observable, and that, at least in some cases, one can tell by observing a single sequence of events that two events are causally related. Secondly, if causation is thus observable, how could causal relations presuppose causal laws? For if causation did presuppose causal laws, it would follow that one could know that a law existed, and hence that some exceptionless regularity obtained, on the basis of a single observation. This is not, of course, to say that one would know exactly what the law in question was. But even the knowledge that there was some law or other would not seem to be something that one could acquire on the basis of observing a single sequence of events.

In short, if one were a realist because one believed that causation was directly observable, then one would also have a reason for holding that causal relations do not presuppose causal laws. But this does not seem to me to be a satisfactory reason for accepting a singularist approach, since I do not think that causation is immediately observable. Causation is, I believe, a theoretical relation, and, if this is right, it is an open question whether a singularist approach to causation is correct.

The discussion in this section is divided into three parts. In the first, I shall sketch my reasons for holding that the relation of causation is not immediately observable. In the second, I shall set out an argument in support of a singularist approach to causation. Finally, in the third part, I shall briefly outline the singularist approach that seems to me most promising.

4.3.1 Causation and Immediate Observation

What is it for a property or relation to be immediately observable? One answer is that something is immediately observable only if it can be immediately given in one's experience. This is a very strong sense of 'immediately observable'. A weaker sense would require, not that the property or relation itself be capable of being immediately given in experience, but that it be closely and analytically connected with something that could be so given. In this latter, weaker sense, if colours are interpreted, for example, as powers to produce experiences of certain sorts in normal perceivers, then colours will qualify as immediately observable even though they could not themselves, as powers, be immediately given in one's experience.

Can the relation of causation be immediately given in experience? A standard empiricist argument for holding that it cannot runs as follows. First, to say that a property or relation is immediately given in an experience is to say that it is part of the experience itself—where the latter is so understood that a property or relation can be part of an experience E only if it would also have to be part of any experience that was phenomenologically indistinguishable from E. Secondly, given any experience E whatever—be it a perception of external events, or an introspective awareness of some mental occurrence, such as an act of willing, or a process of thinking—it is logically possible that appropriate, direct stimulation of the brain might produce an experience, E^*, that was qualitatively indistinguishable from E, but which did not involve any causally related elements. So, for example, it might seem to one that one was engaging in a process of deductive reasoning, when, in fact, there was not really any direct causal connection at all between the thoughts themselves—all of them being caused instead by something outside of oneself. It then follows, from these two premises, that causal relations cannot be immediately given in experience in the sense indicated.

But, if causation cannot be immediately given in experience, is it at least immediately observable in the way that colours, for example, are? That is, is the relation of causation analytically connected with some property or relation that is a reliable indicator, or criterion, of the presence of the relation of causation in the way that certain features of one's experience are reliable indicators, or criteria, that something has a certain colour, or that external objects stand in various spatial relations?

If an object's colour were changed, and no compensating changes were made, then one's experiences would be different. Similarly, if objects are rearranged, then one's experiences of those objects will be different, other things being equal. But suppose that God were to calculate the forces that two physical objects would exert upon each other when they collided, and then, rather than allowing them to collide, intervened to suppress the relevant forces, and instead brought about their subsequent locations by direct action. If the relation of causation gave rise to some reliable indicator of its presence, then one's experience would be different in a case where God prevented two objects from causally interacting. Yet surely it is clear that, in the sort of case described, there would be no difference at all in one's experience. God's suppression of the causal interaction between objects would go undetected, as far as ordinary observation is concerned. It follows, accordingly, that the relation of causation is not immediately observable even in the sense in which features like colours and spatial relations are immediately observable.

4.3.2 An Argument for a Singularist Conception of Causation

If causal relations are not immediately observable, then it is not possible to argue for a singularist view of causation by appealing to the premiss that knowledge of the existence of laws requires more than a single observation. But I believe that there are other, more satisfactory arguments, one of which I shall now describe.

The basic strategy involves attempting to establish a singularist conception of causation by offering reasons for rejecting the alternatives. We need to consider, therefore, just what the alternatives are. Let us begin, then, with what I shall refer to as the supervenience view. According to it, events cannot be causally related unless that relation is an instance of some law. But, in addition, whether or not two events are causally related is logically determined by the non-causal properties of the two events, and the non-causal relations between them, together with the causal laws that there are in the world. The supervenience view of causal relations involves, in short, the following two theses:

(1) Causal relations presuppose corresponding causal laws;
(2) Causal relations are logically supervenient upon causal laws plus the non-causal properties of, and relations between, events.

The obvious alternative to the supervenience view is the singularist view, which can be defined in terms of the rejection of both of the above theses. Traditionally, the supervenience view and the singularist view have been treated as the only alternatives on offer with respect to the question of the relation between causal relations and causal laws. But are they the only possibilities? It would seem not, since the first of the above theses appears to be compatible with a denial of the second. If so, then there is a third view, and one that is intermediate between the singularist position and the supervenience position—the view, namely, that causal relations presuppose corresponding causal laws, even though causal relations are *not* logically supervenient upon causal laws together with the non-causal properties of, and relations between, events.

The relevance of this for the argument that I wish to offer in support of a singularist view is that the argument involves two distinct parts—one directed against the supervenience view, and the other directed against the intermediate view. The first part was set out earlier: it consists of the underdetermination argument against reductionism. That argument, if sound, establishes that thesis (2) is false. But that argument does not show, on the other hand, that thesis (1) is false, since all of the causal relations involved in the case to which I appealed in that argument fall under causal laws. Some other line of argument is needed, then, if the intermediate view is to be rejected. But what form can such an argument take?

The only possibility that I can see here is a somewhat modest argument which turns upon the claims, first, that the intermediate view involves a somewhat richer ontology than the singularist position, and, secondly, that the intermediate position has to postulate an entailment that appears incapable of being explained.

First, then, the question of ontology. Let us begin with the singularist view. It claims that causal relations, rather than causal laws, are in some sense primary. So it is certainly committed to postulating basic causal facts that involve states of affairs standing in causal relations. But what about causal laws? What ontology do they introduce? If a regularity view of laws were tenable, nothing would be needed beyond regularities involving the relation of causation. However, as a number of philosophers have argued, regularity accounts of the nature of laws are exposed to very strong objections.[50] Let us suppose, therefore, that a singularist account of causation is combined with the view that laws—either causal or non-causal—are relations among universals. The result will be that a singularist approach involves, in the case of any world that contains laws, the postulation of two sorts of basic facts—consisting, on the one hand, of relations between particular states of affairs, and, on the other, of relations between universals. But, given these two types of basic facts, it does not need a third type to deal with *causal* laws, since on the singularist view these can be treated simply as laws where one of the universals that enters into the law is the relation of causation.

How does the intermediate account compare with respect to the ontology that it must postulate? The answer, I believe, is that the ontology is necessarily more complex. First of all, since the intermediate position involves a denial that causal relations between events are logically supervenient upon causal laws together with the totality of non-causal facts, it is committed, like the singularist approach, to postulating a special relation that holds between states of affairs. Secondly, like the singularist approach, it must postulate states that serve as the truth-makers for statements of laws. But thirdly, unlike the singularist approach, it would seem that the intermediate approach cannot go on to analyse causal laws simply as laws that involve the relation of causation, since, if that is all that causal laws are, what reason could there ever be why two events could not be causally related without falling under some law? Consequently, if there is to be any hope of rendering comprehensible the exclusion, given an intermediate view, of anomic causation, it would seem that one needs to offer a separate account of the nature of causal laws.[51] An intermediate account therefore involves a somewhat richer ontology.

50 Fred I. Dretske, 'Laws of Nature', *Philosophy of Science,* 44 (1977,) 248–68; David M. Armstrong, *What is a Law of Nature?* (Cambridge: Cambridge University Press, 1983,) esp. chs. 1–5; and my own discussions in 'The Nature of Laws', *Canadian Journal of Philosophy,* 7/4 (1977,) 667–98, and in *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) sect. 2.1.1.

51 For a more detailed discussion, see *Causation,* 268–74.

The second point concerns the relationship between causal relations between events, on the one hand, and causal laws, on the other. Both the intermediate approach and the supervenience approach—in contrast with the singularist view—claim that the existence of causally related events entails the existence of a corresponding law. The supervenience approach, however, can explain this entailment, by appealing to a reductionist analysis of statements about causal relations in terms of statements about the non- causal properties of, and relations among, events, plus statements of laws. This explanation is not open to an advocate of the intermediate view, nor is it clear what alternative account can be given of the entailment in question. The intermediate position involves, therefore, the acceptance of a necessary connection for which it can offer no explanation. The singularist approach, on the other hand, denies that there is any such connection between causally related events and causal laws, and so it is not faced with the problem of explaining the purported entailment.

This completes the argument for a singularist view. We have seen, first, that there are only two alternatives to a singularist conception of causation—namely, the supervenience view and the intermediate view; secondly, that one of the alternatives—the supervenience view—is ruled out by certain logically possible cases involving indeterministic causal laws; and, thirdly, that the other alternative—the intermediate view—is both ontologically less economical than the singularist view, and involves a claimed necessary connection of which it can offer no account. The singularist approach would seem to have the edge, therefore, over its competitors.

4.3.3 A Singularist Conception of Causation

If one adopts a singularist approach to causation, what account is to be given of the concept of causation? Is it analytically basic? Or does it stand in need of analysis, and, if so, what form should that analysis take?

The former possibility is ruled out if traditional empiricism is right. One of the central tenets of empiricism is that an idea can be analytically basic only if it serves to pick out some property or relation with which one is directly acquainted. But what properties and relations can be objects of direct acquaintance? Within traditional empiricism, the answer is that one can be directly acquainted only with properties and relations that can be given within immediate experience. We saw earlier, however, that there is a strong reason for thinking that the relation of causation cannot be given in immediate experience. It therefore follows that, if traditional empiricist views concerning what concepts can be analytically basic are sound, the concept of causation cannot be analytically basic. It stands in need of analysis.

Is traditional empiricism right on these matters? I believe that it is. Arguing for that view would, however, take us rather far afield. But in addition, even if it turned out, contrary to classical empiricism, that analytically basic concepts need not pick out properties or relations that can be given in immediate experience, surely they would at least have to pick out properties or relations that are immediately observable in the sense indicated earlier. But causation is, we have seen, not immediately observable even in that broader sense. Therefore the conclusion would still be that the concept of causation cannot be treated as primitive.

So an analysis is required. But no reductionist account can be satisfactory, in view of the arguments set out in Section 4.2. The only possibility, then, is to treat causation as a theoretical relation. To do this, however, one needs a theory of causation that captures the crucial analytical connections.

What form should such a theory take? The natural idea, within the context of a singularist approach to causation, is to look for a theory that refers to the relation of causation, but not to causal laws. I doubt, however, that such an approach can work, since it is hard to see what the relevant postulates could be. Thus, one possible postulate is that a cause is always earlier than its effect. But that postulate, as we have seen, is far from uncontroversial. Another possibility is the postulate that a cause and its effect must be contiguous, both in space and in time. But that too is controversial, since, on the face of it, there does not seem to be any contradiction in the idea of a cause being either spatially or temporally separated from its immediate effect.[52] Suppose, however, that we were to accept both postulates. The resulting theory would not suffice to characterize causation, since it would not discriminate between one event's causing another, and one event's merely being prior to, and

[52] For further discussion of whether causal processes can be discontinuous, see ibid. 235–6.

spatiotemporally contiguous with, another event. So at least one other postulate would be needed. What could it be? Hume, at this point, could see no alternative to bringing in reference to regularities. It might be suggested, however, that one needs at this point to set aside some of Hume's scruples, and to bring in the idea of powers. The usual account of a power, however, is in terms of an object's having categorical properties that bring it about that it will behave in certain ways, or at least will have a certain probability of so behaving, in virtue of relevant causal laws that apply to it in view of those categorical properties. But that route would involve abandoning the attempt to characterize the relation of causation without bringing in reference to causal laws. One could take the view at this point, of course, that powers can be ultimate properties of objects, rather than properties that objects have in virtue of categorical properties plus relevant laws. But this is on a par, I believe, with the idea of laws that apply to an object in virtue of the particular individual it is, rather than in terms of its properties and/or relations to other objects, and, even if there is no decisive objection to this idea, it seems to me that one should resort to it only after all other avenues have been exhausted.

The upshot is that the idea of trying to formulate a theory that picks out the relation of causation, and that does so without bringing in any reference to causal laws, seems problematic. But what is the alternative, if one accepts a singularist conception of causation? The approach that I want to suggest is as follows. First, let us assume that events can be causally related without falling under any causal law. Secondly, let us assume that both causal and non-causal laws are logically possible, and that, consequently, it must be possible to analyse the general concept of a law without bringing in any causal notions. Given these two assumptions, it then follows that causal laws can be defined as those that involve the relation of causation. But, thirdly, this conclusion is perfectly compatible with there being some further necessary truth concerning the difference between causal and non-causal laws, beyond the fact that the former involve the relation of causation, and the latter do not. The idea behind my approach involves, accordingly, the claim that this is in fact the case—that certain postulates are true of causal laws, but not non-causal laws. But if so, then one can characterize the relation of causation indirectly in the following simple way:

> Causation is that unique relation between events or states of affairs such that, if there are laws involving that relation, those laws must satisfy *P*—a certain set of postulates.

This characterization, while bringing in the concept of a law, does not entail that events can be causally related only if that relation is an instance of some law. In addition, this approach has the advantage that, because the postulates one is utilizing to construct one's theory of causation concern causal laws, rather than the relation of causation, one need not employ either the disputed postulate that a cause must be earlier than its effect, or the even more controversial postulate that causal processes cannot involve either spatial or temporal gaps.

4.4 The Nature of Causation: III. Causal Laws and Probability

But what are the relevant postulates that discriminate between causal laws and non-causal laws? The answer that I favour was set out earlier, in Section 3.2, along with a basic argument in support of the postulates in question. In the present section, accordingly, I shall confine myself to offering, first, a somewhat different illustration that also makes vivid, I think, the intuitions underlying those postulates, and then, secondly, an explicit formulation of the resulting analysis of the concept of causation.

4.4.1 Causal Laws Connecting Simple Events With Very Complex Events

In the earlier exposition of the basic argument in support of the proposed postulates for causal laws, I employed a case involving imaginary, radioactive elements whose half-lives altered under certain conditions. Here I shall use a different illustration that, rather than involving probabilistic laws, focuses upon the contrast between causal and non-causal laws connecting simple properties with very complex ones, and upon the different ways in which those laws bear upon the probabilities of the relevant types of events.

For concreteness, let us suppose that the simple type of event consists of there being two electrons a mile apart, and that the much more complex type of event consists of a solar system in a state that exactly duplicates the state our own solar system will be in at midnight, 1 January, in the year 2000. Then, even in the absence of detailed information about the world, it is surely reasonable to regard the first type of event as very much more likely than the second. In the first place, though both types of events require the existence of electrons, the second requires the existence of many more electrons, plus many other types of particles, in very large numbers. Secondly, as long as the electrons are not too far apart, and are moving around, there will often be two electrons exactly a mile apart, whereas an incredible coincidence will be needed to produce particles that are interrelated in precisely the way that the particles in our solar system are interrelated at some specific time.

Suppose now that one learns that it is a nomological fact that, every time an event of the simple sort occurs in some region, an event of the complex sort also occurs in a related region at about the same time, and vice versa. Then the probabilities that one assigns to the two types of events will have to be revised: rather than one type of event being relatively likely, and the other type being astronomically unlikely, the same probability will have to be assigned to both. But how, exactly, should the adjustment be made? Should one now view it as extremely unlikely that a region will contain two electrons that are exactly a mile apart? Or should one instead view the occurrence of a complex solar system in a certain precise state as relatively likely? There would seem to be no reason to do one rather than the other. Indeed, it seems more reasonable to adjust both probabilities, and to view the very complex type of event as rather more likely, and the relatively simple type of event as rather less likely, than one had previously taken them to be.

Suppose, however, that one learns, not that the occurrence of each type of event is both nomologically necessary and nomologically sufficient for the occurrence of the other type, but that the occurrence of the relatively simple type is both causally necessary and causally sufficient for the occurrence of the very complex type of event. Once again, one must adjust the probabilities so that each type of event is equally likely. But now there is an intuitively correct way of making the adjustment—namely, one should now view the occurrence of a solar system in a certain precise state, not as extremely unlikely, but as having a likelihood equal to what one had previously assigned to there being two electrons exactly one mile apart. On the other hand, if the causal connection runs in the opposite direction, so that the existence of a solar system in a certain very complex state is both causally necessary and causally sufficient for the existence of two electrons exactly a mile apart, then one should now view the latter type of event as being as improbable as one originally took the former sort of event to be. And, in general, the idea is that, when one type of event is both causally sufficient and causally necessary for another type of event, one should equate the posterior probability of the latter type of event with the prior probability of the former type of event.

4.4.2 The Postulates for Causal Laws, and the Analysis of Causation

What if one type of event is causally sufficient for another type of event, but not causally necessary? Then a slightly more complicated account of the relation between posterior probabilities and prior probabilities is required. But that is provided, I believe, by the postulates that were set out earlier, namely:

(C_1): $\text{Prob}(Px, P \Rightarrow Q \;\&\; C) = \text{Prob}(Px, C)$
(C_2): $\text{Prob}(Qx, P \Rightarrow Q \;\&\; C) = \text{Prob}(Px, C) + \text{Prob}(\sim Px, C) \times \text{Prob}(Qx, \sim Px \;\&\; P \Rightarrow Q \;\&\; C)$
(C_3): $\text{Prob}(Qx, \sim Px \;\&\; P \Rightarrow Q \;\&\; C) = \text{Prob}(Qx, \sim Px \;\&\; C)$
(C_4): $\text{Prob}(Qx, P \Rightarrow Q \;\&\; C) = \text{Prob}(Px, C) + \text{Prob}(\sim Px, C) \times \text{Prob}(Qx, \sim Px \;\&\; C)$.

If these postulates are indeed correct, and also complete, then they can be incorporated into the schematic account of the relation of causation, given near the end of Section 4.3, and the result will be the following:

> Causation is that unique relation between events or states of affairs such that, if there are laws involving that relation, those laws must satisfy postulates (C_1) through (C_4).

4.5 The Argument from Causation

Given the above account of causation, I am now in a position to set out what I take to be the most fundamental argument in support of the claim that our world is a dynamic one—the argument from causation. In the first section I shall briefly outline the argument, and then, in the next two sections, I shall set out in a more detailed way, and offer support for, the two crucial steps in the argument. These involve the claims, first, that causation, as characterized above, is to be found in our world, and, secondly, that causation, so understood, presupposes the existence of a dynamic world.

4.5.1 The Structure of the Argument

Stated in the most compact way possible, the argument from causation for the conclusion that our world is dynamic runs as follows. First, our world does contain causal laws. Secondly, causal laws require a dynamic world. Therefore our world is a dynamic one.

Expanded slightly, the argument can be put as follows. First, our world contains many types of events that prima facie, and in the absence of a certain type of explanation, are *extremely* improbable. Secondly, although the events in question do have causal explanations, that fact entails that they are not, all things considered, extremely improbable events, if and only if causal laws satisfy postulates (C_1) through (C_4). So, thirdly, it is reasonable to believe that our world does contain causal laws that satisfy those postulates. But, fourthly, it is possible to explain how causal laws can satisfy those postulates if, and only if, the world is dynamic rather than static. Therefore, it is reasonable to believe that our world is a dynamic one, where what facts there are depends upon what time it is.

4.5.2 The Reality of Causation

The first main stage in the argument from causation is concerned with establishing that our world does contain causal laws, where it is taken to be an essential feature of causal laws that they satisfy postulates (C_1) through (C_4). In the present section I shall set out that stage in a more detailed way, and indicate how it can be supported.

The argument for the reality of causation, conceived of as explained above, begins with the claim that certain states of affairs in this world are, prima facie, highly improbable. The grounds for this claim can be illustrated by any number of familiar scenarios. Consider, for example, what happens when it rains. Near the surface of the earth, a number of drops of water are scattered about throughout the atmosphere in a rather random way. The arrangement of those drops, accordingly, would not seem to be especially improbable. But the situation is quite otherwise with respect to the movements of the drops, since almost all of them are moving towards the surface of the earth, rather than in random directions. Their points of impact upon the relevant region of the earth, on the other hand, seem more or less randomly distributed. But, after striking the earth, many of them may start moving towards one another, forming puddles. These puddles, moreover, are not mere random clusters of molecules. On the contrary, they exhibit a shape that, underneath, conforms to the surface of the earth with which they are in contact, and, on top, is more or less perfectly flat as long as the puddle is shielded from further falling drops of rain. This nearly perfect flatness is, once again, a prima-facie very improbable state of affairs. Finally, consider what happens when a puddle is not shielded from further drops. Shortly after a drop has struck the surface, the vast majority of molecules at the surface of the pond will still be at approximately the same height, but some will have moved so that they are either significantly higher or significantly lower than most molecules at the surface, and they will be arranged, moreover, in circular patterns around the point of impact. This pattern is clearly one that is, prima facie, highly improbable. With the passage of time, moreover, the number of concentric rings increases, so that more and more molecules occupy positions that are either significantly higher, or significantly lower, than most molecules on the top surface of the puddle, and so we have an even more improbable distribution of water molecules.

Does our world, then, simply contain an enormous number of highly unlikely accidents? Not if the account of causation given earlier is correct. According to that account, causal laws must satisfy postulates (C_1) through (C_4)—postulates which entail that, if a type of event with a very low prior probability turns out to be caused by a type of event with a much higher prior probability, then the former type of event must be assigned a posterior probability that is at least as high as the prior (and also posterior) probability of the type of event that is its cause. So if—to use an earlier illustration—the existence of two electrons a mile apart is causally sufficient to bring about the existence of a solar system in a very precise and complex state, the latter state of affairs is no longer astronomically improbable; on the contrary, its probability is quite high. The situation is no different in the more realistic, rain example. The existence of water molecules scattered about in the vicinity of a rather large body is not an especially striking or improbable state of affairs. But that they should all be moving in the same direction is striking, and presumably has a much lower prior probability. But, if bodies exert gravitational forces upon one another, and if forces produce accelerations, then the existence of those causal laws will mean, if the above account of causation is correct, that the existence of a large number of water molecules moving in roughly the same direction towards the surface of the earth must be assigned a posterior probability that is not lower than that of any initial state of affairs that is causally sufficient to bring the raining state of affairs about. In similar fashion, the fact that drops of water, upon an uneven surface, will tend to wind up in clusters whose top surfaces are very nearly flat, and the fact that outgoing concentric waves will arise on such surfaces after an impact, cease to be surprising facts, since the application of postulates (C_1) through (C_4) to the relevant types of events and the associated causal laws leads to the conclusion that, although those types of events have very low prior probabilities, they do not have low posterior probabilities when their causes are taken into account.

In short, if causal laws are so understood that the satisfaction of postulates (C_1) through (C_4) is an essential feature of them, then by postulating causal laws in that sense we can avoid having to believe that our world is full of extraordinarily unlikely accidents. But might there not be some other way of doing this? Perhaps some other account of causation—one according to which causal laws need not satisfy (C_1) through (C_4)—could achieve the same thing?

What other account might be offered? The only type of candidate that springs to mind is an account based upon the idea that causes make their effects more likely. But that, however, does not seem to be a satisfactory alternative, for a number of reasons. First, there are counterexamples to the claim that causes raise the probabilities of their effects—based upon the idea that the presence of a rather weak cause may preclude the presence of more powerful ones, and thus actually lower the probability of the type of effect in question.[53] Secondly, and more importantly, such an approach does not provide the basis for any satisfactory account of either the direction of causation, or even the asymmetry of causation. The reason is that, if the conditional probability of an event of type E given an event of type C is greater than the prior probability of an event of type E, then it must also be true that the conditional probability of an event of type C given an event of type E is greater than the prior probability of an event of type C. So, if a cause raises the probability of its effect, in the sense just indicated, then it is equally true that an effect raises the probability of its cause. The raising of probabilities, so interpreted, cannot therefore provide any ground for either the direction of causation or the asymmetry of causation.

If this is right, then, unless some other acceptable alternative to the above account of causation can be found, it is only by assuming that our world contains causal laws in a sense that involves the satisfaction of postulates (C_1) through (C_4) that one can avoid the idea that extraordinarily improbable events occur with great frequency in our world. I therefore conclude that it is reasonable to believe that the world does contain laws that satisfy postulates (C_1) through (C_4).

4.5.3 Causation and a Dynamic World

The second part of the argument from causation centres upon the question of how it is possible for there to be laws that satisfy postulates (C_1) through (C_4), and the thrust of the argument is that an explanation can be offered of how this is possible if and only if our world is dynamic, rather than static.

Let us begin by supposing that our world is a static world, where what facts there are does not depend upon what time it is: events are either actual or not, *simpliciter,* rather than being actual as of some times, and not as of others. Given such a world, how can one explain the existence of laws that satisfy postulates (C_1) through (C_4)? In particular, how can it be the case that the posterior probability of an effect depends upon the prior probability of the cause, in the way indicated by postulate (C_4)—namely:

[53] Ibid. 234–5.

$$\text{Prob}(Qx,\ P \Rightarrow Q\ \&\ C) = \text{Prob}(Px,\ C) + \text{Prob}(\sim Px,\ C) \times \text{Prob}(Qx,\ \sim Px\ \&\ C)$$

whereas, as is shown by postulate (C_1)—namely:

$$\text{Prob}(Px,\ P \Rightarrow Q\ \&\ C) = \text{Prob}(Px,\ C)$$

the posterior probability of a cause does not depend upon the prior probability of its effect?

If the problem were merely to explain the relationship that is expressed by postulate (C_4), it might seem that a solution was readily available. For consider any temporal slice of the world. 'Prob(Px, C)' gives one the prior probability of there being an event of type P at any location x within that temporal slice. Suppose, now, that it is a causal law that events of type P causally give rise to events of type Q. It must then be the case that, whenever one has an event of type P at any location x within the one temporal slice, there must be an event of type Q at some corresponding location within a slightly later temporal slice of the world. Accordingly, given that it is a causal law that events of type P causally give rise to events of type Q, it follows that the posterior probability of an event of type Q must be at least as great as that of an event of type P. Then, by taking into account the possibility that an event of type Q may occur without being caused by an event of type P, one can derive postulate (C_4)—provided that one can assume that the posterior probability of an event of type P is equal to its prior probability.

The difficulty, however, is that there is no way of justifying the latter assumption, if the world is not dynamic. This emerges very clearly once one notices that, in a static world, a very similar, and, apparently, equally acceptable argument can be used to establish that the posterior probability of a cause depends upon the prior probability of its effect. Consider any temporal slice of the world. 'Prob(Qx, C)' gives one the prior probability of there being an event of type Q at any location x within that temporal slice. Suppose, now, that it is a causal law that events of type P causally give rise to events of type Q. It must then be the case that, whenever one does not have an event of type Q at any location x within the one temporal slice, there cannot be an event of type P at the corresponding location within a slightly earlier temporal slice of the world. Accordingly, given that it is a causal law that events of type P causally give rise to events of type Q, it follows that the posterior probability of there not being an event of type *P* must be at least as great as that of there not being an event of type *Q*. Then, by taking into account the possibility that an event of type *P* may fail to occur at a certain location without there being an absence of a later event of type *Q*, at the appropriate location, that would be incompatible with the occurrence of an event of type *P* at the relevant location, and, by assuming that the posterior probability of the nonoccurrence of an event of type Q is equal to the prior probability of its non-occurrence, one could show that the following analogue of postulate (C_4) must be true:

$(C_4{*})$: $\text{Prob}({\sim}\,Px,\ P \Rightarrow Q\ \&\ C) = \text{Prob}({\sim}\,Qx,\ C) + \text{Prob}(Qx,\ C) \times \text{Prob}({\sim}\,Px,\ Qx\ \&\ C)$.

But (C_4*) says that the posterior probability of the non-occurrence of a cause depends upon the prior probability of the nonoccurrence of an effect in precisely the same way that, according to (C_4), the posterior probability of an effect depends upon the prior probability of its cause. It then follows that the posterior probability of a cause depends—albeit in a slightly different way—upon the prior probability of its effect. But such dependence is ruled out by postulate (C_1)—namely:

$\text{Prob}(Px,\ P \Rightarrow Q\ \&\ C) = \text{Prob}(Px,\ C)$

—for the latter asserts that the relevant posterior probability of a cause must always be equal to its prior probability.

But cannot this second argument be challenged? In particular, what is the justification for the assumption that the posterior probability of the non-occurrence of an event of type *Q* is equal to the prior probability of its non-occurrence? The answer is: none. But equally, there is no justification—if one assumes that the world is static—for the corresponding assumption in the first argument—namely, the assumption that the posterior probability of an event of type *P* is equal to its prior probability.

To sum up. While there is an argument that might seem to be available, in a static world, to establish that postulate (C_4) holds, that argument cannot succeed, and this for two reasons. First, the argument involves a crucial assumption that cannot be justified in a static world. Secondly, there is a parallel argument—and one which is equally acceptable, given a static world—which can be employed to show that postulate (C_1) cannot hold. In a static world, then, it is impossible to explain how the crucial asymmetry expressed by postulates (C_1) and (C_4) can obtain.

What if one assumes instead that the world is dynamic? Is it then possible to explain the asymmetry? The answer depends upon the type of dynamic world. With some dynamic worlds, the situation will not be altered. Thus, for example, if the world is one where the past, the present, and the future are all equally real, and the dynamic quality derives from changes in what tensed facts there are, the situation will be the same as with a static world: there will be no way of capturing the asymmetry expressed by postulates (C_1) and (C_4). The same is true if the world is one where only the present is real. Here too there is no ontological difference between what is causally prior and what is causally posterior: both are, in this case, equally unreal from the perspective of a given moment.

What is needed, if there is to be any hope of capturing the asymmetry involved in causation, and which is expressed by postulates (C_1) and (C_4), is an ontological asymmetry in the world, and the obvious candidate is the view that, while the past and the present are real, the future is not. Suppose, then, that the world is dynamic in that way. Given that assumption, let us ask what bearing it would have upon the probability of an event of type *Q* if there were a causal law to the effect that events of type *P* bring about slightly later events of type *Q*. As before, one can take the prior probability of an event of type *P* as an indication of how likely it is that there will be an event of type *P* at some location in a given temporal slice. Whenever there is such an event, there would also have to be a corresponding event of type *Q* at some slightly later time, if the causal law in question were to obtain. It may be, of course, that in the world as it actually is the causal law does not obtain, nor is there any event of type *Q* at the relevant location. That fact, however, cannot provide the basis of any argument to the effect that, if the causal law did exist, there would not be an event of type *P* at the relevant location, on the grounds that that would be precluded by the absence of an event of type *Q* at the corresponding, later location. If the future is not real, then, as of the time of the occurrence of the event of type *P*, the non-occurrence of an appropriately related, later event of type *Q* is not actual. So, if it were a law that events of type *P* give rise to events of type *Q* at a slightly later time, it would not be an open question whether the result would be the addition of an event of type *Q* at a later time or the removal of an event of type *P* at the moment in question. The nature of the world would be determined by the laws together with what was *actual* as of the moment in question, and so the event of type *P* would give rise to a later event of type *Q*. Consequently, the posterior probability of an event of type *Q* would have to be at least as great as the *prior* probability of an event of type *P*.

By contrast, the argument cannot be run in the opposite direction. If one focuses upon a certain location where there is no event of type *Q*, and then tries to argue that, if it were a law that events of type *P* give rise to events of type *Q* at a slightly later time, then an event of type *P* which, as things are in the absence of the law, occurs at the corresponding location at a slightly earlier time would have to be absent, the argument will not succeed. Given that the past is real, the event of type *P* that occurs at a slightly earlier time is actual as of the time that one is considering, and so an appeal to the idea that what is actual as of a time determines what exists, tenselessly, will lead to the conclusion that, if the law in question did exist, there would be an event of type *Q* at the later location, rather than an absence of an event of type *P* at the earlier location.

How can there be causal laws that conform to postulates (C_1) through (C_4)? The basic answer that I am proposing is this. Causal laws are not merely patterns that events exhibit, for, as I argued earlier, a reductionist account of causation is untenable. Causal laws, rather than being merely regularities in the history of the world, *control* the course of history; they underlie, and account for, any patterns that the world may exhibit over time. But how is this control to be understood? One way—and, I think, the only satisfactory way—is if causal laws, in conjunction with what is actual as of a given time, determine what states of affairs will be added to what is already actual, and, thereby, what will ultimately exist, in a tenseless sense. And, if laws together with what is actual as of a given time do determine how the world will be, then causal laws will necessarily conform to postulates (C_1) through (C_4), and the asymmetry that is expressed, in particular, by postulates (C_1) and (C_4) will be captured and explained.

4.6 Causation and What Is Actual

The conclusion of the preceding argument is that causation cannot exist in a static world, nor in many dynamic worlds. It can exist, however, in a dynamic world where the past and the present are real, but the future is not. The argument does not show, however, that causation can exist only in the latter sort of world. In the present section, accordingly, I want to focus upon the question of the *minimum* properties a world must have in order to contain causally related events. I shall then consider whether a world possessing those properties must be one where the past and the present are real, while the future is not.

4.6.1 Causality, Simultaneity, and Actuality Postulates

The world is to be one where it is possible to explain how there can be causal laws—where it is taken as an essential feature of causal laws that they satisfy postulates (C_1) through (C_4). We have seen, however, that the extent to which events are actual as of different times is crucial with respect to the possibility of there being causal laws, so conceived. Accordingly, a plausible way of attempting to arrive at the minimum properties is by considering ways in which the relation of causation might be connected to facts about what is actual as of a given time. Moreover, given that there can be causal laws in worlds where the past and the present are real, but the future is not, a natural way of proceeding is by considering the connections between causation and what is actual as of a time that obtain in worlds of that sort, since, in generating a list of relevant connections in this way, we may find at some point that we have principles that, though sufficient to ensure that there can be causal laws satisfying postulates (C_1) through (C_4), do not entail that the world is one where the past and the present are real, while the future is not.

What we are looking for, accordingly, are postulates dealing with what states of affairs are actual as of a given time, and which will be true of worlds where the past and the present are real, but the future is not. Since the present is, in such worlds, the point at which states of affairs come into existence, one postulate that immediately suggests itself concerns the relation between the occurrence of an event, or state of affairs, and its actuality:

I. The Occurrence and Actuality Postulate

An event or state of affairs is actual as of the time of its occurrence.

Next, we need some postulates dealing with the relation between causation and actuality. Given—cases of backward causation aside—that, on the one hand, the reality of the past entails that a cause is actual as of the time of its effect, while, on the other, the unreality of the future entails that an effect is not actual as of the time of its cause, the following postulates are very natural additions:

II. The Causal Posteriority Postulate
A cause is always actual as of the time of any of its effects.

III. The Causal Priority Postulate

An effect is never actual as of the time of any of its causes.

Will these three postulates suffice? That is to say, can one show that a world where they hold must be such that there can be causal laws in the sense involving the satisfaction of postulates (C_1) through (C_4)? It would seem not. For consider the simple world that is described in Fig. 4.4. If one is to show that postulates (C_1) through (C_4) are satisfied in that world, one has to show, for example, that, if the world had contained a law that events of type *P* causally prevent the existence of events of type *Q,* at the same spatial location, at a slightly later time, then, first, there would still have been an event of type *P* at location (1) at time 1, but, secondly, rather than there being an event of type *Q* at location (1) at time 2—as in the above world—no such event would have been present at that spatiotemporal location. To show this, one needs the assumption that the event of type *Q* at location (1) at time 2 is not actual as of time 1. Of the three principles set out above, only the causal priority principle can be used to generate conclusions that certain states of affairs are not actual as of a given time. Applying that principle to the causal connections between the events of types *R* and *S* will allow one to conclude that the event of type *S* at location (2) and time 2 is not actual as of the time 1. But, if one is to draw the further conclusion that the event of type *Q* at location (1) at time 2 is also not actual as of time 1, one needs a further postulate that makes use of the fact that the event of type *Q* is

Fig. 4.4

Locations	Times: 1		2
(1)	P		Q
(2)	R	$\rightarrow$	S

Fig. 4.5

Locations	Times: 1		2		3
(1)	P				Q
(2)	R	$\rightarrow$	S		
(3)			T	$\rightarrow$	U

simultaneous with an event that is not actual as time 1. The natural proposal is:

IV. The Simultaneity Postulate

If two events or states of affairs are simultaneous, there is no time as of which one is actual and the other not.

For given this principle, one can argue that, since the event of type *S* at location (2) and time 2 is not actual as of time 1, and the event of type *Q* at time 2 is simultaneous with the event of type *S,* the event of type *Q* at time 2 cannot be a state of affairs that is actual as of time 1.

But, while the simultaneity postulate is a natural one, and enables one to deal with the above case, it is not quite sufficient to handle all cases, as illustrated by the world described in Fig. 4.5.

The problem here is that, while the simultaneity postulate tells one that the event of type *Q* at time 3 must be actual as of every time at which the event of type *U* at time 3 is actual, and while the causal priority postulate then enables one to conclude that neither of those states of affairs can be actual as of time 2, in virtue of the causal connection between the event of type *T* and the event of type *U,* there is no way to go on to conclude that neither of those states of affairs can be actual as of time 1, in virtue of the causal connection between the event of type *R* and the event of type *S*. The reason is that, while one can conclude that events that are simultaneous with the event of type *S* at time 2 cannot be actual as of time 1, one has no grounds for concluding that events that, rather than being simultaneous with the event of type *S,* are not actual as of the time of that event also cannot be actual as of time 1. So, if one is to be able to conclude that the event of type *Q* at time 3 is not actual at the time of the event of type *P*—and one needs to be able to draw this conclusion in order to show that the above world can contain causal laws satisfying postulates (C_1) through (C_4)—one needs, it would seem, the following postulate:

V. Causation and the Backward Transmission of Non-Actuality

> If a state of affairs, *A,* is not actual as of the time of some state of affairs, *B,* then neither is it actual as of the time of any cause of *B.*

Given this additional postulate, one can argue that, since the event of type *Q* at time 3 is not actual as of time 2, in view of the causal priority postulate and the simultaneity postulate, so neither is it actual at the time of any cause of the event of type *S,* and so, in particular, it is not actual at the time of the event of type *R.* This in turn generates the required conclusion that the event of type *Q* at time 3 is not actual as of the occurrence of the event of type *P* at time 1.

We are now close to having what is needed if one is to be able to show that the above world can contain causal laws satisfying postulates (C_1) through (C_4). But for that result, it is not enough that it be true that the event of type *Q* at time 3 is not actual as of the occurrence of the event of type *P* at time 1: we must also be able to show that the occurrence of the event of type *P* at time 1 is also actual as of time 3. This would seem to call for the following postulate:

VI. Causation and the Forward Transmission of Actuality

> If a state of affairs, *A,* is actual as of the time of some state of affairs, *B,* then it is also actual as of the time of any effect of *B.*

Given this sixth postulate, I believe that we have all that we need, since it would seem that the type of argument that was used earlier—to show that, if the world is one in which the past and present are real, but the future is not, then there can be causal laws satisfying postulates (C_1) through (C_4)—can equally well be employed in the case of any world that satisfies the above six postulates.

In setting out the above postulates, I have tried to do so in a way that brings out the underlying reason why each is needed, rather than aiming at the most economical formulation. But perhaps it is worth remarking at this point that a reduction in the number of postulates is possible, since, given postulate I, which states that an event or state of affairs is actual as of the time of its occurrence, it is clear that, by considering the special case of postulate VI where states of affairs *A* and *B* are one and the same, one can derive postulate II. So only postulates I, III, IV, V, and VI are really needed.

4.6.2 The Ontological Status of Past, Present, and Future

How does a world that satisfies the postulates just set out compare with one where the past and present are real, but the future is not? The answer is that, at the very least, they are extremely close. Let *W* be any world that satisfies the above postulates. For *W* to be a world where the past is not always real, there would have to be times, *r* and *s,* such that *r* is earlier than *s,* and where some event *E* occurs at *r,* but is nevertheless not real at the later time, *s.* Similarly, for *W* to be a world where the future is sometimes real, there would have to be times, *r* and *s,* such that *r* is earlier than *s,* and where some event *E* that occurs at *s* is real at the earlier time, *r.* So let us consider how either of those things could be the case. The answer, as we shall see, is that this could only be so if the relevant times were not causally connected.

Let us say that two states of affairs, *P* and *Q,* are directly linked if and only if either *P* causes *Q,* or *P* is simultaneous with *Q,* and indirectly linked if and only if they are connected by a chain of direct links. Next, let us say that two times, *r* and *s,* are causally linked if and only if there is some state of affairs, *P,* at time *r,* that is directly or indirectly linked to some state of affairs, *Q,* at time *s.* Now consider the case where event *E* occurs at time *r,* which is earlier than *s,* but where *E* is not actual as of the later time, *s.* The crucial question now is whether time *r* is causally linked with time *s.* If it is, then it follows, in virtue of postulates I and VI, that no state of affairs that occurs at time *r* can fail to be actual as of time *s,* and thus, in particular, event *E* cannot fail to be actual as of time *s.* So the past must be real. Similarly, suppose that event *E* occurs at time *s,* which is later than *r,* but that *E* is nevertheless actual as of the earlier time, *r.* Again, the crucial question is whether time *r* is causally linked with time *s.* If it is, then it follows, in virtue of postulates I and V, that no state of affairs that occurs at time *s* can be actual as of time *r,* and thus, in particular, event E cannot be actual as of time *r*. So the future cannot be real.

The conclusion, therefore, is that a world that satisfies the postulates in question can fail to be a world where the past is real, or where the future is not real, only if there are times that are not causally linked. Is this a genuine possibility? According to some views of time, it certainly is, for, in order for two times not to be causally linked, all that is necessary, after all, is that there not be causally related states of affairs at certain places, and, although it is surely true that in the actual world all times are causally linked—probably even directly linked—surely it could have been otherwise. Could not causal processes have been very rare? Indeed, might there not even have been no causally related events at all? For if absolute space and time, or space-time, is possible, could there not have been a world that consisted of space and time, or space-time, and nothing else? In short, is it not logically possible for there to be a world where some times, or even all times, are *temporally* related, but not *causally* linked?

Perhaps. But I am inclined to think not. My reason—as will emerge later—is that I believe that the direction of time is given by the direction of causation. So no causation, no time. But where does that leave what appears to be a genuine logical possibility—that of empty space and time? Must that be rejected? Not necessarily. As will also be discussed later, there is no reason why spatiotemporal points cannot stand in causal relations to one another. So the view that it is causation that gives time its direction is perfectly compatible with the possibility of a world that consists of space and time, and nothing else.

If this view of the direction of time is correct, then one moment cannot be earlier than another without their being causally linked, and so any world that satisfies the above postulates must be a world where the past and present are real, but the future is not. It will then be true that the latter is the only kind of world where events can be causally related, for only in such a world can postulates (C_1) through (C_4) be satisfied.

What if the direction of time is not given by the direction of causation? Then a world that satisfies postulates I through VI need not be a world where the past and present are real, while the future is not. But it will be a very close approximation to such a world.

4.7 Backward Causation Revisited

In the second section of Chapter 3 we saw how very difficult it is to generate a satisfactory argument against backward causation, since, while some of the arguments discussed in Section 3.2 may be good arguments against the possibility of causal loops, the cases discussed in Section 3.2.4 strongly suggest both that it is possible to have backward causation without having causal loops, and that the most promising arguments against causal loops leave untouched the latter possibility.

This outcome is not satisfactory if one wishes to defend a dynamic view of the world. Or at least, it is not satisfactory in the case of most dynamic accounts, including the one I am defending. The view that only the present is real, on the other hand, may be an exception, since that approach—assuming it leaves room for any conception of causation at all—does not seem to preclude backward causation.

If, however, the arguments advanced in Sections 4.5 and 4.6 are correct, the problem of backward causation vanishes: on the one hand, only a world that satisfies postulates I through VI can contain causally related events, and, on the other, those postulates, conjoined with the assumption that all times are causally linked, rule out backward causation.

The argument can be stated very quickly. We have already seen that postulates I and V entail that, if time *r* is earlier than, and causally linked with, time *s,* then no state of affairs that occurs at time *s* can be actual as of time *r.* Suppose, then, that we have backward causation, and that some state of affairs, *A,* that occurs at time *s* causes a state of affairs, *B,* that occurs at the earlier time *r.* It then follows, in virtue of postulates I and II, that *A,* which is a state of affairs that occurs at time *s,* must be actual as of the earlier time *r.* So we have a contradiction. Hence backward causation is logically impossible, and is so even when it does not involve any causal loops.

If times need not be causally linked, however, this argument collapses. But, while this observation certainly has its worrying side, it also means that advocates of a dynamic conception of time have a strong reason to take seriously the view—which I shall argue is independently very plausible on other grounds—that the direction of time is to be defined in terms of the direction of causation.

If temporal order depends, ultimately, upon causal order, then there cannot be times that are not causally linked.

4.8 Summing Up

Is the world dynamic or static? My discussion of this issue began, in Chapter 3, with the setting-out of the argument from preventability in support of the claim that what facts exist depends upon what time it is. That argument seemed initially rather promising, since the idea that there are facts that are preventable at some times, but not at others, seems to support the idea that facts are temporally relative. But that route to a dynamic view of the world appeared, in the end, to be impassable, for two reasons. In the first place, that approach requires a proof of the impossibility of backward causation, and one, moreover, that is neutral with respect to the question of static versus dynamic conceptions of time—for otherwise the argument from preventability would be circular. An examination of the arguments that have been advanced against backward causation, however—and especially the consideration of worlds containing backward causation without causal loops—made it seem very unlikely that any such proof is possible.

In the second place, the counterfactuals that lie at the heart of the argument from preventability appear to be such as, on standard accounts of the truth conditions of subjunctive conditionals, can perfectly well be true even in a static world. But if so, then surely any argument from the truth of such counterfactuals to the conclusion that the world is dynamic must be unsound.

The discussion in the present chapter developed out of these two difficulties faced by the argument from preventability. The result was two related arguments: the argument from subjunctive conditionals, and the argument from causation. The thrust of the former argument was that standard accounts of the truth conditions of subjunctive conditional statements are unsatisfactory, either because they assign the wrong truth-values to some counterfactuals, or because there is no way of providing any intuitive grounds for the truth conditions that are offered. I then argued that one can set out truth conditions which result in the correct assignment of truth- values, and which can be motivated, provided that the world is a dynamic one, of a certain sort—namely, one where the past and the present are real, but the future is not.

I then turned to the second, and more basic argument—the argument from causation. The starting-point of that argument was that reductionist approaches to causation—and in particular to the direction of causation—are untenable. What account can be given, then, of the direction of causation? My answer was that the direction of causation derives from the fact that causal laws must satisfy certain postulates—(C_1) through (C_4). The argument then turned upon the question of how there could be causal laws in a sense that involved the satisfaction of those postulates, and I argued, first, that those postulates could not be satisfied in a static world, and, secondly, that the same was true of most dynamic worlds. What is needed is a world in which the relation of causation is connected with what is actual as of a time in certain ways, and it turned out that either such a world is one in which the past and the present are real, but the future is not, or else it is a very close approximation to such a world.

This conclusion also provides one with a clearer perspective on the argument from subjunctive conditionals. The reason that satisfactory truth conditions can be given for the relevant subjunctive conditionals only by incorporating reference to a dynamic world where the past and the present are real, and the future is not, is that reference to causation is needed in the truth conditions of those conditionals, and causation itself presupposes such a world.

Part II Semantical Issues

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5 Truth and Truth at a Time

According to tensed accounts of the nature of time, the world is dynamic, and what facts there are can vary from moment to moment. Quite naturally, then, advocates of tensed approaches to time almost always hold that the proper conception of truth is a temporally relativized one, according to which a proposition can have different truth-values at different times. On the other hand, philosophers who do not accept a tensed approach to time have often contended that any temporally relativized concept of truth is profoundly problematic, if not simply incoherent, and a variety of arguments have been offered in support of this claim. Most of these will be discussed later, in Chapter 10. There are, however, two objections that I think it is important to address before proceeding further. The first is to the effect that a temporally relativized concept of truth rests upon an elementary confusion—a confusion, namely, between propositions and propositional functions. The second objection is that the concept of truth at a time commits one to a three-valued logic, and that the latter is very problematic.

Where does the idea of a temporally relativized concept of truth leave the familiar notion of truth *simpliciter*? Most philosophers who accept the idea of truth at a time maintain that the concept of truth *simpliciter* should be rejected. This seems to me a mistake. The final section of this chapter, accordingly, will be devoted to a consideration of the concept of truth *simpliciter*.

5.1 Truth at a Time: An Initial Objection

A number of objections have been directed against a temporally relativized conception of truth. The one that I shall consider in this section maintains that the idea of truth at a time involves a confusion between propositions and propositional functions.

5.1.1 The Objection: Propositions Versus Propositional Functions

Various philosophers have advanced this objection. Consider, for example, the following passage from C. J. Ducasse's article, 'Truth, Verifiability, and Propositions about the Future':

> Thus, the reason why a proposition about the future or the distant cannot be said either to be true now here or false now here is not that it is neither true nor false, but that to qualify the adjectives 'true', or 'false', by the adverbs 'here' and 'now' or by any other place-date adverbs is absurd. It is absurd for the same sort of reason that it would be absurd to say either that the cube of 8 is married or that it is single. The cube of 8 is not the sort of thing that has marital status, of any kind; and, similarly, the truth or falsity of a proposition is not the sort of thing that has a place or date at all, for it is not an event.
>
> That truth and falsity have no place or date seems at first sight refutable by urging, for instance, that at the moment at which rain begins falling at a given place, it becomes true that it rains at that place at that time, whereas a moment before it was false. But to say this is only to mistake a propositional function for a proposition.[54]

Ducasse is claiming here that the concept of truth at a time is absurd, and in support of that contention he is arguing that the truth or falsity of a proposition is not an event, and thus not the sort of thing that can have a place or date. He realizes that one may be tempted to object that there may be a time at which a proposition becomes true, but he maintains that this response rests upon mistaking a propositional function for a proposition. Thus, to expand on Ducasse's own example, it is certainly the case that an utterance, at five o'clock, of the sentence 'It is now raining here' may be false, while an utterance of the same sentence at six o'clock is true. But it would, Ducasse contends, be a mistake to view this as a case where a proposition has changed its truth-value at some point, since the meaning of the sentence 'It is now raining here' is not a certain proposition, but a propositional function. So when the sentence is uttered in different contexts, different propositions are expressed. Accordingly, since the proposition associated with the five o'clock utterance is not identical with the proposition associated with the six o'clock utterance, we do not have a case where a proposition is true at one time, and false at another.

[54] C. J. Ducasse, 'Truth, Verifiability, and Propositions about the Future', *Philosophy of Science,* 8 (1941,) 329–37, at p. 334.

The idea that talk about truth at a time rests upon a confusion of propositions and propositional functions is, I think, a fairly common one—due in part, perhaps, to some potentially misleading statements made by advocates of a tensed approach to time. Arthur N. Prior, for example, in his article 'Three-Valued Logic and Future Contingents', remarks that

> The terms 'proposition' and 'true' are nowadays generally used in such a way that we cannot speak of the truth-value of a proposition as altering with the passage of time. This usage, however, has not always been the common one. Ancient and medieval usage was generally such that logicians could speak (as Aristotle did speak) of 'Socrates is sitting down' as a 'proposition' which is 'true' at those times at which he is sitting down and false at those times at which he is not.[55]

Prior is certainly right regarding this change in the usage of the relevant terms. But in the context of a discussion of three-valued logic, and of statements about the future, his observation is in a way unfortunate, since it tends to fuel the idea that it is a failure to keep firmly in mind the distinction between propositions and propositional functions that lends an unwarranted attractiveness to the idea that the truth-value of propositions may change with the passage of time.

As a consequence, I think it is important to stress that the temporally relativized concept of truth to be set out later in this chapter does not rest upon any confusion of propositions and propositional functions. That this is so can perhaps be most clearly brought out by considering the tensed approach that I am defending—according to which the future is not actual as of the present moment—and then by focusing, not upon a tensed statement, but upon a statement with a tenseless copula along with a date specifying the time in question. Consider, in particular, the following sentence: 'There are (tenselessly) unicorns on earth in the year ad 2000.' This sentence expresses the same proposition regardless of when it is uttered. Nevertheless, I wish to maintain that, although the proposition that it expresses may be true in the year 2001,[56] it is certainly not true in the year 1996. So, given a temporally

55 Arthur N. Prior, 'Three-Valued Logic and Future Contingents', *Philosophical Quarterly,* 3 (1953,) 317–26, at p. 322.

56 As Colin Allen has pointed out to me, if one holds that 'unicorn' is a natural-kind term, and also accepts Saul Kripke's account of the meaning of such terms, one will need, here and elsewhere, to shift to a slightly different statement, such as 'There are (tenselessly) purple sheep in the year ad 2000.'

relativized concept of truth, the truth-values of *tenseless, fully specified statements* can be different at different times.

The situation is, admittedly, much less clear-cut if one adopts an alternative tensed approach to time according to which the past, the present, and the future are all real—for then the truth-value of a tenseless statement cannot vary from one time to another. But if one accepts such an approach to time, one will still be committed to the idea that there will be some propositions whose truth-value does vary over time, since advocates of the above approach to time maintain that a tensed sentence such as '*E* is present' always expresses the same proposition, whenever it is uttered, even though its truth-value clearly depends upon the time.

Is a person who advances the latter claim failing to distinguish between propositions and propositional functions? In some cases, perhaps. But not, I think, in most, since advocates of the above view often contend—contrary to what is claimed by those who favour a tenseless view of time—that ordinary tensed sentences express propositions, rather than propositional functions:

> To say that Mrs Brown is not at home always amounts to affirming the same state of affairs: the failure on the part of the same person to display the same property. But since that state of affairs is intermittent, so is the truth of what is affirmed; the proposition that Mrs Brown is at home is sometimes true and sometimes false.[57]

In saying that advocates of the concept of truth at a time are mistaking propositional functions for propositions, Ducasse was probably not saying, however, that such philosophers were failing to draw a certain distinction. It seems more likely that what he was saying was that certain sentences—such as 'World War II is now taking place'—whose meanings are in fact given by propositional functions, and which thus express different propositions when uttered on different occasions, are mistakenly viewed as expressing the same proposition whenever they are uttered. This mistake then leads to the conclusion that a proposition can have different truth-values at different times, and thus to the idea that there must be a coherent concept of temporally relativized truth.

If this is the thrust of Ducasse's criticism, then I think it is right

[57] Pavel Tichy, 'The Transiency of Truth', *Theoria,* 46 (1980,) 165–82, at p. 166. Tichy proceeds, on pp. 167–9, to offer a number of arguments against the view that different tokens of a given tensed sentence express different propositions.

up to a point, since I agree with advocates of a tenseless approach to time that no satisfactory account can be given of *ordinary* tensed statements, unless they are taken as involving indexicals, and therefore as expressing different propositions when uttered on different occasions.[58] But, as the above discussion shows, even if this is correct, it is wrong to conclude from this that the concept of truth at a time rests upon this mistake, since one can support the idea of truth at a time by appealing, not to a very controversial, and, I believe, ultimately untenable claim concerning ordinary tensed sentences, but, instead, to the idea of the sort of dynamic world where what *tenseless* facts there are changes with the passage of time. When this is done, the argument for a temporally relativized concept of truth clearly does not rest upon any confusion between propositions and propositional functions.

5.1.2 Dynamic Worlds, Correspondence, and Truth at a Time

If this is right, then it is a mistake to argue—as advocates of tensed approaches to time are wont to do—from a rejection of indexical accounts of the truth conditions of ordinary tensed sentences to the conclusion that a temporally relativized concept of truth is necessary. The premiss in question is, at the very least, far too controversial. The correct course, I am suggesting, is one that confines itself, instead, to tenseless statements, interpreted in the ordinary way, and then moves from the idea of a dynamic world to the idea of truth at a time.

The argument, given the latter approach, is very brief, since it is simply a matter of appealing to a correspondence theory of truth. Thus, if what tenseless, temporal facts there are depends upon what time it is, and if truth, at least in the case of contingent propositions, is a matter of correspondence with facts, then one can certainly introduce the notion of truth at a time, defining it as a relation of correspondence between a proposition and states of affairs that are actual as of the time in question. If, therefore, the idea of a dynamic world is coherent, then so is the concept of temporally relative truth, at least in the case of tenseless propositions about temporal states of affairs.

[58] This issue is discussed in Sect. 8.3.

Correspondence theories of truth come, of course, in different forms, but, as regards the present argument, the precise form does not seem crucial. Thus, for example, it would not seem to matter exactly what sorts of entities the bearers of truth are. So, while I am inclined to hold, first, that, although sentences and utterances can be true and false, the fundamental bearers of truth are propositions, and, secondly, that the latter, rather than being viewed as denizens of a third world, are to be understood as constituents of mental states, the above argument would not be affected by the adoption of more linguistic, or more Platonic, approaches.

The same would seem to be the case with respect to the precise account of the relation of correspondence between propositions (or other bearers of truth) and the aspects of the world that determine the truth-values of those propositions. My own preference here is for an account, first, that distinguishes between simple propositions and complex ones; secondly, that makes use of causal theories of reference and meaning to give an account of the correspondence relation in the case of simple propositions; and, thirdly, that explains the correspondence relation in the case of complex propositions in the familiar, recursive fashion. But again, there seems to be no reason to think that a different account of the relation of correspondence would affect the argument.

5.2 Tensed Views of Time and Three-Valued Logic

A second issue that needs to be considered concerns the relation between dynamic accounts of the nature of time and three-valued logic. This issue is important both because it illuminates some central aspects of the concept of truth at a time, and because it focuses upon what many philosophers may feel is a decisive stumbling-block for the whole programme.

5.2.1 Reasons for Adopting a Three-Valued Logic

Does a tensed approach to time require a three-valued logic? It depends upon the type of tensed approach. If one opts for the view that there are no ontological chasms between the past, the present, and the future, but simply intrinsic properties of pastness, presentness, and futurity, each of which is possessed by every event at some time or other, then one neither needs, nor wants, a three-valued logic, for, if the past, the present, and the future are equally real, there is no room for a class of facts whose absence, or non-actuality, as of a given time makes it the case that some statements are neither true nor false at that time.

By contrast, if one holds that there is an ontological gulf between the future, on the one hand, and the past and the present on the other, then I believe that a metaphysically satisfactory representation of the situation requires a three-valued logic, for, while it will still be the case that every statement is either true at a given time, or not true at that time, there are two very different ways in which a statement may fail to be true at a given time, if the future is not real. Compare, for example:

S: There are (tenselessly) no dinosaurs.
T: There are (tenselessly) unicorns in the year ad 2000.

The former of these is not true, in the year 1980, say, because it is true in the year 1980 that there exist (tenselessly) positive states of affairs that render any denial of *S*—such as, 'There are (tenselessly) dinosaurs'—true at that time. *T,* on the other hand, also fails to be true in the year 1980, but for a different sort of reason. It is not true in the year 1980 that there exists (tenselessly) some positive state of affairs that renders any denial of *T*—such as, 'It is not the case that there are (tenselessly) unicorns in the year ad 2000'—true in the year 1980. It is simply that there is no positive state of affairs that is actual as of the year 1980 that renders *T* true at that time. In short, given the type of tensed account being defended here, some statements fail to be true at a time simply because there is nothing that is actual, as of that time, that makes them true, while others fail to be true at a time because there is, as of that time, a positive truth-maker for some logically incompatible statement. And given that this is so, to hold that there are only two truth-values—namely, truth and falsity—would seem unsatisfactory, since it does not bring out the fact that statements may fail to be true in two very different ways. A three-valued logic with truth, falsity, and indeterminateness provides a vivid representation of this fact.

A related point is this. I stressed in the previous section that, if the future is not real, then even a tenseless, indexical-free statement may have different truth-values at different times. 'There are (tenselessly) unicorns in the year ad 2000' may be true in the year 2001, even though it is not true in the year 1996. Such statements may therefore change from being not true at one time to being true at some other time. But if, in addition, one holds that there are only two truth-values, one must hold that change in the opposite direction is also possible, since the statement 'It is not the case that there are (tenselessly) unicorns in the year ad 2000', is, on that view, true in the year 1996, and it may very well not be true in the year 2001. If, however, tenseless statements which are false at one time can become true at a later time, and those which are true at one time can become false at a later time, one might wonder whether some statements can oscillate back and forth between truth and falsity. The answer, of course, is that this is not possible: a statement expressing a proposition can change its truth-value only once. To explain why this is so, however, one needs to bring in, once again, the fact that there are two very different ways in which a statement may fail to be true, and so, in the end, one is in effect making use of three truth-values. Is it not better, therefore, to make everything explicit, by formulating things in terms of a three-valued logic? Then one can say, first, that, if a tenseless statement is either *true* or *false,* this is in virtue of the existence of a relevant truth-maker—that is, a truth-maker either for the statement or for its denial—and this will enable one to explain why a statement cannot be true at one time, and false at another time. And, secondly, that, if a statement has the truth-value *indeterminateness,* this is because of the absence of relevant truth-makers, and so such a statement may, at some later time, become either true or false. These facts, taken together, then entail that a tenseless statement may change its truth-value only once. A three-valued logic provides, therefore, a more perspicuous representation of the underlying metaphysics.

5.2.2 Three-Valued Logic and the Third Truth-Value

If one does accept the conclusion that, in the case of a temporally relativized concept of truth, there are three truth-values that a proposition may have at a time, how are those three truth-values to be viewed? In particular, how does the third truth-value compare with the other two?

What I want to suggest is that it is illuminating, in a number of respects, if one views the third truth-value—indeterminateness—as metaphysically inferior to the other two. In particular, try thinking of truth and falsity as the 'metaphysically real' truth-values, and indeterminateness as simply the absence of both truth and falsity, as a truth-value gap. One thing that this will do is to enable one to make sense of the fact that, while tenseless propositions that have the truth-value indeterminateness may become either true or false, those that are either true or false can never change their truth-values. Now this may be viewed as a matter of its being possible, on the one hand, for a proposition which lacks a (genuine) truth-value to acquire one, but impossible, on the other hand, for a proposition which has a (genuine) truth-value ever to lose it.

A second advantage that accrues from this discrimination against the third truth-value is that one can offer a rationale for the procedure that is implicit in the construction of the three-valued truth-tables for the logical connectives. Consider, for example, the table for disjunction. The part of the table that agrees with the corresponding truth-table in two-valued logic poses, of course, no problem, since, if it were not the same, it would be impossible to hold that one was dealing with the same logical connective. So part of the three-valued truth-table for disjunction will certainly be as indicated in Fig. 5.1. How are the remaining entries to be filled in? If one thinks of the truth-value *i* as really indicating a truth-value gap, then it is natural to consider how the truth-value of the disjunction will turn out given the different possible ways of filling in those truth-value gaps. If the same truth-value results for every possible filling-in, then one can take that truth-value as the appropriate entry. Thus, for example, in the case where *p* has the truth-value *t,* and *q* the truth-value *i,* the appropriate truth-value for the disjunction is *t,* since that will be the truth-value it will receive when *q*'s truth-value gap is filled in either by the truth-value *t,* or by the truth-value *f.* On the other hand, if some replacements of the truth-value *i* by the truth-values *t* and *f* result in the disjunction's being true, and others in its being false, then the appropriate entry for the

Fig. 5.1

p or q

p	*q*:	*t*	*f*	*i*
t		*t*	*t*	
f		*t*	*f*	
i				

relevant point in the table is *i,* since the assignment of either *t* or *f* would mean that there could be tenseless statements which possessed different (genuine) truth-values at different times. The case where *p* has the truth-value *f,* and *q* the truth-value *i,* will be such a case, and so the appropriate entry for that point in the truth-table will be *i.*

A third advantage is that this way of viewing the three truth-values provides a rationale for the account that is needed in the case of logical truth. In two-valued logic, the tautologies are the statements that turn out to be true under every possible assignment of truth-values to their elements. But this is not the case in three-valued logic. If, for example, *p* has the truth-value *i,* then so does '*p* or not *p*'. But it is well known that, if one applies van Fraassen's method of supervaluations,[59] one captures, within a three-valued logic, precisely those propositions that are logical truths within two-valued logic. The method of supervaluations involves considering, however, what happens when truth-value gaps are filled in. The upshot, therefore, is that, within a three-valued logic, logical truths are those propositions that are true under any assignment of 'genuine' truth-values to their components. Consequently, given an appropriate and quite natural understanding of the expression 'possible world', it remains true in a three-valued logic that logical truths are those propositions that are true in all possible worlds.

5.2.3 Three-Valued Logic as a Stumbling-Block

But if the type of tensed approach to be defended here is best served by a three-valued logic, does not that fact itself constitute a stumbling-block? May it not turn out that the required three-valued logic exhibits features found in other non-classical logics—features that appear quite problematic? In intuitionistic logic, for example, it is held that it need not always be the case that *p* or not *p*. More dramatically, in more recent, dialethic logics, it is maintained that it may sometimes be the case that both *p* and not *p*.[60]

[59] Bas van Fraassen, 'Singular Terms, Truth-Value Gaps, and Free Logic', *Journal of Philosophy,* 63 (1966,) 481–95, contains an exposition of the method of supervaluations.

[60] See e.g. Graham Priest, *In Contradiction—A Study of the Transconsistent* (Dordrecht: M. Nijhoff, 1987.)

Confronted with such rejections of the law of excluded middle, or of the principle of non-contradiction, it is very natural to wonder whether what is being called 'negation' really is negation. And in general, when a non-classical logic entails that certain statements that are classified as expressing logical truths, not only by classical logic, but by our ordinary, pre-theoretical logical intuitions, do not really do so, there would seem to be strong prima-facie grounds for concluding that some of the logical connectives employed in the non-classical logic in question cannot be identical with standard ones. Moreover, if the latter is the case, it raises the very strong suspicion that the reason that there are non-standard logical connectives masquerading as standard ones is that there is no way, in the logic under consideration, of expressing the standard logical connectives in question.

The question thus arises whether the same problem may not be present in the case of three-valued logic. Do some statements that we ordinarily take to be tautologies turn out not to be logical truths? If they do, is not that a good reason for concluding that one or more of the logical connectives cannot be identical with standard ones, and for suspecting, moreover, that the reason that this is so is that it is impossible properly to express some of the ordinary logical connectives in three-valued logic?

This line of thought receives considerable confirmation, moreover, when one turns to what, in the words of Prior, 'might now be described as the "classical" system of three-valued logic',[61] namely, that introduced by Jan Łukasiewicz in 1920, and a system that, moreover, arose out of reflection upon Aristotle's famous discussion, in his *De interpretatione,* of the question of the truth-values of propositions concerning contingent future events. Consider the truth-tables for negation, conjunction, disjunction, and the material conditional, in the system of three-valued logic proposed by Łukasiewicz, as set out in Figs 5.2–5.5.[62] Examining these tables, it can be seen that some of the logical connectives are interrelated in the normal ways. This is true as regards negation, disjunction, and

[61] Prior, 'Three-Valued Logic and Future Contingents', 317.

[62] Jan Łukasiewicz, 'O logice trójwartościowej', *Ruch Filozoficzny,* 5 (1920), 169–71. For presentations and discussions in English, see C. I. Lewis and C. H. Langford, *Symbolic Logic* (1932; 2nd edn., New York: Dover, 1959), 213ff., and William Kneale and Martha Kneale, *The Development of Logic* (Oxford: Oxford University Press, 1962,) 568–75.

Fig. 5.2

not p

p	
t	*f*
f	*t*
i	*i*

Fig. 5.3

p and q

q:	*t*	*f*	*i*
p			
t	*t*	*f*	*i*
f	*f*	*f*	*f*
i	*i*	*f*	*i*

Fig. 5.4

p or q

q:	*t*	*f*	*i*
p			
t	*t*	*t*	*t*
f	*t*	*f*	*i*
i	*t*	*i*	*i*

Fig. 5.5

if p, then q

q:	*t*	*f*	*i*
p			
t	*t*	*f*	*i*
f	*t*	*t*	*t*
i	*t*	*i*	*t*

conjunction. Thus, for example, these tables assign the same truth-values to '*p* or *q*' and to 'not (not *p* and not *q*)', and similarly, to '*p* and *q*' and to 'not (not *p* or not *q*)'. On the other hand, the conditional is not related to disjunction and negation in the normal way, as is shown by the fact that, if '*p*' and '*q*' both have the truth-value *i,* 'not *p* or *q*' also has that truth-value, whereas the conditional, 'if *p,* then *q*', has the truth-value *t.*

Apparently even more serious, however, is the fact that certain statements that are normally taken as expressing logical truths do not do so in Łukasiewicz's system. Thus, neither '*p* or not *p*' nor 'not (*p* and not *p*)' express tautologies, since if '*p*' has the truth-value *i,* then so do '*p* or not *p*' and 'not (*p* and not *p*)'. So neither the law of excluded middle, nor the law of non-contradiction, obtains.

The first of the above difficulties could be escaped by altering the truth-table for the conditional, so that 'if *p,* then *q*' would get assigned the truth-value *i,* rather than the truth-value *t,* when both '*p*' and '*q*' had the truth-value *i.* This would restore the normal relation among material implication, disjunction, and negation. It would do so, however, at the cost of augmenting the second sort of difficulty, since the change in question would have the result that 'if *p,* then *p*' would no longer express a tautology, since its truth-value would be *i* when '*p*' had the truth-value *i.*

What of the second difficulty? A familiar line of thought may seem to show that it is inescapable, with the result that one has here a decisive objection to three-valued logic. The argument runs as follows. First, if '*p*' has the truth-value *i,* then 'not *p*' must have that truth-value as well. Secondly, if '*p*' and '*q*' are unrelated, and if both have the truth-value *i,* then surely the disjunction of them, '*p* or *q*', must also be assigned the truth-value *i.* But, thirdly, '*p* or not *p*' is a necessary truth, and so '*p* or not *p*' must be assigned the truth-value *t* regardless of the truth-value of '*p*'. These three conditions, taken together, entail that in some cases where both '*p*' and '*q*' have the truth-value *i,* '*p* or *q*' has the truth-value *i,* while in other cases it does not. This implies that the truth-functional connective, 'or', is not truth-functional! So three-valued logic must be rejected as an absurdity.

This is, surely, a crucial objection to three-valued logic. Moreover, since I have argued that, given a tensed approach according to which the past and the present are real, but the future is not, the concept of truth at a time is most naturally formulated in terms of three truth-values, it would seem that this is also a crucial objection to the view of time that I am defending. In the next section, however, I shall argue that a completely satisfactory answer is available.

5.3 Truth-Functionality and the Logical Connectives

As we have just seen, any three-valued logic is exposed to the following objection. First, while the familiar logical connectives of classical, two-valued logic are truth-functional, the logical connectives employed in three-valued logic are not, and cannot be, truth-functional. But, secondly, truth-functionality is surely of the very essence of the connectives in question. It therefore follows not only that the logical connectives typically employed in three-valued logic are not what they purport to be, but that there is no way in which a three-valued logic can include the ordinary logical connectives.

In the present section, I want to offer a detailed reply to this objection. Before doing that, however, I think that it may be helpful if I briefly indicate the overall structure of my response. First, central to my argument will be a distinction between factual truth and logical truth. I shall therefore begin by offering some support for that distinction. My appeal at that point will be to a correspondence theory of truth, and I shall argue that, if one takes a correspondence theory seriously, one has good reason to draw a distinction between factual truth and logical truth. Secondly, given that distinction, I shall then go on to argue that, if one considers what are normally referred to as the truth-functional connectives, it becomes clear that, in addition to being functions that map truth-values into truth-values, they are also functions that map what I shall call factual-truth-values into factual-truth-values. The question therefore arises as to which of those properties of the familiar logical connectives should be viewed as more fundamental: their truth-functionality, or their factual-truth-functionality?

Neither philosophers nor logicians have, I believe, ever addressed this issue. The standard view of the familiar logical connectives implicitly involves, however, the idea that truth-functionality is the basic property, for it is assumed that the very meaning of those connectives is to be given via truth-tables. I shall argue, however, that it is not truth-functionality, but factual-truth-functionality, which is more basic. The third stage of my argument, accordingly, involves offering support for this claim, and this will take the form of the following three points. First, it certainly *seems* that the familiar logical connectives are perfectly intelligible within the three-valued logic that is needed if the world is a dynamic one where the future is not real as of the present moment. Secondly, if the logical connectives are intelligible in that context, then one must adopt the view that it is factual-truth-functionality, and not truth-functionality, that defines the nature of those connectives, since, while the logical connectives are functions with regard to factual-truth status in both three-valued logic and two-valued logic, they are functions with regard to truth status only in two-valued logic. Thirdly, the view that the fundamental property of the familiar logical connectives is factual-truth-functionality rather than truth-functionality would not be acceptable, of course, if the connectives thus defined did not turn out to be truth-functional within two-valued logic. A crucial step in the argument, therefore, involves showing that, if factual-truth-functionality is taken as the basic property, it follows that the connectives in question are truth-functional within two-valued logic, but not within three-valued logic.

My conclusion, accordingly, will be that factual-truth-functionality, rather than truth-functionality, is the basic property of the familiar logical connectives, and that, as a consequence, the claim that the logical connectives found in three-valued logic cannot be the standard logical connectives of classical two-valued logic is not justified.

5.3.1 Factual Truth and Logical Truth

Let us now turn to the details. The starting-point of the above objection is certainly correct. On the one hand, in the case of two-valued logic, what are normally referred to as truth-functional connectives are indeed fully truth-functional: given the truth-values of the components of any complex proposition, the relevant truth-tables necessarily assign the correct truth-value to that proposition. By contrast, in the case of three-valued logic, when one is dealing with truth at a time, what purport to be the ordinary logical connectives are not always fully functional with respect to truth-values at a given time—as we saw in Section 5.2.

It certainly seems very plausible, initially, to conclude that this feature points to a defect in three-valued logic. But I believe that further reflection shows that that is not the case. To see why this is so, we need to begin by drawing a distinction between, on the one hand, factual truth, and factual truth at a time, and, on the other hand, logical truth. Factual truth, and factual truth at a time, as they will be understood here, are both a matter of correspondence between a proposition and the world, or between a proposition and the world as it is as of a given time. Thus, in the case of factual truth *simpliciter,* a proposition (or statement, or sentence, etc.) is factually true if, and only if, there is some external truth-maker for it—that is, if and only if there is some fact outside the proposition itself that suffices to ensure that the proposition is true. Similarly, in the case of factual truth at a time, a proposition is factually true at a given time if, and only if, some external truth-maker for it is actual as of the time in question. Logical truth, on the other hand, does not require any correspondence with an external truth-maker: a proposition's being logically true is simply a matter of the logical form of the proposition itself.

At this point, I think that it will be very helpful to adopt a certain terminological convention. In the case of two-valued logic, I shall be referring frequently to truth-values, and factual-truth-values. In the case of three-valued logic, on the other hand, the relevant concepts are instead truth-values-at-a-time, and factual-truth-values-at-a-time. It will greatly simplify the discussion, however, if I refer in both cases to truth-values and factual-truth-values, taking it as understood that in the case of three-valued logic all such references have to be viewed as implicitly indexed to some specific time.

It is important to notice that the above characterization of the concepts of factual truth and logical truth does *not* make them mutually exclusive concepts. A proposition is factually true if there is some fact outside it that *suffices to ensure* that the proposition is true, and this may be so without its being the case that the fact in question is *necessary,* in the circumstances, for the truth of the proposition. As a consequence, it is possible for a proposition to be both factually true and logically true. Indeed, in the case of two-valued logic, every logical truth will also be a factual truth. The corresponding relation does not obtain, however, in the case of three-valued logic, where it is possible for a proposition to be logically true without its being factually true at a given time.

Consider, for example, the proposition that unicorns either exist or do not exist. This is a logical truth, but, given a two-valued logic, it must also be factually true, since one of its disjuncts must be such that the way the world is makes that disjunct true, and anything that makes one of the disjuncts true must also serve to ensure that the disjunction is true. So there is, in the world, a truth-maker for the disjunction, and this means that, according to the above definition, it is factually true. By contrast, the disjunction may very well not be factually true at a given time, for there need not be any state of affairs that is actual as of a given time that suffices to make either disjunct true.

5.3.2 Logical Connectives as Functions With Respect to Factual Truth

Given the above accounts of factual truth and logical truth, consider the familiar logical connectives. Those connectives are certainly truth-functional within two-valued logic. But they also have another property—namely, they are functions with respect to factual-truth-status, since, if one takes the familiar truth-tables, and replaces all of the references to truth and falsity by references to factual truth and factual falsity, the resulting 'factual-truth-tables' are sound: given any specification of which components of some complex proposition are factually true, or factually false, those tables will correctly specify whether the complex proposition is factually true or factually false.

To see why this is so, one needs to establish the following two important claims:

(1) *p* is true *simpliciter* if, and only if, *p* is factually true *simpliciter*;
(2) *p* is false *simpliciter* if, and only if, *p* is factually false *simpliciter*.

The 'if' part of each of these claims is trivial. Being factually true was defined in terms of there being a state of affairs in the world that suffices to ensure that the proposition in question is true. So a proposition cannot be factually true without also being true. Similarly, a proposition cannot be factually false without also being false.

The 'only if' claims, however, do require an argument, which is as follows. Suppose that *p* is any true proposition, and consider all of the atomic propositions that are relevant to it. Each of those propositions must, in a two-valued system, be either true or false. The truth-values of those atomic propositions must suffice, moreover, to make it the case either that *p* is true, or else that *p* is false, in virtue of the relevant truth-tables. But, given that *p* is true, they cannot suffice to make *p* false. Hence they must suffice to make it the case that *p* is true. Those propositions, however, are atomic. So none of them can be true, or false, in virtue of logical form: each must be either factually true or factually false. But, then, the set of facts in the actual world that makes each of those atomic propositions either factually true of factually false must, together with the relevant truth-tables, also suffice to ensure that *p* is factually true. So the fact that atomic propositions can be true or false only by being, respectively, factually true or factually false entails that a complex proposition can be true only if it is also factually true. And a precisely parallel argument shows that a complex proposition can be false only if it is also factually false.

The fact that (1) and (2) are true entails that one can, in the familiar two-valued truth-tables for the connectives, replace all references to truth and falsity by references to, respectively, factual truth and factual falsity, and generate, thereby, tables that are also correct. So, within two-valued logic, the familiar logical connectives are not merely functions with regard to truth-values: they are also functions that correctly map the factual-truth-values of ordered *n*-tuples of simpler propositions into the factual-truth-values of more complex propositions.

But what is the situation in the case of three-valued logic, where one is dealing, not with truth *simpliciter,* but with truth at a time? The answer is that, when the two-valued truth-tables for the logical connectives are extended to three-valued tables in the appropriate way, it turns out that the logical connectives thus defined are also functions that correctly map the factual-truth-values of ordered sets of propositions at a given time into the factual-truth-values of more complex propositions at the time in question. The type of argument that was just set out in the two-valued case cannot, however, be paralleled in the three-valued one, for the thrust of that argument was that, if the logical connectives are truth-functional, they must also be functions with respect to factual-truth-status, and we saw earlier that the logical connectives are not truth-functional in the three-valued case. So a different line of argument is obviously needed.

The desired result can, however, be established along the following lines. First, recall the method for constructing truth-tables for three-valued logical connectives that was described earlier, in Section 5.2.2. The basic ideas were, first, that the three-valued truth-tables are to agree with the corresponding two-valued tables whenever the third truth-value is not involved, and, secondly, that, when one or more of the component propositions does have the third truth-value, the correct truth-table entry is to be determined by considering all possible ways of replacing the third truth-value, indeterminateness, by either truth, or falsity. If the compound proposition is true under every such replacement, the correct truth-table entry at the relevant location is truth. Similarly, if the compound proposition is false under every such replacement, the correct truth-table entry at the relevant location is falsity. Finally, if the compound proposition is true given some replacements, and false given others, then the correct truth-table entry is the third truth-value—indeterminateness.

Secondly, consider all of the three-valued logical connectives whose truth-tables can be constructed in this way on the basis of *any* truth-functional, two-valued connective. Is it the case that all of them are functions with respect to factual-truth-status at a time? The answer is that this is not the case. But, while certain three-valued connectives are not functional with respect to factual-truth status, it can be argued that those ones can be set aside without loss, on the grounds that they turn out to be in a certain sense trivial. It can then be shown that the remaining, non-trivial three-valued logical connectives *are* functional with respect to factual-truth-status at a time.

Let us now turn to the details of this argument. Consider, then, any three-valued logical connective that has been constructed on the basis of some two-valued truth-functional connective in the way just described. If one starts from any two-valued truth-function that might naturally be viewed as a logical connective, there is no problem, as we shall see shortly. But if one works simply with the general idea of *any* mapping from *n*-tuples of truth-values into truth-values, it is important to notice that certain two-valued truth-functions must be excluded. These are the *constant* functions—that is, those truth-functions that map all *n*-tuples of truth-values into the same truth-value. The reason that they must be excluded is as follows. First, when a three-valued connective is constructed, in the manner described above, on the basis of any constant, two-valued, truth-function, the resulting three-valued connective will also be a constant function, since, given that the two-valued function is a constant function, the same truth-value will result no matter how occurrences of the third-truth value in any *n*-tuple are replaced by truth or falsity.

Secondly, if the three-valued function must also be a constant function, this implies, in particular, that the resulting three-valued connective must map the *n*-tuple, all of whose elements are identical with the third truth-value, either into truth or into falsity, rather than into the third truth-value.

But then, thirdly, when truth, falsity, and indeterminateness are replaced throughout by factual truth, factual falsity, and factual indeterminateness, the resulting connective will not be sound. The reason is that the existence of such a connective would imply that, given only the fact that a number of propositions are factually indeterminate at a time, it follows that there is some proposition that is *factually* true at that time (or factually false at that time), and that is obviously impossible: the absence of states of affairs that would render certain propositions true, or false, cannot entail the existence of a state of affairs that makes some other proposition either true, or false.

Consequently, constant functions must be excluded if the claim is to be sustained that, when the familiar logical connectives, truth-functionally interpreted, are extended from the two-valued case to the three-valued case, they will be functional within three-valued logic with respect to factual-truth-status at a time. But, given that the constant functions are not even such as it is natural to classify as logical connectives, let alone as functions that correspond to any standard logical connectives, their exclusion cannot, I should think, be the basis of any interesting objection to three-valued logic.

What has to be shown, accordingly, is that any three-valued logical connective that has been constructed on the basis of some *non-constant,* two-valued truth-functional connective in the way described earlier is functional with respect to factual-truth-status at a time. To do this, we need to consider three cases: first, where an *n*-tuple of factual-truth-values at a time is mapped into the value, factual truth at that time; secondly, where the mapping is into factual falsity at that time; and, finally, where the mapping is into factual indeterminateness at that time.

First, then, consider a case where some *n*-tuple of factual-truth-values at a time is mapped into the value of factual *truth* at that time, and let us ask whether that type of mapping could possibly be unsound. The crucial point to notice is that, given the earlier exclusion of constant functions, it cannot be the case that *all* of the elements of the *n*-tuple are identical with the third truth-value. The reason is connected with the fact that the method of constructing the three-valued logical connectives involves assigning the value truth at a time to a given location in the three-valued truth-table only if *every* way of filling in the relevant truth-value gaps—that is, of replacing occurrences of the third truth-value by one of the other two truth-values—results in the value truth. Given this method, any three-valued logical connective that mapped an *n*-tuple, every element of which was identical with the third truth-value, into either of the other two truth-values would have to be a constant function.

Consequently, at least one of the elements in any ordered *n*-tuple that gets mapped into factual truth at a time must be identical either with factual truth at a time or with factual falsity at a time.

We can consider, then, the ordered set of all the elements of the *n*-tuple in question that are not identical with the third truth-value, and we now know that that set cannot be empty. But we also know that, if any element of the *n*-tuple that is identical with the third truth-value were to be replaced by either of the other two truth-values, the mapping in question would also have to take the resulting *n*-tuple into the value, factual truth at a time, in virtue of the second rule for constructing the three-valued truth-table. This means that the ordered set of all the elements of the *n*-tuple in question that are *not* identical with the third truth-value suffices by itself to determine the truth-value into which the *n*-tuple is mapped. Therefore, given that the ordered set of propositions that corresponds to that ordered set of truth-values consists of propositions all of which are either factually true at the time or factually false at the time, the world as it is as of the time in question must contain states of affairs that suffice to ensure that the complex proposition that is constructed out of simpler propositions via the logical connective in question is true at the time. It therefore follows that that complex proposition is, by definition, *factually* true at the time in question.

A precisely parallel argument applies to the case of any mapping from an *n*-tuple of factual-truth-values at a time into factual *falsity* at a time. Accordingly, we are left only with the case of the mapping of an *n*-tuple into the truth-value of factual *indeterminateness* at a time. Here the argument is simply that, since the procedure for constructing the three-valued truth-tables assigns the value indeterminateness only if some ways of filling in the truth-value gaps result in the value truth, while others result in the value falsity, the states of affairs that make it the case that the *n*-tuple contains elements that are identical either with factual truth at a time, or with factual falsity at a time, cannot be sufficient to ensure that the complex proposition in question is either true or false, and it therefore follows that that proposition is, by definition, factually indeterminate at the time in question. So the mapping does assign the correct factual-truth-value in this case as well, and this completes the proof that any three-valued logical connectives that are constructed, in the manner indicated above, from any two-valued logical connectives—aside from the case of those trivial 'logical connectives' that correspond to constant truth-functions—must be functions with respect to factual-truth-values at a time.

The overall conclusions to this point, accordingly, are as follows. First, if one takes the familiar truth-table definitions of the logical connectives, and extends them to the three-valued case, the resulting definitions are not sound—for, as we have seen, the connectives in question are not truth-functional in the case of three-valued logic. Secondly, however, if one interprets the tables as dealing not with truth-values, but with factual-truth-values, the resulting definitions are sound—for the logical connectives are functions with respect to factual-truth-values in both the two-valued case and the three-valued case.

5.3.3 What Is the Basic Property of the Logical Connectives?

Given that the familiar logical connectives are, in the two-valued case, not only functions that map the truth-values of constituents into the truth-values of complex propositions, but also functions that correctly map the factual-truth-values of constituents into the factual-truth-values of complex propositions, the question arises as to which of these two properties one should take as defining the logical connectives: truth-functionality, or factual-truth-functionality?

The fact that the meanings of the logical connectives are typically explained by means of truth-tables makes it very natural to hold that it is truth-functionality that should be taken as defining the familiar logical connectives. But then one needs to consider what one is to say about the case of someone who accepts a dynamic view of the world according to which the future is not now real, and who maintains, for example, that, although the sentence 'Either there are unicorns in the year 2000 or it is not the case that there are unicorns in the year 2000' is true now, neither of the disjuncts of that sentence is true now. If one holds that truth-functionality is the very essence of the familiar logical connectives, one is forced to conclude that the person in question must either be saying something that is simply self-contradictory, or else he or she must be using the word 'or' in some eccentric way.

How plausible are these two alternatives? According to the first, philosophers who accept a certain dynamic view of the world are committed to views that are not only self-contradictory, but are so in a very straightforward and immediate way. According to the second, a philosopher who shifts from a dynamic view of the world to a static one, or vice versa, must change the meanings that he or she assigns to the familiar logical connectives on making that shift. Neither of these hypotheses, I suggest, is really very plausible.

What about the other alternative? If it is factual-truth-functionality, rather than truth-functionality, that is the defining property of the familiar logical connectives, then the above utterance is not self-contradictory, since, when the logical connectives are defined by means of factual-truth-tables, it turns out that they are not truth-functional within the three-valued context that one has when one is dealing with truth at a time. But what happens if one shifts from a dynamic view of the world to a static one, or vice versa? Can one avoid having to reinterpret the logical connectives?

The answer to this question turns upon whether, if factual-truth-functionality is taken as the defining property of the logical connectives, it follows that the logical connectives, thus understood, are truth-functional within a two-valued context. Is this the case or not? The answer is that, when the logical connectives are defined as factual-truth-functions, it does turn out that they are also truth-functions, in the two-valued case, since this follows from two propositions that were established in the preceding section, namely:

(1) *p* is true *simpliciter* if, and only if, *p* is factually true *simpliciter*;
(2) *p* is false *simpliciter* if, and only if, *p* is factually false *simpliciter*.

For if the logical connectives are defined as functions that map factual-truth-values into factual-truth-values, it follows, given (1) and (2), that in a two-valued context they also map truth-values into truth-values. Factual-truth-functionality entails truth-functionality within two-valued logic.

To sum up. The view that the defining property of the logical connectives is that they are truth-functions leads to unacceptable consequences when one considers the possibility that the world is a dynamic one. By contrast, the view that the defining property of the logical connectives is that they are functions with respect to factual-truth-values enables one, first of all, to assign coherent sense to propositions advanced by those who hold that the future is not now real; secondly, to interpret the logical connectives in the same way regardless of whether one adopts a dynamic view of the world, or a static one; and, thirdly, to explain why it is that the logical connectives are truth-functional within two-valued logic, but not within three-valued logic. As a consequence, there seems to be excellent reason for accepting the view that it is factual-truth-functionality, rather than truth-functionality, that is the basic property of the logical connectives, and thus for concluding that the fact that the familiar logical connectives are not truth-functional within three-valued logic is no reason for thinking that three-valued logic is in any way problematic.

5.4 Truth Simpliciter

If the world is a dynamic one, it is both possible to employ the concept of truth at a time, and very natural to do so. But then where does that leave the other, and undoubtedly more familiar concept of truth, according to which truth is simply a property of a proposition, rather than a property of a proposition at a time? Most advocates of a tensed approach to time seem to hold that the concept of truth *simpliciter* should simply be rejected.[63] I shall argue, however, that this view is mistaken.

My discussion is divided into three sections: the first focuses upon a central difference between truth at a time and truth *simpliciter*; the second, upon the need for the concept of truth *simpliciter*; and the third, upon its definability.

5.4.1 Truth Simpliciter as Two-Valued

A proposition need not be either true at a time or false at a time: it may, instead, be indeterminate. Truth at a time is, in short, three-valued, whereas truth *simpliciter* is two-valued, and this latter fact is one of the main reasons that the concept of truth *simpliciter* is typically rejected by advocates of a dynamic view of the world. For if, say, the world is one where events come into existence, and where the past and the present are real, but the future is not, then there must always be, at absolutely every moment, propositions that are neither true nor false. So how can there be any room for the concept of truth *simpliciter*—given that, according to that conception

[63] See e.g. Quentin Smith, *Language and Time* (New York: Oxford University Press, 1993,) esp. pp. 98ff.

of truth, it seems that every proposition, without exception, must be either true or false?

But is truth *simpliciter* necessarily two-valued? Or is that just an assumption that is very natural to make if one believes in a static world, rather than a dynamic one? The answer is that truth *simpliciter* is necessarily two-valued—a fact that can be established by a simple argument based upon what Tarski referred to as the conditions under which any definition of the truth-predicate can be considered as 'adequate from the material point of view'.[64]

The material condition of adequacy formulated by Tarski is concerned with equivalences of the following form—

(T) *X* is true if, and only if, *p*

—and what the requirement states is that a definition of truth is adequate only if it entails all of the equivalences that result when, in (T), '*p*' is replaced by any sentence of the language in question, and '*X*' by any name of that sentence.[65]

Let us now assume that the language is one where we can form a name of a sentence by placing the sentence within single quotes, and that '*p*' is some specific sentence in the language, and 'not *p*' its negation. Then any adequate account of the truth-predicate for that language must entail the following two equivalences:

(1) '*p*' is true if and only if *p*;
(2) 'not *p*' is true if and only if not *p*.

But then, in view of the fact that it is a logical truth that

(3) *p* or not *p*,

it follows from (1) and (2) that

(4) Either '*p*' is true or 'not *p*' is true.

Finally, however, we also have the following definition

(5) '*p*' is false if and only if 'not *p*' is true,

and it then follows from (4) and (5) that

(6) Either '*p*' is true or '*p*' is false.

64 Alfred Tarski, 'The Semantic Conception of Truth and the Foundations of Semantics', *Philosophy and Phenomenological Research,* 4 (1944,) 341–76.

65 Ibid. 344.

In the case of truth *simpliciter,* therefore, there can be only two truth-values: truth and falsity. To embrace that notion is to hold, therefore, that every proposition to which it applies is either true or false.

5.4.2 The Need for the Concept of Truth Simpliciter

If the world is dynamic, rather than static, why is there any need to go beyond the concept of truth at a time, and to employ the concept of truth *simpliciter*? I shall argue that there are at least three reasons why the latter concept is necessary—namely, to make sense of the attribution of truth to at least the following sorts of propositions: first, propositions expressing logical truths; secondly, propositions about entities that do not have temporal location; and, thirdly, temporally unrestricted, universally quantified propositions.

5.4.2.1 Logically True Propositions and Correspondence Truth

One reason for thinking that one needs not only the concept of truth at a time, but also that of truth *simpliciter,* concerns the problem of formulating a correspondence theory of truth that is applicable to both contingently true and logically true propositions. Consider propositions that express logical truths. Some will be true at a given time. Thus, for example, the proposition that either there are (tenselessly) dinosaurs, or it is not the case that there are (tenselessly) dinosaurs, is true in the year 1980, because what is actual as of 1980 contains a state of affairs that is a truth-maker for that proposition. But many other propositions that have the same logical form—such as the proposition that either there are (tenselessly) unicorns, or it is not the case that there are (tenselessly) unicorns—are not true in the year 1980. So it would seem that, if propositions that are normally characterized as expressing logical truths are to be described as true, the relevant concept of truth cannot be that of truth at a time: it must be that of truth *simpliciter.*

A possible response to this line of argument is to say that one needs to distinguish between truth at a time and factual truth at a time, and that when this is done, logical truths, though they may not be factually true at a time, are true at absolutely every time. But how, then, is truth at a time to be defined? The answer, presumably, will be via the method of supervaluations mentioned earlier: a proposition is true at a time if and only if it comes out true under every possible way of filling in the truth-value gaps—that is, of replacing the third truth-value, in the case of any of its constituent propositions, by either truth or falsity.

Defining truth at a time in this way will certainly have the result that all logical truths are true at every time. But it does this only by abandoning the idea of a correspondence theory of truth in the case of logical truths, since what is actual as of the year 1980 does not contain a state of affairs that is a truth-maker for either disjunct of the proposition that either there are (tenselessly) unicorns, or it is not the case that there are (tenselessly) unicorns. By contrast, if one applies the concept of truth *simpliciter* to such propositions, one can hold that such propositions are true in a sense that involves a correspondence between the proposition and what is real, since the totality of what is actual will either make it true that there are (tenselessly) unicorns, or else make it true that it is not the case that there are (tenselessly) unicorns. A correspondence theory of truth in the case of propositions expressing logical truths requires, in short, the concept of truth *simpliciter*.

5.4.2.2 Atemporal Entities

A second reason for employing the concept of truth *simpliciter,* in addition to that of truth at a time, is that it seems possible that there are atemporal entities, and, moreover, that there are propositions about such entities that do not refer, either directly or indirectly, to anything that has temporal location. But if this is so, then the truth of such propositions cannot depend upon, and so cannot be a matter of correspondence with, what is actual as of any given time. Hence, such propositions, rather than being true or false at a time, must be true or false *simpliciter*.

What entities might be held to be atemporal? Possible candidates fall, I suggest, into two very different classes: necessarily existent entities, and certain merely contingent entities. Let us begin, then, with the former. Among the most commonly suggested candidates of this first sort are mathematical entities, such as numbers; propositions; logical possibilities; and transcendent, or Platonic, universals. In each case, it seems rather natural to think that, if there are such entities, they are *basically* atemporal, since, although it might be argued that some particular examples have temporal location, it seems quite plausible that, at the very least, there are some entities of each of the above types that do not have temporal location. Thus, while some numbers characterize instantaneous sets of objects, and so might be held to have temporal location—in at least one sense—other numbers do not. Similarly, while some propositions enter into psychological states, or are expressed by someone at some time, other propositions are never related either to utterances or to actual psychological states. Equally, some possibilities are actualized at some time, but others are not. Finally, if there are Platonic universals, some are instantiated, and so have temporal location, while others are not. So if it is logically possible for there to be entities of any of these kinds, it would seem that it must be possible for there to be things that do not have temporal location.

This line of argument can, however, be challenged in a number of ways. One is to argue that such entities are simply fictions, and do not exist at all. Another response is that, although we do not normally ascribe temporal location to such entities, they do in fact have temporal location, since they are logical constructs out of things that do have temporal location. Or, thirdly, one can try to show that, even if these things are basic entities, rather than logical constructs, they still have temporal location.[66]

These responses raise some large and difficult issues, and with regard to entities of the above kinds I shall have to content myself with the point that an advocate of a tensed approach to time who wishes to reject the idea of truth *simpliciter* faces an important challenge: he or she needs to show either that such entities are logically impossible, or that, contrary to what one ordinarily thinks, they do have temporal location.

Let us now turn to a second, and quite different class of entities that may lack temporal locations. These other candidates emerge if one considers a certain non-reductionist view of laws of nature—according to which laws of nature are to be identified with second-order states of affairs consisting of universals standing in certain relations. The issue then arises as to whether, if there are such second-order states of affairs, they have temporal location. According to one version of this realist theory—advanced by

[66] Thus Quentin Smith, for example, attempts to show that such things as numbers and propositions have temporal locations. See his *Language and Time,* 209ff., 234ff.

Armstrong[67]—they do: the second-order state of affairs that is a given law is present in all of the instances of that law, and nowhere else. But this view is open to at least two objections. First, it implies that it is logically impossible for there to be basic laws that lack instances—something that, as I have argued elsewhere, seems very counterintuitive. Secondly, if it is combined with a tensed view according to which the future is not real, it follows that a law does not exist until there is a first instance of it, and this means that there is no ground for relevant counterfactuals concerning what would have happened prior to the first instance of the law, had the world been slightly different.[68] So assigning temporal locations to a law on the basis of the locations of its instances seems unsatisfactory. But is there any other basis for assigning temporal locations to such second-order states of affairs? It is not easy to see what it could be. Consequently, it seems reasonable to hold that such states of affairs do not have temporal locations.

If there can be basic laws that never have instances, and if laws are relations between universals, then it would seem that uninstantiated universals must also be possible. Suppose, for example, that there are basic laws linking complex neurological states with raw feel qualities. If the world had been slightly different, such complex neurological states might never have arisen, and so the laws in question would never have had any instances, and certain phenomenological properties would never have been instantiated. But, if laws are relations between universals, the phenomenological properties in question would still have had to exist in that world. So there can be uninstantiated universals, and, as there seems to be no basis for such entities' having temporal location, we have here another candidate for a type of entity that can exist without having temporal location.

How do these last two candidates differ from those considered earlier? If laws are second-order states of affairs, then, assuming that laws of nature are not logically necessary, the second-order states of affairs are contingent entities. The same is true of uninstantiated universals, provided that, rather than being Platonic forms whose existence is supposed to be logically necessary, they

[67] David M. Armstrong, *What Is a Law of Nature?* (Cambridge: Cambridge University Press, 1983.)

[68] For a fuller discussion of these two objections, see my *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) 72–5, and 307–8, respectively.

exist only if they are constituents of basic laws of nature that lack instances. By contrast, numbers, propositions, possibilities, and Platonic universals are all, if they exist, necessarily existent entities, and the propositions about such entities that do not involve any reference, either direct or indirect, to temporal entities will, if true, be necessarily so. But how does this difference bear upon the argument? The answer is that, when one is dealing with necessarily true propositions, it is tempting to hold that such propositions are analytically true, and thus that the propositions in question do not really entail that there are any entities that either have, or lack, temporal location. By contrast, provided that laws of nature are contingent, nomological statements can be true only if certain sorts of states of affairs obtain, and, if there is no basis for holding that the relevant states of affairs have temporal location, then one may well be justified in concluding that there are atemporal entities.

5.4.2.3 Universally Quantified Propositions

A final reason for employing the concept of truth *simpliciter* is that there are propositions which, though they can be true, cannot be true at any time. Consider, for example, the proposition that there will never be three neutrinos that form an equilateral triangle with sides exactly one metre in length. While that proposition can certainly be false at a time, it could never be true at a time, since it would always be logically possible for there to be a later state of affairs that made it false. The same is true, moreover, of any universally quantified proposition that does not involve a temporal restriction that renders future states of affairs irrelevant to its truth: such a temporally unrestricted, universally quantified proposition can be false at a time, but can never be true at a time. Such propositions, however, will often be perfectly consistent, and so it must be possible for them to be true. The relevant sense of truth, accordingly, must be that of truth *simpliciter*.

5.4.3 The Definability of Truth Simpliciter

The concept of truth *simpliciter* must be definable on any dynamic approach to the nature of time. First of all, as we saw in Chapter 2, no tensed account can be satisfactory unless it incorporates the idea of the totality of existence, since, even if one discounts the idea of atemporal entities, one still has to make sense of statements about what is not actual as of a given time, including statements with quantifiers that range over absolutely all times—such as the statement that there never were, are not now, and never will be, purple sheep. But secondly, given the concept of the totality of existence, one can define truth *simpliciter*—at least in the case of tenseless propositions—as a matter of a familiar, recursively defined correspondence between propositions, and the sum total of what exists.

So the concept of truth *simpliciter* is definable, not only on a tenseless approach to the nature of time, but on any dynamic approach as well. This is not to say, however, that there are no differences with regard to truth *simpliciter* between tensed and tenseless approaches to time. In particular, according to tenseless approaches, absolutely every proposition is either true or false, whereas this is true on *some* tensed approaches, but not on others.

The reason is connected with the two different definitions of actual, temporal states of affairs that were given in Chapter 2. Recall that, according to the one,

> X is an actual, temporal entity or state of affairs

means the same as

> X is a part of the mereological whole that is composed of every state of affairs that is actual as of some time t or other.

This definition is perfectly satisfactory, given the type of tensed view being defended here. If the world changes only by the addition of new, tenseless facts, then there will be a consistent state of affairs that is the mereological union of all of the states of affairs that are actual as of one time or another, and, given a state of affairs that includes all states of affairs that are actual as of some time, every temporal proposition must be either true or false *simpliciter*.

Given some tensed approaches to the nature of time, however, change in the world is not (or not simply) a matter of the addition of new tenseless facts, and this has the consequence that the above definition will not be satisfactory. Consider, for example, the very common tensed claim that the same proposition is expressed by the sentence 'World War II is now taking place', regardless of when it is uttered. Given that view, the proposition in question would have to have changed from being false in 1936 to being true in 1942, and then, with the conclusion of World War II, have changed back to being false once again. When a proposition changes from being indeterminate to being either true, or false, that change can be viewed as involving just the addition of some new fact. But this cannot be done when a proposition changes from being false to being true, or vice versa, let alone when it undergoes both of these changes, since then the dynamism of the world must be viewed as involving both the addition of new facts, and the deletion of old ones. This entails, in turn, that there could not possibly be a consistent state of affairs that included every state of affairs that is actual as of some time or other. So the above definition of what it is to be an actual, temporal state of affairs has to be replaced by something along the lines of:

> X is an actual, temporal state of affairs

means the same as

> X is a member of the set whose members are all and only states of affairs that are actual as of some time t or other.

But when this alternative definition is adopted, one cannot define truth *simpliciter* in the case of absolutely all temporal statements in terms of a correspondence with the totality of what is actual, since the result would be that *tensed* statements such as 'World War II is now taking place' would, under the common tensed interpretation mentioned above, then turn out to be both true *simpliciter* and false *simpliciter*.

To sum up. I have argued here that both the concept of truth at a time and the concept of truth *simpliciter* are intelligible and coherent, and that no dynamic approach to the nature of time can be satisfactory unless it incorporates both concepts. It is a further question, however, whether there are propositions that, though true or false at times, are not true or false *simpliciter*. This will not be so if, as I shall argue in Section 8.3, ordinary tensed sentences involve indexicals, and so express different propositions when uttered at different times. Nor will it be the case if the correct account of the nature of time is a dynamic one according to which the world changes only by the accretion of new facts. If either of these claims is correct, then absolutely every proposition will have to be either true or false *simpliciter*.

Part III Tensed Facts

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6 Tensed Accounts of the Nature of Time

This chapter, and the following two, are concerned with the meaning of tensed language. In the present chapter I shall be clearing the way for a positive account of tensed statements by critically examining certain theses typically associated with tensed approaches to the nature of time. The claims in question concern the status of tensed statements, and their relation to tenseless ones. The basic thrust of those claims, as we shall see, is to support two closely related ideas: first, that tenseless temporal concepts are to be analysed in terms of tensed ones; and, secondly, that tensed concepts are analytically basic. Not surprisingly, the claims in question enjoy very widespread acceptance among those who favour a tensed view of the nature of time. I shall argue, however, that they must be rejected.

This rejection is crucial, moreover, for the positive account of the meaning of tensed statements that I shall be setting out in Chapter 7, since what I shall be proposing there is that, given either the ontological concept of states of affairs that are actual as of a given time, or, alternatively, the very closely related semantical concept of truth at a time, tensed statements are analysable in terms of tenseless ones.

In the third and final chapter in this part I shall consider the alternative accounts of the meaning of tensed statements that have been advanced both by advocates of tensed views of the nature of time, and by defenders of tenseless approaches, and I shall argue that all of them are exposed to decisive objections.

In the present chapter I shall begin by attempting to establish two negative results concerning the analysability of tenseless language in tensed terms, the first concerned with whether it is possible to give a tensed analysis of the relation of temporal priority, and the second with whether tenseless quantifiers can be analysed in terms of tensed ones. In both cases, one of the arguments that I offer involves a crucial assumption, to the effect that the concept of the future cannot be analytically basic. I therefore go on to consider this issue, and I argue that the concept of the future—and also the concept of the past—must be analysable. Ultimately, however, I want to defend a stronger thesis, to the effect that *no* tensed concept, without exception, can be analytically basic. In support of this latter thesis, I offer a very general argument—involving the idea of supervenience, and based upon the two earlier, negative results—which leads to the conclusion not only that all tensed language must be analysable, but that the analysis must be along certain lines. So not even the central tensed concept of the present can be analytically basic—a thesis that I shall also support, by a more direct argument, in Chapter 7.

6.1 A Tensed Analysis of the Relation of Temporal Priority?

How should one view the concept of temporal priority? Is it analytically basic, or does it need to be analysed in terms of other concepts? If the latter is the case, what is the appropriate analysis?

The idea that the concept of temporal priority is analytically basic is not without appeal. One might support that view, for example, by arguing, first, that the concept of a given relation may properly be treated as analytically basic if one sometimes has non- inferential knowledge that two things stand in that relation, and, secondly, that the fact that one can see that changes are occurring shows that one can have non-inferential knowledge of the fact that one event is earlier than another.

Given the psychological immediacy of one's perception of some changes—such as the motion of an object—this argument may seem plausible. But, as proponents of the representative theory of perception have argued, the inference involved in inferential knowledge is not to be equated with a conscious process. Consequently, psychological immediacy is one thing; the absence of inference quite another. When this is noted, it becomes clear that one's perception of the motion of an object may very well not be a case of immediate perception; it may instead be a case of inferential knowledge based upon immediate perception of a momentary state, together with memories of slightly earlier perceptual states.

There is, moreover, an argument on the other side, which seems to me to provide strong grounds for holding that the concept of temporal priority cannot be analytically basic. The argument turns upon the ideas, first, that, given a proposition that seems to express a necessary truth, some explanation of that necessity is surely desirable; and, secondly, that Quinean doubts about the intelligibility of analyticity notwithstanding, the most satisfactory type of explanation is one where it is shown how the statement in question can be derived from logical truths, in the narrow sense, simply by substitution of definitionally equivalent expressions. If these points are sound, one can then appeal to the fact that the relation of being earlier than appears to have certain necessary properties—namely, irreflexivity, transitivity, and asymmetry. It then follows that acceptance of the view that the concept of temporal priority is analytically basic rules out the most satisfactory sort of explanation that might be offered of why it is the case, for example, that no event can be earlier than itself.

I think it is plausible, then, to regard the concept of temporal priority as analysable. But how is it to be analysed? Three main possibilities need to be considered, two of them associated with tensed approaches to time, and one not. First, there is the suggestion that the concept of temporal priority can be analysed in terms of the concepts of past, present, and future. Secondly, there is the possibility of an analysis that, rather than being in terms of the concepts of past, present, and future, is in terms of concepts that, on some tensed approaches, are held to be more basic. Finally, there is the idea of giving a causal analysis of temporal priority.

Examination of the latter approach will be left until Chapter 9. The discussion here will be confined to the question of whether any sort of tensed analysis of the concept of temporal priority is satisfactory.

6.1.1 Temporal Priority and the Concepts of Past, Present, and Future: I. Events and Properties

Let us begin by considering, then, the possibility of analysing temporal priority in terms of the familiar tensed concepts of past, present, and future. Why might it be thought that such an analysis should be possible? One reason is that there are certain entailments between statements involving tensed concepts, and statements involving the concept of temporal priority. The statement

'*A* is past and *B* is present', for example, entails the statement '*A* is earlier than *B*'. Given such entailments, it may be tempting to suppose, first, that, for any tenseless temporal statement, one can construct tensed statements that say everything the tenseless statement says, and perhaps something more, and, secondly, that tenseless statements must therefore be analysable in terms of tensed ones.

How might such an analysis run? Given the above entailment, along with the related entailments of '*A* is earlier than *B*' by '*A* is past and *B* is future' and by '*A* is present and *B* is future', a natural starting-point is the following, disjunctive analysis of temporal priority:

> *X* is earlier than *Y*

means the same as

> Either *X* is past and *Y* is present, or *X* is past and *Y* is future, or *X* is present and *Y* is future.

This first attempt, however, is obviously unsatisfactory, since it does not capture the case where *X* is earlier than *Y,* and *X* and *Y* are either both in the past, or both in the future. How might one deal with this difficulty? One rather natural response was suggested by Wilfrid Sellars,[69] who proposed a more sophisticated analysis which, for our purposes here, can be expressed as follows:

> *X* is earlier than *Y*

means the same as

> Either *X* is present and *Y* is future, or *X* was present and *Y* future at the time of *X,* or *X* will be present and *Y* future at the time of *X*.

This account avoids the objection to which the initial attempt fell prey, for, whenever *X* is earlier than *Y,* Sellars's proposed analysans will be true. Sellars's account, however, is exposed to two other objections, both of which are, I believe, decisive. First, consider an objection advanced by Richard Gale. Sellars's analysis,

[69] Wilfrid Sellars, 'Time and the World Order', in Herbert Feigl and Grover Maxwell (eds.), *Scientific Explanation, Space, and Time* (Minnesota Studies in the Philosophy of Science, 3; Minneapolis: University of Minnesota Press, 1962), 527–616. See p. 546.

Gale argues, is circular, on the grounds that '*Y* is future at the time of *X*', for example, means the same as '*Y* is later than *X*'.[70]

Gale's objection is, I think, slightly flawed, since it might well be argued, at least if one accepts certain tensed accounts of the concepts of past, present, and future, that to say that *Y* is future at the time of *X* is to say something more than merely that *Y* is later than *X*. (As we shall see later, in Section 7.1, this will be the case given the analysis of tensed statements to be defended here.) But even if this is so, it does not undermine the substance of Gale's point. As long as it is true that the statement '*Y* is future at the time of *X*' is to be analysed in terms of the statement '*Y* is later than *X*', possibly together with some other statements, such as 'There are future events', Sellars's proposed analysis will be implicitly circular.

The second objection arises from the fact that Sellars's analysis involves the concept of the future. One needs to consider the status of this concept. Is it analytically basic? If not, how is it to be analysed? If it turns out that the concept of the future cannot be basic, it may well be that the analysis of it will involve the concept of temporal priority, in which case Sellars's proposed account of the latter will again suffer from implicit circularity.

In Section 6.3, I shall argue that this is indeed the case. There I shall attempt to show, first, that the concept of the future cannot be analytically basic, and, secondly, that the analysis of the concept of the future does involve the relation of temporal priority.

Can one improve upon these attempts to provide a tensed analysis of the concept of temporal priority? A number of philosophers have tried to do so—among them, George Schlesinger, Richard Gale, and Arthur Prior. As their attempts appear to exhaust the main possibilities, a consideration of how they fare should provide a good basis for evaluating the prospects for a tensed analysis of the concept of temporal priority.

The analysis proposed by Schlesinger is, in effect, as follows:

> *X* is earlier than *Y*

means the same as

> There is some time *t* such that either *X* is past at *t* and *Y* is present at *t* and *t* is in the present, or *X* is past at *t* and *Y* is

[70] Richard M. Gale, *The Language of Time* (London: Routledge & Kegan Paul, 1968,) 91.

> present at *t* and *t* is in the past, or *X* is past at *t* and *Y* is present at *t* and *t* is in the future.[71]

This account seems open to the same two objections as Sellars's account. In the first place, it would seem that either the statement that *X* is past at *t* says just that *X* is earlier than *t,* or else it says something that is analysable in terms of the statement '*X* is earlier than *t*', together with some other statement, such as 'There are past events'. So the use of the sentential form '*X* is past at *t*', in Schlesinger's analysis, makes the definition implicitly circular.

In the second place, Schlesinger's proposed analysis also involves the concept of the future. Accordingly, if this concept needs to be analysed, and if no satisfactory analysis is forthcoming, other than one involving the concept of temporal priority, Schlesinger's account suffers from circularity in a second way.

Next, consider the account proposed by Richard Gale, according to which the statement '*P* is earlier than *Q*' can be analysed as:

> *P* is past and *Q* is present or *P* is past and *Q* is future or *P* is present and *Q* is future or *P* is more past than *Q* or *P* is more future than *Q*.[72]

Gale realizes that, in view of the fact that the statement '*P* is more past than *Q*' is analytically equivalent to the statement '*P* is earlier than *Q* and *Q* is now past', it may well be objected that the former is to be analysed in terms of the latter, and thus that his account of temporal priority also suffers from circularity. But, although he expresses some uneasiness on this matter, Gale seems to feel that this objection can be successfully resisted:

> A more effective way to meet this charge of circularity in our reduction . . . is to claim that '*P* is more past than *Q*' entails '*P* is earlier than *Q*' but deny that we must analyse '*P* is more past than *Q*' into the conjunction of '*P* is earlier than *Q* and *Q* is now past'. . . . And I know of no argument that can be given to show that we must accept this as an analysis of '*P* is more past than *Q*'.[73]

It may be difficult to show that this *must* be accepted as an analysis; however, I certainly think that one can argue that there

[71] George N. Schlesinger, *Aspects of Time* (Indianapolis: Hackett Publishing Company, 1980,) 47.

[72] Gale, *Language of Time,* 92. Gale offers other analyses as well, but they are exposed to precisely parallel difficulties.

[73] Ibid. 96.

are good grounds for doing so, and the place to begin, I suggest, is by raising the question whether the concept of being more past than can plausibly be taken as analytically basic. If it is suggested that perhaps it can be, one can either try to generate arguments against that, or, more simply, shift the argument to the case of the concept of being more future than. If, as I shall argue in Section 6.3, there is good reason for holding that the concept of the future cannot be analytically basic, there is surely at least equally good reason for maintaining that the concept of being more future than cannot be analytically basic.

If it is granted that the concept of being more future than cannot be analytically basic, the question is what analysis can be given. One proposal, of course, is the one that Gale needs to reject, namely:

P is more future than *Q*

means the same as

Q is earlier than *P*, and *Q* is future.

But is there any alternative analysis that might be suggested? In particular, is there any that does not involve the concept of temporal priority? Gale does not propose any, nor do I think that any is forthcoming. Consequently, I believe that there is good reason to accept the above analysis of '*P* is more future than *Q*', and from this it follows that Gale's analysis of temporal priority is implicitly circular.

Secondly, Gale's account is also open to the other objection advanced against the accounts of Sellars and Schlesinger, for it also involves the concept of the future, and Gale provides no reason for thinking either that the concept of the future is analytically basic, or that, if it is not, it can be analysed in a way that does not involve the concept of temporal priority. Gale's account, no less than the others, is circular in two respects.

6.1.2 Temporal Priority and the Concepts of Past, Present, and Future: II. A Tense-Logic Account

Finally, let us consider the sort of analysis that has typically been advanced by philosophers interested in tense logic, such as Arthur Prior. To formulate the analysis, we shall need to express things a bit differently than has been done in the preceding analyses. Up to this point, tensed terms such as 'past', 'present', and 'future' have in effect been treated as belonging to the syntactical category of predicates—and, specifically, predicates that function to assign properties to events. Prior and other tense logicians, however, usually favour a different view of the logical grammar of tensed sentences, according to which tensed terms are operators upon sentences. Consider, for example, the sentence 'Julius Caesar was killed by Brutus'. On the model suggested by the analyses of Sellars, Schlesinger, and Gale, a more perspicuous way of expressing the fact in question would be by means of some such sentence as 'The killing of Julius Caesar by Brutus lies in the past', where a predicate is apparently being used to attribute a tensed property to an event. But on the model preferred by Prior and others, the perspicuous way of putting things is by means of a sentence such as 'In the past, Julius Caesar is killed by Brutus', or, alternatively, 'It was the case that Julius Caesar is killed by Brutus', where a tensed operator—'in the past', or 'it was the case that'—is applied to a core sentence which is in the present tense—namely, 'Julius Caesar is killed by Brutus'.

Spelt out a little more fully, the basic idea is this. Tensed terms fall into two categories: those that express presentness, and those that express other tenses. Terms of the latter sort function as operators; those of the former sort do not. So, given any tensed sentence, one can affix operators such as 'in the past' and 'in the future' to it, thus forming further sentences, and, because these further sentences are also tensed, one can continue to add on tensed operators, thereby generating sentences such as 'In the past, in the future, in the past, Julius Caesar is killed by Brutus'. But one cannot, it is claimed, form sentences such as 'In the present, in the past, Julius Caesar is killed by Brutus', since there is no present- tense operator.

But why is it held that there is no present-tense operator? The answer is tied up with the fact that advocates of this view wish to maintain that the *core* sentences from which one starts are themselves in the present tense. The next question, of course, is why those sentences must be in the present tense. The answer is that, if one were to hold, instead, that the core sentences are tenseless, and that present-tense sentences are to be viewed as arising from the application of a present-tense operator to tenseless sentences, one could not hold, on pain of circularity, that tenseless sentences—such as 'There are (tenselessly) unicorns'—are to be analysed in terms of tensed ones.

The convenience of this sort of regimentation for the purpose of doing tense logic becomes clear if one considers what happens when one moves from a sentence that contains a single tensed term to one that involves an embedding of tensed terms within tensed terms. Consider, for example, the proposition expressed in everyday language by 'The world's strongest chess player was either female or a computer'. The tense-logical formulation can be expressed by 'In the past, the world's strongest chess player is either female or a computer', while the alternative formulation in terms of the language of events and predicates assigning tensed properties to events might be expressed by 'The event that is the world's strongest chess player's being either female or a computer lies in the past'. Now consider what happens when one shifts to the sentence 'It will be the case that the world's strongest chess player was either female or a computer'. On the tense-logical approach, one merely has to prefix the appropriate tensed operator, giving one: 'In the future, in the past, the world's strongest chess player is either female or a computer.' But in the case of the approach that utilizes tensed predicates of events, one needs to introduce reference to a different event—namely, the event that consists of the event referred to in the simpler sentence lying in the past—since the required formulation will take the form: 'The event that is the lying in the past of the event that is the world's strongest chess player's being either female or a computer lies in the future.' The point, in short, is that, on the latter approach, reference to a new event needs to be introduced each time one tensed term is embedded within another, whereas nothing of the sort is required when one adopts the tense-logical formulation.

But, while treating tensed terms as operators on sentences may be convenient for the formulation of a logic of tense, is it also metaphysically perspicuous? I do not believe that it is. In order for a given regimentation of tensed sentences to be metaphysically perspicuous, the syntax needs to reflect the structure that would need to be present in states of affairs to render tensed sentences true. States of affairs, however, involve things' having properties and/or standing in relations. A perspicuous formulation, therefore, should make it clear, first, what sorts of things are involved in the states of affairs that serve as truth-makers for tensed sentences, and, secondly, whether it a matter of the possession of some property, or of two or more things' standing in some relation, or some combination of these.

Consider, then, the proposal that tensed sentences—other than those in the present tense—should be viewed as involving tensed operators applied to other tensed sentences. Does this way of regimenting tensed sentences provide any indication of the nature of the states of affairs that would serve as the relevant truth- makers? It would seem that it does not. One can say, of course, that a sentence such as 'In the past, Julius Caesar is killed by Brutus' is true just in case the sentence 'Julius Caesar is killed by Brutus' *was* true. However, that does not get one back to the state of affairs in the world that makes the original sentence true. The tense-logical formulation appears, therefore, to leave it completely obscure what sorts of states of affairs are truth-makers for tensed sentences. As a consequence, I do not believe that any satisfactory defence of a tensed view of time can accept the idea that a tense-logical formulation of tensed sentences is fundamental.[74]

For the moment, however, let us waive this point, and consider the sort of account that can be advanced of the relation of temporal priority, if one adopts a tense-logical regimentation of tensed sentences. A typical proposal would be:

> X is earlier than Y

means the same as

> Either in the past (Y occurs and in the past X occurs) or (Y occurs and in the past X occurs) or in the future (Y occurs and in the past X occurs).[75]

How does such a tense-logical analysis compare with the analyses formulated in terms of a language in which tensed terms are viewed as predicates that function to attribute properties to events? Analyses of the latter sort, as we have seen, are typically open to two objections. The first is that they involve expressions—such as 'future

[74] Cf. Quentin Smith's discussion in *Language and Time* (New York: Oxford University Press, 1993,) 166–9.

[75] Cf. Arthur N. Prior, *Time and Tense* (Oxford: Oxford University Press, 1968,) 64, and Ferrel M. Christensen, 'A Defense of Temporal "Becoming"' (Ph.D. thesis, Ann Arbor, 1971,) 8.

quo ad X', 'past at *t*', and 'more past than'—that cannot plausibly be treated as analytically basic, and that appear to be analysable only in terms of concepts, one of which is that of temporal priority. The second is that the concepts of the past and the future—or, at the very least, the latter—are not analytically basic, and that the analysis of those concepts likewise appears to require the concept of temporal priority. Does a tense-logical account escape either or both of these objections?

That it does not avoid the second is clear, since the proposed analysis of temporal priority requires both past- and future-tense operators. The status of the first objection, on the other hand, is less clear. Prima facie, it might seem that the tense-logical analysis is not open to the first objection, since it seems to employ only non- relational tensed terms, rather than relational ones such as 'past at time *t*'. But I think that appearances are deceptive, since I believe that it can be shown that one cannot supply adequate truth conditions for sentences that involve a nesting of tensed terms unless one has *relational* tensed concepts.

The argument involves a crucial premiss for which I shall be arguing only later, in Section 8.3. The premiss is this:

> (*) The proposition that is expressed by a token of an ordinary tensed sentence, and hence also the truth-value of that token, depend upon the time of the token.

This assumption is, I believe, very plausible, and I shall attempt to show in Section 8.3 that it can be supported by two very strong arguments. It is important to emphasize, however, that the premiss is a controversial one which would be rejected by many advocates of tensed approaches to time, and that I am at this point issuing a promissory note on which I need to make good.

Given the above assumption, the argument turns upon the question of what account is to be given, for example, of the truth conditions of past tense statements, such as 'Dinosaurs once roamed the earth'. Three answers suggest themselves, all of them based upon the following two ideas. First, the function of the tensed-operator part of a tensed utterance is to pick out the time at which the core sentence is to be evaluated. Secondly, the truth or falsity of the core sentence *at that time* thereby determines the truth-value of the original sentence. The accounts differ, however, with respect to the core sentence. On one view, it is a tenseless sentence of the form 'Dinosaurs roam the earth at time *t*', where '*t*' refers to the time picked out by the tensed operators of the original sentence. On the second approach, the core sentence is a sentence involving a relational, tensed expression—namely, a sentence such as 'Roaming the earth by dinosaurs lies in the present at time *t*'—where, again, *t* is determined by the tense of the original sentence. Finally, according to the third view, the core sentence is simply an ordinary present-tense sentence, such as 'Dinosaurs are now roaming the earth'.

The structure of the argument which shows that the tense-logical approach is also exposed to the first objection is now as follows. First, the third view is the one that is favoured by advocates of a tense-logic account of tensed sentences, and, if it could be sustained, the first objection would not apply. But the third view is, it turns out, untenable, provided that assumption (*) is correct. Secondly, since the idea that core sentences are tenseless will not commend itself to advocates of a tensed view of the nature of time, the only option that remains is the second, and this means that one must make use of at least the relational tensed concept of lying in the *present* at time *t*. But, thirdly, the core sentences that are employed in the proposed, tense-logic analysis of temporal priority require that one also employ the relational tensed concept of lying in the *past* at time *t*. So a tense-logic analysis of temporal priority is also exposed to the first objection.

First, then, there is the question of the tenability of the view—which the advocate of a tense-logical approach wishes to embrace—that the core sentences are in the present tense. My basic contention here is that, if it is the case that the proposition that is expressed by a token of an ordinary tensed sentence, and hence the truth-value of that token, depend upon the time of the token, then the core sentences cannot be present-tense sentences. The reason derives from the fact that, if the truth-value of an ordinary tensed sentence depends upon the time of its occurrence, the relevant truth conditions will need to refer to a token at the time in question. The problem, however, is not just that there may not be any actual tokens of the sentence at that time, since one may be able to get around that problem by considering hypothetical tokens. The crucial problem is rather that the truth-value of the original sentence might have been different had there been tokens of the sentence at the relevant time. Consider the sentence 'Once upon a time there were neither languages nor psychological states.' On the tense-logical regimentation, this sentence is to be regimented as a core sentence in the present tense embedded within a past-tense operator: 'In the past, there are now neither languages nor psychological states.' But, if one considers some time in the past when there were neither languages nor psychological states, not only will it be the case that there were not, at that time, any tokens of the sentence 'There are now neither languages nor psychological states'; it will also be the case that, had there been any tokens, they would have been false. So consideration of hypothetical tokens does not generate the correct truth-value for the original sentence, since the original sentence is true, whereas any tokens of the core, present-tense sentence, at any time in the past, would have been false.[76]

The third approach is therefore precluded, and one is forced to adopt either the view that the core sentences are tenseless, or else the view that they involve relational tensed concepts, such as that of lying in the present at time *t*. The advocate of a tense-logical approach certainly wishes to reject the former, and therefore must embrace an account involving relational tensed concepts. This, however, does not yet show that the tense-logical account of temporal priority is exposed to the first objection, since what the argument to this point establishes is only that an advocate of a tense-logical approach must accept tensed sentences that involve at least one particular relational tensed concept—namely, the concept of lying in the *present* at time *t*—if he or she is to be able to specify truth conditions for sentences involving nested temporal terms. It has not been established that the analysis also involves either the concept of being *past* at time *t*, or that of being *future* at time *t*, and, until that has been done, no problem of circularity arises, since there is no immediately apparent reason for thinking that the concept of being present at a time involves the concept of temporal priority.

This brings me to the third and final step in the argument. The crucial feature of the analysis of temporal priority that is being proposed, with respect to the present argument, is that it involves *the conjunction of a present-tense sentence and a past-tense sentence, within the scope of a temporal operator*. The first disjunct, for example,

[76] I shall return to this issue in Sect. 7.3.1.

is of the form 'In the past (Y occurs and in the past X occurs)'. Let us consider, then, the question of the conditions under which such a sentence is true. The basic idea underlying the assignment of truth-values to sentences that involve nested temporal operators—such as this one—is to strip off the temporal operators one by one, and then to evaluate the core sentence at the appropriate time as determined by the sequence of temporal operators that have been removed. But, as we just saw, there is a problem about precisely how the core sentence is formulated. In particular, in view of the previous step in this argument, the core sentence cannot be an ordinary tensed sentence: it must be either a tenseless sentence, or a tensed sentence of the relational sort. What, then, must the core sentence be in the case of the sentence 'In the past (Y occurs and in the past X occurs)', if it is not to be tenseless? The answer is that it must be a tensed sentence of a relational sort, and the natural view to take is that, in particular, it will be of the form, 'That Y occurs is present at time t and that X occurs is past at time t'—where t is some time in the past. Accordingly, it seems that the use of a conjunction of present- and past-tense sentences within a temporal operator means that one has to accept the concept of being *past* at a time as well as that of being present at a time. It therefore follows that the proposed tense-logic analysis of temporal priority presupposes the concept of being past at a time, and thus that the analysis is also exposed to the first of the two objections directed against other attempts to analyse temporal priority in terms of tensed concepts.

To recapitulate. All of the attempts to analyse the relation of temporal priority in terms of tensed concepts appear to suffer from circularity in two respects. First, they involve, either explicitly or implicitly, what I have called *relational* tensed concepts—concepts such as those of being past *quo ad* some event, or being more past than some event, or being past at time t. None of these relational tensed concepts is plausibly taken as analytically primitive, nor does any analysis in temporal terms seem possible, other than ones that employ the concept of temporal priority. Secondly, all of these analyses involve the concepts of both the past and the future. Can those concepts be treated as analytically basic? I shall be arguing in Section 6.3 that they cannot, and, moreover, that, if they are to be analysed in temporal terms, there does not seem to be any alternative to an analysis involving the concept of temporal priority.

6.1.3Broad's Account of the Later-Than Relation

Let us now turn to a quite different, and less well-known approach to the problem of giving a tensed account of temporal priority/ posteriority. It involves offering an analysis that, rather than being in terms of the concepts of past, present, and future, is in terms of more basic, underlying concepts. The sort of analysis that I have in mind here is that advanced for the later-than relation by C. D. Broad in his book, *Scientific Thought*: 'A moment *t* is later than a moment *t*′ if the sum total of existence at *t* includes the sum total of existence at *t*′ together with something more.'[77]

This analysis differs sharply from those considered so far, since it does not involve, either explicitly or, it would seem, implicitly, the concepts of past, present, and future. It is, none the less, obviously a tensed account, since it presupposes a view of time according to which the sum total of what exists can be different at different times.

How does Broad's analysis fare? The answer, it seems to me, is that, while it may be true—and even analytically true—that one moment is later than another moment if (and only if) the sum total of existence at the former moment includes the sum total of existence at the latter moment, together with something more, this analytical truth cannot provide us with a definition of what it is for one moment to be later than another.

First, then, why might Broad's claim be true? The answer is that it will be true, for example, if both of the following are true:

(1) Causation requires a dynamic world of the sort indicated by the argument in Chapter 4;
(2) The direction of time is, by definition, fixed by the direction of causation.

So the proposition that Broad advances—but not the claim that it provides an analysis of the later-than relation—is a consequence of views that I am defending here.

But why can it not provide a definition of the later-than relation? The answer emerges if one contrasts Broad's view of the nature of time with an inverted ontology. Recall Storrs McCall's conception of a dynamic world—discussed in Chapter 1. On that conception, the world is like a tree where, at every moment, rather than its growing, or adding new branches, all of the lowest branches, except

[77] C. D. Broad, *Scientific Thought* (London: Routledge & Kegan Paul, 1923,) 67.

for one, are continually dropping off. The branches here represent future possibilities, so that, at each moment in the passage of time, only one of the many possibilities that there were for that moment gets actualized, and all of the other possibilities are eliminated. McCall, however, also embraces a realist ontology for possibilities, so that, when something that was a possibility ceases to be such, what has really happened is that something that was actual has ceased to be actual. On McCall's view, then, the passage of time involves a deletion, rather than an accretion, of states of affairs.

The view that I want to consider here, however, is not McCall's. It shares with McCall's conception the idea that the passage of time involves the dropping-out of existence of states of affairs; however, it is both a simpler picture and a more radical one. Simpler, because realism with regard to future possibilities is rejected. The only future states of affairs that exist now are those that will be actualized: unactualized future possibilities do not exist. More radical, because the idea is that no past states of affairs at all are actual, whereas, for McCall, possibilities that get actualized remain actual—always part of the branchless section of the tree.

The relevant view, in short, is one where the present and the future are real, but the past is not. A somewhat strange view, no doubt, and not easy to motivate—though perhaps one might appeal to the ideas that one cannot interact with the past, and that what one cannot interact with is not something real. In any case, strange views are not unknown in the philosophy of time!

If the inverted picture were correct, then Broad's account of the later-than relation would be unsound, since in the inverted world, where the present is the point at which things drop out of existence, rather than the point at which they come into existence, one moment will be later than another if, and only if, the sum total of existence at the latter moment includes the sum total of existence at the former moment, together with something more. But does this show that Broad's proposed analysis is incorrect? If the inverted world were logically possible, it would. But what if the inverted world is not genuinely possible? Must not Broad's analysis emerge unscathed in that case?

The inverted world is, I believe, logically impossible. But it does not follow from this that it poses no threat to Broad's analysis. The reason is that, if Broad's account of the later-than relation is correct, it will not be true merely that the inverted world is logically impossible: it will also be the case that this fact should be one that is immediately obvious, on a par with the impossibility of unmarried wives. The impossibility of an inverted world is, in short, an *immediate* consequence of Broad's analysis of the later-than relation. Yet surely—assuming that the very idea of a dynamic world is not straightforwardly incoherent—the logical impossibility of an inverted world is not a trivial and obvious truth. So Broad's analysis of the later-than relation cannot be correct.

Another way of making this same point is by appealing to the idea of a static world. If Broad's analysis of the later-than relation is correct, then it follows that a static world in which events stand to one another in the later-than relation is logically impossible: that relation can exist only in a dynamic world. Yet, even if that is so, it cannot, surely, be an *immediate* consequence of the definition of the later-than relation. That would make it very puzzling indeed how clear-headed advocates of a tenseless approach to time could have failed to notice that the view that they are advancing is logically impossible. If the tenseless view is impossible, that must be a matter, surely, of rather subtle conceptual connections.

My conclusion, accordingly, is that the very different tensed analysis of the later-than relation that was proposed by Broad also fails. But what, then, is to be done? Must the concept of the later- than relation be taken as analytically basic, or can some other analysis be offered? The only serious possibility that remains, I think, for an analysis of the later-than relation, is a causal account, and, in Chapter 9, I shall defend such an approach. A causal analysis of the later-than relation is not, of course, a tensed account. Consequently, the failure of the tensed approaches considered above provides good grounds for concluding, I believe, that tenseless temporal relations cannot be analysed in tensed terms.[78]

6.2 Are Tenseless Quantifiers Analysable in Tensed Terms?

It is possible to interpret phrases that express existential quantification—such as ‘there are’, ‘there exist’, ‘for some *x*’, and so on—in

[78] It is perhaps worth mentioning in this regard that recent advocates of tensed approaches to time appear to have given up on the project of offering such an analysis. See e.g. Smith, *Language and Time,* 195–6.

such a way that it is true that there are dinosaurs, even though none exists at present. Similarly, terms and phrases that express universal quantification—such as 'all', 'no', 'any', 'for every *x*', and so on—can be construed in such a way that its being true that there are no unicorns is not just a matter of there not being any unicorns now. But what account is to be given of such quantifiers?

This is another important issue that typically divides those who favour a tenseless view of time and those who advocate a tensed approach. The former hold that precisely the same quantifiers are involved when one says, for example, that there are dinosaurs, and when one asserts that there is a prime number larger than six and less than ten: the fact that in the one case the quantifier ranges over temporal entities, and in the other case not, does not affect the nature of the quantifiers themselves. The concept of existence is, in short, univocal.[79]

Advocates of a tensed approach, by contrast, almost invariably maintain that the quantifier involved when one says, truly, that there are dinosaurs itself involves some notion of temporal existence, and so is to be analysed in terms of the corresponding, *tensed,* existential quantifiers. Thus Wilfrid Sellars, for example, has maintained that tenseless statements concerning the existence of temporal objects are to be analysed in terms of a disjunction of the relevant tensed statements. To say that there are (tenselessly) dinosaurs is just to say that either there were dinosaurs, or there are now dinosaurs, or there will be dinosaurs.[80] The tenseless existential quantifier that ranges over temporal entities is not, therefore, analytically basic.

This view should be rejected, for at least two reasons. In the first place, no equivocation appears to be involved if one asserts that, in addition to physical objects and minds, there are such things as uninstantiated universals, sets, and numbers.[81] But if this is right, then to say that some temporal object exists—in the tenseless sense

[79] Two very vigorous statements of this view can be found in W. V. O. Quine, 'Mr Strawson on Logical Theory', *Mind,* 62 (1953), 433–51, and in Donald C. Williams, 'The Sea Fight Tomorrow', in Paul Henle, Horace M. Kallen, and Suzanne K. Langer (eds.), *Structure, Method and Meaning* (New York: Liberal Arts Press, 1951,) 282–306. See, esp. pp. 441–3 of the former, and pp. 286–8 of the latter.

[80] Sellars, 'Time and the World Order', 546–50, 566.

[81] Cf. W. V. O. Quine's discussion in his essay 'On What There Is', in *From a Logical Point of View* (Cambridge, Mass.: Harvard University Press, 1961,) 1–19. See p. 3.

of 'exists'—cannot be analysed as saying that either it did exist, or it exists now, or it will exist, since that sense of existence is not applicable to such things as numbers and sets.

On its own, this first consideration might be resisted. There is, however, a second objection to the present view, which is, I believe, decisive. It arises when one asks what account is to be given of the meaning of statements asserting that something *will* exist. The response that most advocates of a tensed approach to time would offer, of course, is that no analysis need be given: the concept of the future is analytically basic. In the next section, however, I shall argue that that view is untenable. If so, some analysis of statements about the future is required, and the question is what form that analysis can take.

The possibilities are very limited. It is surely clear, for example, that there is no way that statements about what will exist can be analysed in terms of statements about what did exist or what now exists, since statements that refer only to the past and the present can never entail any statements about the future. What analysis, then, can be offered? The only possibility, it would seem, is the sort of analysis that I shall be proposing in the next section, and which involves analysing statements about the future using the concept of the present, the concept of temporal priority, and tenseless existential quantification. But, if this is the only possibility, then the tenseless existential quantifier cannot itself be analysed in terms of the tensed, existential quantifiers, including the future-tense quantifier, on pain of circularity.

The situation, in short, is that statements about what will exist stand in need of analysis, and there does not appear to be any viable alternative to an approach that makes use of tenseless, existential quantification. As a consequence, the thesis that a statement asserting that some temporal entity exists (tenselessly) can be analysed as saying that either it did exist, or it exists now, or it will exist, must be rejected. Tenseless quantification is analytically more basic than tensed quantification.

6.3 Are Tensed, Temporal Concepts Unanalysable?

A third claim that is widely accepted by those who favour tensed accounts of the nature of time is that tensed, temporal concepts are analytically basic. In this section I shall offer the first of three arguments against this view.

Before considering this issue, however, I need to say something about the concept of analysis that is relevant here. The crucial point is that a distinction needs to be drawn between *translational* analyses and *truth-conditional* analyses. A translational analysis of a concept consists of a procedure for translating any statement involving that concept into a statement that involves concepts that are in some sense more basic. A truth-conditional analysis, on the other hand, involves a specification, in conceptually simpler terms, of the conditions under which statements involving the concept in question are true. Clearly, these conceptions are rather closely related. In particular, any translational analysis of a concept automatically specifies truth conditions for all statements involving the concept. The converse, however, does not hold. There are cases where a truth-conditional analysis is possible, while a translational analysis is not.

To see why this is so, consider the sentence 'Sandra is here'. There is no problem about explaining the conditions under which any particular utterance of that sentence will be true: it will be true when, and only when, Sandra is in the vicinity of the person who produces the utterance in question. But, though the specification of truth conditions is a straightforward matter, this does not provide a translational analysis. To see why, compare the sentence 'Sandra is here' with the sentence 'Sandra is in the vicinity of the speaker of this utterance'. Initially, it may be tempting to view the latter as a translation of the former. A little reflection shows, however, that that is not the case, since, on the one hand, any utterance of the sentence 'Sandra is in the vicinity of the speaker of this utterance' necessarily refers to the utterance itself, and therefore to a token of the sentence 'Sandra is in the vicinity of the speaker of this utterance', whereas, on the other hand, no utterance of the sentence 'Sandra is here' contains any reference to a token of the former sentence. The referents of tokens of the two sentences necessarily differ, and thus one cannot be a translation of the other.

This situation arises in the case of a sentence that contains a term—such as 'here'—that picks out an entity via direct reference, rather than by means of some individual description that applies to the object. If one is to specify the truth conditions of a sentence containing such an indexical term, one will need to refer, in some way, to the entity that is picked out by the indexical term. But if one uses a name, or a definite description, to do this, one will be using a semantical element that is not part of the original sentence, and so, even if the resulting sentence does correctly specify the truth conditions, it cannot provide a translational analysis of the original sentence.

Does this mean that a translational analysis is never possible in the case of sentences that contain indexical terms? No, translational analyses are sometimes possible. Imagine, for example, someone who learns a fragment of English that does not contain the word ‘here’. Rather than saying ‘Sandra is here’, the person might say ‘Sandra is at this location’. If he or she then started using the term ‘here’ as an abbreviation for ‘at this location’, one could certainly analyse ‘Sandra is here’, as the person uses that sentence, in terms of ‘Sandra is at this location’. The moral, then, is not that translational analyses are never possible in the case of sentences containing indexicals. It is rather that, first, one must be careful about assuming that a sound specification of the truth conditions of a sentence provides a translational analysis of the sentence, and, secondly, that if, in the case of a sentence containing an indexical term, one specifies the truth conditions by means of a sentence that does not contain any indexicals, then one cannot be offering a translational analysis.

Given that one does want to be able to explain how indexicals function, and that a translation into another sentence containing, in effect, the same indexical will not do this, there are good grounds for adopting a broader conception of analysis, according to which any specification of the truth conditions of relevant sentences, in conceptually simpler terms, whether via a procedure for translation, or in some other way, constitutes an analysis. This broader conception of analysis is, moreover, especially important in the present context, since, as we shall see, some central temporal concepts lend themselves to an analysis in the broader sense, but not in the narrower.

Can the concepts of past, present, and future be analysed? Advocates of a tenseless account of the nature of time hold that this is possible, and the general sort of programme that they advance rests upon the idea that tensed sentences, such as ‘It rained yesterday’, are similar, in two crucial respects, to sentences such as ‘There is a mountain over there’. First, the term ‘yesterday’, like the term 'there', is an indexical, and, consequently, just as any token of 'There is a mountain over there' has truth conditions that involve reference to the token itself, the same is true of tokens of 'It rained yesterday'. Secondly, just as whether any particular utterance of 'There is a mountain over there' is true depends only upon how things are spatially related to the utterance in question, so it is claimed that a similar thing is true of tokens of tensed sentences, such as 'It rained yesterday': whether a particular utterance is true depends only upon the tenseless temporal relation in which that utterance stands to the event in question.

If the first of these claims is correct, and tensed sentences do involve indexicals, then it is impossible to translate tensed statements into tenseless ones. But, on the other hand, if the second claim is also correct, then, just as one can specify truth conditions for sentences such as 'There is a mountain over there', even though one cannot offer any translational analysis, so it will also be possible to specify truth conditions for tokens of tensed sentences in tenseless terms.

This programme of analysis is rejected by advocates of a tensed approach to time—the latter generally maintaining, on the contrary, not only that the concepts of past, present, and future cannot be analysed in tenseless terms, but that they cannot be analysed at all. As regards the second of these claims, however, there are exceptions. C. D. Broad, for example, in the tensed approach that he developed in his *Scientific Thought,* argued that statements about the past and about the present can be analysed in terms of statements about the sum total of existence at various times.[82] He also held, however, that statements about the future could not be analysed along similar lines, nor indeed, in any way at all:

> We cannot then analyse *will* away, as we can *has been* and *is now.* Every judgment that professes to be about the future would seem to involve two peculiar and not further analysable kinds of assertion. One of these is about becoming; it asserts that further events will become. The other is about some characteristic; it asserts that this will characterise some of the events which will become.[83]

With regard to the concept of the future, then, Broad shared the view that is almost universal among those who follow a tensed approach to time—namely, that that concept is unanalysable.

[82] Broad, *Scientific Thought,* 76.

[83] Ibid. 76–7.

The position to be defended here, by contrast, is that the concepts of the past, the present, and the future are all analysable. In the present section, however, I shall consider only the concepts of the past and of the future. The analysis of the concept of the present will then be taken up in the next chapter.

Let me begin with the concept of the future. The thesis that this concept must be analysable can be supported by at least two arguments. First, one can ask what characterizes analytically basic, descriptive concepts. A very plausible answer, I suggest, is that a descriptive concept cannot be analytically basic for a given person unless that concept picks out a property or relation that, for the individual in question, is, or has been, either an object of direct, non-causal awareness, or an object of immediate perception. But both immediate perception of a property, and direct awareness of a property, seem to imply that one must have non-inferential knowledge of the fact that something has the property in question. If this is right, the conclusion that the concept of the future cannot be analytically basic follows very quickly, since, even if, as some have argued, it is logically possible to have non-inferential knowledge of the future, humans at present certainly do not possess that capacity.

The second argument appeals to the methodological principle, urged earlier, that, as far as possible, one should attempt to show that necessary truths are analytic. Consider, then, the following propositions:

(1) Any event causally dependent upon a present event lies in the future;
(2) Any event later than a present event lies in the future.

If, as I argued earlier, it is logically impossible for an effect either to precede its cause, or to be simultaneous with it, then the first of these is a necessary truth—and it would be so viewed by most, albeit not all, philosophers—while the second would be accepted by almost everyone as a necessary truth. So, if the above methodological principle is accepted, the question arises as to how one can show that these propositions are analytically true.

There are, of course, ways in which one might try to show that these statements are analytic, while holding that the concept of the future is unanalysable. The most common attempt, among those who favour a tensed view of time, would probably be to argue, in the case of the first statement, that the concept of causation involves the concept of temporal priority, with the result that the analyticity of the first statement can be reduced to that of the second; and, in the case of the second statement, that it is analytic because the concept of being later than can be analysed in terms of the concepts of past, present, and future. Neither move is, I believe, successful. As regards the first, I have argued elsewhere that the correct account of causation does not involve any temporal concepts,[84] and the account offered earlier, in Chapter 4, satisfies that constraint. And, as regards the second, it was argued in Section 6.1 that the concept of being later than cannot be analysed in terms of the concepts of past, present, and future, and, while one of the arguments in support of that claim involved the thesis under discussion here, the other did not. Consequently, it seems reasonable to conclude that one cannot explain the necessity of the above statements by an appeal to analyticity unless one abandons the view that the concept of the future is unanalysable.

There are, then, at least two reasons for holding, contrary to the view accepted by almost all advocates of a tensed view of time, that the concept of the future is not analytically primitive. But how, then, is the concept of the future to be analysed? The full answer to this question will be set out in the next chapter. In outline, however, the answer that I favour is this. *Ordinary* tensed sentences about the future necessarily involve indexicals. An analysis of them cannot take the form, therefore, of a translational analysis: truth conditions will have to be specified in a different way—namely, in the way that one does for any sentence involving an indexical. I shall also argue, however, that, in giving those truth conditions, one must introduce a more basic tensed concept, and one that does not involve any indexicality—namely, the relational, tensed concept of lying in the future *at time t*. One way of analysing that more fundamental concept, in turn, is as follows:

E is future at time t

means the same as

E is later than time t, and time t lies in the present at time t.

Almost all advocates of a tensed approach to time would, of course, be inclined to maintain that this proposed line of analysis is

[84] Michael Tooley, *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) 205–16, 244ff.

unacceptable, and that for a number of reasons. In the first place, they would generally want to resist the claim that ordinary tensed sentences necessarily involve indexicals. In the second place, they would generally be inclined to reject the claim that the concept of lying in the future at time *t* is a tensed concept, let alone one that is more basic than the concept of being in the future *simpliciter,* since they tend to agree with advocates of tenseless approaches in accepting the following two claims: first, that to say that something is future at time *t* is to say nothing more than that it is later than time *t*; and, secondly, that the concept of being future at a time is not, consequently, a tensed concept. Finally, they would also argue, I believe, that the above analysis of the concept of being future at a time is implicitly circular, for it involves the concept of the later- than relation, which, as we have seen, advocates of a tensed view of time have generally held is to be analysed in terms of the tensed concepts of past, present, and future.

I believe, however, that none of these objections is sound. As regards the first, it rests upon a correct intuition—the intuition, namely, that, if a tensed view of time is to be defensible, it cannot be an intrinsic feature of tensed sentences that they involve indexicals. But it does not follow from this that, if a tensed approach to time is to be defensible, ordinary tensed sentences must not involve indexicals: even if ordinary tensed sentences do involve indexicals, there may be other, more basic, tensed sentences that do not.

At this point the first objection connects up with the second, since I am claiming that it is sentences about what is past, present, or future at a time that are the non-indexical, tensed sentences. That they are not indexical is, of course, accepted by all parties. What is controversial is the claim that they are tensed sentences, rather than tenseless sentences in disguise. But I shall show, in the next chapter, that, while a sentence such as '*E* lies in the future at time *t*' does entail that *E* is later than *t,* it also entails something more, and something that is, moreover, a tensed proposition, since it implies that the future is not real. So one can grant that ordinary tensed sentences involve indexicals, while rejecting the view that indexicality is a necessary property of tensed sentences in general. The first two objections can thus be set aside.

The final objection—to the effect that the proposed analysis of the concept of being future at a time suffers from circularity—rested upon the contention that the relation of temporal priority is analysable in tensed terms. This claim has already been examined, and found wanting.

In conclusion, then, I believe that there are good reasons for thinking that the concept of the future is analysable, and that there is a natural analysis which can be offered, and which can be defended against objections typically advanced by those who favour a tensed view of time.

Let us turn, then, to the concept of the past, and ask whether there are reasons for thinking that this concept must also be analysable. I believe that there are. In particular, I want to argue that the considerations advanced above in support of the claim that the concept of the future cannot be taken as analytically basic can be paralleled here.

The first of those arguments rested upon the thesis that a descriptive concept cannot be analytically basic for a given person unless that concept picks out a property or relation that, for the individual in question, is, or has been, either an object of direct, non-causal awareness, or an object of immediate perception. Can it be established that the property of lying in the past is not an object of direct awareness, or immediate perception? The argument here is admittedly less straightforward than in the case of the concept of lying in the future, for there one could appeal to the uncontroversial thesis that one does not have non-inferential knowledge of the future, whereas the corresponding claim—that one does not have non- inferential knowledge of the past—would certainly be rejected by some philosophers. Nevertheless, I believe that the corresponding claim is in fact correct, since it seems to me that memory knowledge of the past is most plausibly viewed, not as involving non-inferential knowledge of past events, but as a matter of non-inferential knowledge of present beliefs about the past, coupled with an inference to the best explanation of those beliefs. But one can avoid this controversial issue by developing the argument in a different way. The alternative line of argument turns upon a principle—which I suggest is very plausible—to the effect that one cannot be directly aware of, or immediately perceive, a state of affairs without being directly aware of, or immediately perceiving, all of the constituents of the state of affairs in question. Given this principle, one can argue that, if memory knowledge of a past event did involve a direct awareness, or immediate perception, of some event's having the property of pastness, one would also have to have a direct awareness, or immediate perception, of the event in question, and this in turn would require a direct awareness, or immediate perception, of at least some of the other properties of the event. However, a comparison of the phenomenological content of memory, on the one hand, and perceptual experience, on the other, seems to make it clear that the remembering of an event does not involve the sort of direct acquaintance with the properties of an event that there is when one is experiencing that event: a memory of having experienced greenness, for example, does not involve the same raw-feel quality that an experience of greenness itself does. If this is right, then, regardless of whether one has, in some sense, non-inferential knowledge of past events, it is not the case that one is directly acquainted with the property of pastness, and so the concept of pastness cannot be analytically basic.

The second argument for the analysability of the concept of the future appealed to the methodological principle that one should attempt to cash out necessary truths as analytic truths. A precisely parallel argument can be offered here. Consider the following propositions:

(1) Any event causally prior to a present event lies in the past;
(2) Any event earlier than a present event lies in the past.

As with the corresponding propositions about future events, most philosophers would view the first as a necessary truth, while almost everyone does so with the second. But if (1) and (2) do express necessary truths, what account is to be given of that fact?

Here, as in the case of the corresponding statements about the future, one can attempt to argue that these two statements are analytic, while, at the same time, rejecting the claim that the concept of the past is analysable. But this would involve, in the case of the second statement, the thesis that the earlier-than relation can be analysed in terms of tensed concepts, and, in the case of the first statement, the claim that the analysis of the concept of causal priority involves the concept of temporal priority—theses which are, I believe, to be rejected, for the reasons indicated earlier.

If this is right, then statements (1) and (2) can be analytic truths only if the concept of the past is analysable, and the problem is then to provide a satisfactory analysis of that concept. But, if the account of the concept of the future sketched above is sound, the concepts presupposed by that analysis—namely, that of the present, and that of the earlier-than/later-than relation—can be used to set out a parallel and equally plausible analysis of the concept of the past. Here too, of course, just as in the case of sentences about the future, one will not be able to offer a translational analysis of ordinary tensed statements about the past, since those statements involve indexicals. But one will be able to provide a truth- conditional analysis. Moreover, the formulation of those truth conditions will involve a more basic tensed concept that is free of all indexicality—the concept, namely, of lying in the past at time *t*—and a translational analysis of that more fundamental tensed concept can then be given as follows:

E is past at time *t*

means the same as

E is earlier than time *t,* and time *t* lies in the present at time *t.*

A brief summary at this point may be helpful. In this section I have tried to do three main things. First, I have argued that, contrary to the views of most advocates of tensed accounts of the nature of time, tensed concepts—or at least those of the past and of the future—are analysable. Secondly, I have suggested that the basic tensed concepts are not those that occur in the most familiar tensed sentences, but, instead, the relational ones of lying in the present at a time, lying in the past at a time, and lying in the future at a time. Finally, although I have not dealt with the first, and the most important, of these three relational, tensed concepts, I have offered analyses of the concepts of lying in the past at a time, and of lying in the future at a time.

It perhaps needs to be emphasized, however, that the above accounts of what it is to lie in the past or in the future at a time are, as far as they go, perfectly compatible with a tenseless view of time. Someone who accepts a tenseless view of time can interpret the clause '*t* is present at time *t*' as expressing nothing more exciting than the proposition that *t* is simultaneous with itself, and it would then follow that to say that *E* lies in the future at time *t,* or that *E* lies in the past at time *t,* is to say nothing more than, respectively, that *E* is later than *t,* and that *E* is earlier than *t.* But I shall be offering a very different analysis of what it is to lie in the present at a time—an analysis, namely, that takes temporal becoming seriously, and that rests upon the accounts of actuality as of a time, and truth at a time, that were set out earlier. This divergence with respect to the analysis of what it is to lie in the present at time *t* will then mean that my accounts of all tensed sentences, both those that involve indexicals, and those that do not, will differ radically from those advanced by advocates of a tenseless view of time.

6.4 An Argument for the Analysability of Tensed Concepts

What lies at the very heart of a tensed approach to time is, I believe, the idea of a dynamic world, and in Chapter 4 I argued that it is reasonable to believe that our world is dynamic, on the grounds that it contains causally related events, and that the only satisfactory account of the nature of causation is a realist one which entails that causation is only possible in a dynamic world. However, not just any dynamic world will suffice: causation requires a world where the past and present are real, but the future is not—or at least, a very close approximation to such a world.

But where does that leave the question of the meaning of tensed statements? Does the above ontology place restrictions upon the accounts that can be given, or are we still faced with a rich range of alternatives? The answer is that the view that the past and the present are real, while the future is not, does not on its own, perhaps, narrow the range of alternatives very much. But, in conjunction with the negative results concerning the analysability of certain tenseless notions in tensed terms, which I argued for in Sections 6.1 and 6.2, it appears to impose very severe constraints upon what views can be taken concerning the meaning of tensed statements, since it seems to follow—perhaps surprisingly—that tensed language must be analysable, and analysable along certain general lines.

The argument in support of this contention can be put as follows. What are the main options concerning the relation between tensed language and tenseless language? The most important would seem to be these:

(1) Tensed language is analytically more basic, and all tenseless statements can be analysed in terms of tensed ones;

(2) Tenseless language is analytically more basic, and all tensed statements can be analysed, either in terms of tenseless statements alone, or in terms of tenseless statements together with the general idea of a dynamic world;

(3) Tensed language and tenseless language are both analytically basic, so that neither can be analysed in terms of the other.

There are, of course, more complex possibilities, according to which some tenseless statements can be analysed in terms of tensed statements, but not others, and so on. But such possibilities have not yet been seriously explored by philosophers, and I shall disregard them in the argument that follows.

Which of the above three positions, then, is the most plausible? I believe that the second is, in view of the following argument. In the first place, we have seen that there are good reasons for holding that neither the tenseless relation of temporal priority, nor tenseless quantification, can be analysed in tensed terms. So the view that tensed language is more basic, and that all tenseless statements can be analysed in tensed terms, can be set aside.

Secondly, consider a world where the past and present are real, but the future is not, and that, like ours, contains various tenseless facts. What sort of *basic* facts must it contain? If thesis (1) were true, it would have to contain basic tensed facts. But we have seen that there is good reason to reject thesis (1). And this would seem to imply that our world *could* be one where the only basic facts were *tenseless* ones, since both thesis (2) and thesis (3) assert that tenseless language, rather than being parasitic upon tensed language, is analytically basic.

It seems that it must be possible, then, to have a dynamic world where what facts there are depends upon what time it is, but where all of the basic facts are *tenseless* ones. Such a world, being dynamic, would involve change of a sort that is not compatible with a tenseless approach to time. So, thirdly, it would be a world with a genuine flow of time, and thus a world in which there would be true statements about the past, the present, and the future.

Fourthly, it is not merely that there would have to be *some* tensed statements or other that would be true in such a world. For suppose that one tries to conceive of two possible worlds that satisfy the following three conditions:

(*a*) Both worlds are dynamic ones in which what is actual as of a given time includes states of affairs that are simultaneous with that time, plus all earlier states of affairs, but no later ones;
(*b*) The two worlds agree completely with regard to the totality of tenseless states of affairs that are actual as of every time;
(*c*) The worlds differ, however, with respect to the truth values of at least some tensed statements.

Is it possible to have two worlds satisfying all three conditions? The crucial issue is whether there could be some special fact of presentness that has different locations in the two worlds relative to the tenseless states of affairs that are actual as of some particular time. For this to be so, it would have to be possible for presentness, in at least one of the worlds, to lie somewhere other than at the cutting edge of reality, somewhere other than at the time of the latest tenseless facts that are actual as of the time in question. This, however, seems to me impossible: presentness must lie at the point where facts are coming into existence in the dynamic world.

But, if the two worlds cannot differ with regard to presentness, then neither can they differ with respect to any other tensed facts. The reason is that, first of all, given that they agree with regard to all tenseless facts, they must also agree with regard to the temporal ordering of events, since one event's being earlier than another is, in view of the fact that temporal priority cannot be analysed in tensed terms, a tenseless state of affairs. Secondly, given that they do not differ with regard to presentness, they cannot disagree with respect to either pastness or futurity, since that would entail a difference with respect to temporal ordering. Consequently, dynamic worlds of the relevant sort cannot differ merely with respect to tensed states of affairs, and we are forced to conclude not only that a dynamic world where the only basic facts are tenseless ones must be a world that contains some tensed truths or other, but also that what tensed truths there are is *logically supervenient* upon what tenseless facts there are as of different times.

Finally, if this logical supervenience does obtain, two conclusions would seem to follow. The first is that, since the truth-values of tensed sentences are fixed by what tenseless states of affairs are actual as of different times, it should be possible to offer at least a truth-conditional analysis of tensed sentences in terms of sentences describing the supervenience base. But what tenseless facts there are as of different times can be completely described by means of tenseless sentences, together with the concept of a state of affair's being actual as of a given time. Therefore, secondly, tensed sentences must be capable of being analysed in terms of tenseless sentences, together with the concept of being actual as of a given time.

6.5 Summing Up

In this chapter, I have discussed three important propositions that are accepted by most philosophers who defend a tensed account of the nature of time:

(1) The relation of temporal priority is analysable in terms of tensed, temporal concepts;
(2) Tenseless quantifiers that range over temporal entities are analysable in terms of tensed quantifiers;
(3) Tensed, temporal concepts are themselves unanalysable.

I have argued that all three of these claims are unacceptable. My initial discussion of the third claim was restricted, however, to the concepts of the past and the future, and I did not deal with the central question of the analysability of the most basic, tensed concept—that of the present. In Section 6.4, however, I did set out an argument, based upon the earlier conclusions concerning the untenability of claims (1) and (2), for the general thesis that all tensed concepts must be analysable. If that argument is sound, then statements about the present must be analysable, and analysable in a certain way—namely, in terms of tenseless statements, plus the concept of a state of affair's being actual as of a given time. In the next chapter, I shall offer such an analysis.

7 Past, Present, and Future

In this chapter, I shall set out an account of the truth conditions of tensed statements. The account offered will be based upon the following three fundamental theses. First, some tensed statements involve indexicals, but others do not, and the latter are analytically more basic. Secondly, truth conditions for indexical tensed statements can be given in terms of non-indexical tensed statements. Thirdly, the latter can be analysed in terms of tenseless statements, together with either the ontological concept of what is actual as of a given time, or, alternatively, the corresponding semantical concept of truth at a time.

7.1 The Analysis of Simple, Non-Indexical Tensed Statements

One of the central differences between my approach and other tensed accounts is that I maintain that all tensed statements are analysable. In this respect, my position is much closer to tenseless views of time, given that the latter maintain that truth conditions for tensed utterances can be specified in tenseless terms. At the same time, there are crucial differences. These will emerge very clearly in the discussion that follows, but it may be best to point out the two most important at the very beginning. In the first place, then, either the concept of truth at a time, or the corresponding ontological concept of what is actual as of a given time, is essential to the present account: truth conditions for tensed statements cannot, I maintain, be formulated in terms of tenseless statements alone. In the second place, the present approach involves the thesis that indexicality is not intrinsic to tensed statements. Some tensed statements involve indexicals, but others do not, and it is precisely the latter that are fundamental.

7.1.1 Are All Tensed Statements Indexical?

The present is not fixed. What lies in the present at one time cannot do so at other times. As a consequence, any statement about the present must, in some way, specify the time in question. This, in turn, can be done in two ways. First, the sentence itself may contain a reference to some specific time as part of its content. Secondly, the sentence may be free of such reference, but its meaning be such that the time at which it is uttered determines the time that is relevant to the proposition expressed by that particular utterance of the sentence.

Any sentence of the former sort—provided that it is free of all indexicals—always expresses the same proposition, regardless of when it is uttered, and, as a consequence, any two utterances, either actual or possible, must always agree in truth-value at a given time. By contrast, in the case of sentences of the second sort, the proposition expressed depends upon the time of utterance. Different utterances of the same sentence may therefore have different truth-values at a given time.

Sentences containing tensed verbs, in English and other languages, typically employ the second method of specifying the relevant time. Thus, a sentence such as 'It is raining in London' contains no expression that specifies the time in question. The relevant time is simply the time at which the sentence is uttered, and, as a consequence, the proposition expressed by an utterance of such a sentence a week ago necessarily differs from the proposition expressed by an utterance of it today.

It is not, however, only sentences that refer to tensed facts by means of inflected verbs that share this feature, since, if one dispenses with tensed verbs in favour of tenseless verbs, coupled with temporal phrases such as 'in the past', 'at present', 'in the future', and the like, one is also employing sentences where the specification of the relevant time is fixed by the time at which the sentence is uttered.

The situation, in short, is that it seems to be the case that most of the natural ways of expressing tensed propositions, at least in those languages that are most familiar, fix the time in question by the second method, rather than by the first. This fact may, I suspect, lend an unwarranted appearance of plausibility to the approach to tensed statements advocated by those who favour a tenseless view of time—for, if the relevant time is not given by the content of the sentence itself, being fixed rather by the time of utterance, how is this achieved? The only answer would seem to be that any such sentence must contain an indexical expression which functions, in any utterance of that sentence, to indicate the relevant time.

But, if it is true that an utterance that does not contain, as part of its content, any explicit characterization of a time, can specify the relevant time only if the sentence in question involves an indexical, and if, further, one assumes that all sentences that can be used to express tensed propositions fix the time by the second of the two methods mentioned above, then it would seem reasonable to conclude that indexicality is something that lies at the heart of tensed propositions.

This in turn suggests the conclusion that, although there are tensed propositions, there are no tensed facts, since, if indexicality is an essential feature of sentences that express tensed propositions, it is natural to compare such sentences with other sorts of sentences containing indexical expressions. In particular, it is natural to consider sentences that contain terms such as 'here' and 'there'. In the case of such spatial, indexical sentences, it is agreed by all that there are no special facts about hereness and thereness that serve to determine when utterances of such sentences are true. The truth-values of utterances of sentences containing terms such as 'here' and 'there' are fixed by ordinary facts about the spatial locations of objects, together with the speaker's location at the time the utterance is made. Indexical sentences about the spatial locations of objects do not describe special spatial facts; they simply describe ordinary spatial facts from the spatial perspective of the speaker. But, then, why should the situation be different in the case of indexical sentences about the temporal locations of events? Is it not equally plausible to conclude that such sentences, rather than describing any special, tensed facts, simply describe familiar tenseless facts, but do so from the temporal perspective of the speaker?

The point, in short, is that, if tensed propositions are always expressed by indexical sentences, then there is a natural account of the truth conditions of such sentences—namely, the sort of account that one uses in the case of the analogous indexical sentences about spatial locations—and which, if adopted in the case of statements about the past, the present, and the future, would provide one with truth conditions for such statements without invoking the existence of a realm of special, tensed facts.

This line of thought is not, of course, conclusive. However, I suspect that there may be other arguments, starting out from the same premisses, that are. In particular, may it not be argued that, if sentences about the past, the present, and the future, although involving an indexical element, have truth conditions that also require reference to special, tensed facts, then it should be possible to formulate sentences that, first, are true simply in virtue of the existence of the appropriate tensed facts, and, secondly, do not involve any indexicals? If, therefore, it is not possible to formulate such sentences, one is justified in concluding that there are no special tensed facts.

Perhaps this reasoning can be resisted. I shall not, however, pursue that question, as I believe that the fundamental defect in this argument lies rather in one of the premisses. In particular, I wish to maintain that it is not the case that tensed propositions can be expressed only by sentences containing indexicals.

Given the remarks above, to the effect, first, that any statement about the present must specify a time, and, secondly, that there are two ways in which this might be done, what we should be looking for, at this point, are sentences that express tensed propositions, and that contain, as part of their content, reference to a specific time. Are there such sentences? Yes, there are, since any sentence of the following form will be an example:

Event E lies (tenselessly) in the present at time t.

Any sentence of this form, in virtue of the explicit temporal reference that it contains, will express the same proposition whenever it is uttered, and any two utterances of it, at whatever times, must therefore have the same truth-value at a given time. In both of these respects, any such sentence will differ from a tensed sentence that involves an indexical.

Almost all writers on time define tensed sentences in such a way that it is an essential property of such sentences that, aside from those that are logically true or logically false, the truth-value of an utterance of such a sentence can vary with the time of utterance.[85] If

[85] See e.g. D. H. Mellor, *Real Time* (Cambridge: Cambridge University Press, 1981), esp. ch. 2; Richard M. Gale, *The Language of Time* (London: Routledge & Kegan Paul, 1968,) 49; and George N. Schlesinger, *Aspects of Time* (Indianapolis: Hackett Publishing Company, 1980,) 26–7.

this characterization were correct, sentences of the above sort would not qualify as tensed sentences. But this requirement is simply mistaken, as is clear once one realizes that, although any utterance of a tensed sentence must somehow specify the relevant time, this need not be done by means of indexical expressions. And, given this fact, there is no ground for holding that it must always be possible for utterances of a tensed sentence at different times to have different truth-values.

7.1.2 Non-Indexical Tensed Statements About the Present

Let us now consider how non-indexical tensed statements about present events are to be analysed. Consider, in particular, sentences of the form mentioned above—namely, 'Event *E* lies (tenselessly) in the present at time *t*.' What account is to be offered of the truth conditions of such sentences?

Advocates of a tenseless approach to time would contend that any sentence of the following form

Event *E* lies (tenselessly) in the present at time *t*

is to be analysed as equivalent in meaning to

Event *E* exists (tenselessly) at time *t,*

or, alternatively, as equivalent in meaning to

Event *E* is simultaneous with time *t.*

Indeed, it is not only those who favour a tenseless approach to time who accept such analyses. Some advocates of a tensed approach do so as well—as we saw in the previous chapter, when we considered Richard Gale's criticism of an analysis of the earlier-than relation proposed by Wilfrid Sellars.

The above analyses, however, are not satisfactory. While the proposition that *E* lies (tenselessly) in the present at time *t* does entail the propositions that *E* exists (tenselessly) at time *t,* and that *E* is simultaneous with time *t,* it is not entailed by either of those propositions, since it appears to entail something that they do not—namely, that the world is dynamic, rather than static.

If it turned out that dynamic accounts of the nature of time were incoherent, or that, while they were coherent, our world is not in fact a dynamic one, then one might decide to accept the above proposals. In that case, however, one would be accepting them not as analyses, but as plausible recommendations as to how the meanings of certain sentences should be changed in order to eliminate the false presupposition that the world is a dynamic one.

How, then, are tensed sentences of the above sort to be analysed? Given the dynamic account that I am defending, the idea is simply that the present, at a given time, consists of those states of affairs that are actual as of that time, and which are such that there are no later states of affairs that are actual as of that time. So the appropriate analysis is simply this:

> Event E lies (tenselessly) in the present at time t

means the same as

> E is an instantaneous state of affairs, E is actual as of time t, and no state of affairs that is later than E is actual as of time t.

Alternatively, rather than employing the concept of being actual as of a time, one could formulate the account in terms of the idea of truth at a time. The analysis would then be:

> Event E lies (tenselessly) in the present at time t

means the same as

> E is an instantaneous state of affairs such that it is true at time t that E exists (tenselessly), and indeterminate at time t that there is (tenselessly) any state of affairs that is later than E.

It follows from either analysis that E lies (tenselessly) in the present at time t only if E is simultaneous with t. Consider, for example, the first analysis. If E is actual as of time t, then, in view of the fact that what is actual as of a given time consists only of states of affairs that exist at the time in question, together with earlier states of affairs, E cannot be later than t. Nor can E be earlier than t, since there would then be a state of affairs—namely, the existence of time t itself—in virtue of which something would be actual as of time t that was later than E. Accordingly, E must be simultaneous with time t.

Both of the above analyses presuppose, of course, a thesis defended in the previous chapter—namely, that the relation of temporal priority cannot be analysed in tensed terms. If that thesis were false, the use of the later-than relation in the analyses of what it is for an event to lie in the present at a given time would make the analyses circular.

7.1.3 Non-Indexical Tensed Statements About Past and Future Events

The thesis that the concept of temporal priority cannot be analysed in tensed terms is also crucial in connection with the analysis of tensed statements about the past and the future, since, given that thesis, one is free to employ the concept of temporal priority in analysing sentences such as the following:

> Event *E* lies in the past at time *t*;
> Event *E* lies in the future at time *t*.

Thus, one very natural idea, for example, is simply to view the concept of the past as the concept of what is earlier than the present, and the concept of the future as the concept of what is later than the present. This gives one the following, initial analyses:

> Event *E* lies in the past at time *t*

means the same as

> *E* is earlier than time *t,* and *t* lies in the present at time *t.*
> Event *E* lies in the future at time *t*

means the same as

> *E* is later than time *t,* and *t* lies in the present at time *t.*

These analyses can then be expanded by using, for example, the first analysis of statements about the present set out in the previous section—namely, that

> Time *t* lies in the present at time *t*

means the same as

> Time *t* is an instantaneous state of affairs, *t* is actual as of time *t,* and no state of affairs that is later than *t* is actual as of time *t.*

Substitution in accordance with this equivalence then yields the following analyses of non-indexical sentences about past and future events:

Event E lies in the past at time t

means the same as

Event E is earlier than time t, and t is an instantaneous state of affairs, t is actual as of time t, and no state of affairs that is later than t is actual as of time t.
Event E lies in the future at time t

means the same as

Event E is later than time t, and t is an instantaneous state of affairs, t is actual as of time t, and no state of affairs that is later than t is actual as of time t.

There is, however, a slightly different approach that one can take to the analysis of non-indexical sentences about the past and the future, based upon the idea that, if something is now past, then it was the case that it was present, while, if something is now future, then it will be the case that it is present.[86] This starting-point then gives rise to the following analyses:

Event E lies in the past at time t

means the same as

There exists (tenselessly) a time, t^*, such that t^* is earlier than t, and event E is present at time t^*.
Event E lies in the future at time t

means the same as

There exists (tenselessly) a time, t^*, such that t^* is later than t, and event E is present at time t^*.

These analyses can then be expanded by making use of the analysis of what it is for an event to be present at a given time set out in the previous section, so that one has:

Event E lies in the past at time t

means the same as

[86] I am indebted to Colin Allen for drawing my attention to this alternative approach.

> There exists (tenselessly) a time, t^*, such that t^* is earlier than t, E is an instantaneous state of affairs, E is actual as of time t^*, and no state of affairs that is later than E is actual as of time t^*.
>
> Event E lies in the future at time t

means the same as

> There exists (tenselessly) a time, t^*, such that t^* is later than t, E is an instantaneous state of affairs, E is actual as of time t^*, and no state of affairs that is later than E is actual as of time t^*.

How are the alternative analyses related to one another? The answer is that they are provably equivalent, provided, first, that the postulates concerning causality and actuality that were set out in Chapter 4 are correct, and, secondly, that the causal theory of temporal priority to be defended in Chapter 9 is also correct. For suppose that E lies in the past at time t. According to the first of the analyses offered above, this means that E is earlier than time t. If the causal account of temporal priority that I shall set out later is correct, it follows from the earlier postulates concerning causation and actuality that no states of affairs that are later than the time of E can be actual at that time. Hence E lies in the present at the time that it occurs. So the second analysis of what it is for event E to lie in the past at a given time is also satisfied.

Consider, on the other hand, the second analysis. According to it, there must be some time, t^*, such that t^* is earlier than t, and E lies in the present at time t^*. It then follows from the analysis of temporal priority to be offered later that E is earlier than time t, while that analysis of temporal priority, together with the postulates concerning causality and actuality, also entails that time t must lie in the present at time t. So the first analysis of what it is for event E to lie in the past at time t is also satisfied. Therefore, given the present approach to the nature of time, the two analyses are analytically equivalent.

This completes my analysis of non-indexical tensed sentences about past, present, and future events. In Section 7.2, I shall consider the case of more familiar tensed sentences, involving indexicals, and there we shall see that it is a very simple matter to formulate truth conditions for such sentences using the nonindexical tensed sentences analysed in this section.

7.1.4 Some Consequences of the Above Analyses

Before doing that, however, I want to point out, very briefly, some of the consequences of the above account—consequences which show that this account satisfies certain important constraints. What constraints one thinks should be satisfied by an account of the concepts of pastness, presentness, and futurity will depend in part, of course, upon one's views on the nature of time. Some requirements, however, are clearly appropriate, regardless of what view one accepts. Thus, the concepts of pastness, presentness, and futurity need to stand in the right relations to temporal priority, and they must also be mutually incompatible. The first two consequences set out below show that these neutral constraints are met.

Other requirements would be rejected by those who accept a static view of the nature of time, but be accepted by those who favour a dynamic account—or, at least, by those who hold that the future is not real. Examples are the constraints, first, that in a static world no event would ever be either past, present, or future; secondly, that (non-analytic) statements about the future are not now either true or false; and, thirdly, that the tensed properties of events alter with the passage of time. The third, fourth, and fifth consequences set out below show that these 'tensed' requirements are also satisfied.

First of all, then, the above accounts entail that past, present, and future events stand in the appropriate tenseless temporal relations. If E lies in the past at time t, and F in the present at time t, then E is earlier than F. Similarly, if E lies in the present at time t, and F in the future, or if E lies in the past at time t, and F in the future, then E is earlier than F. These are immediate consequences of the fact that the earlier-than relation enters into the above analyses of sentences about past and future events.

Secondly, it also follows that pastness, presentness, and futurity are mutually incompatible. If it were true, for example, both that E lies in the past at time t, and that E lies in the present at time t, then it would follow that E is earlier than itself, and this is impossible. At any given time, therefore, an event can possess only one of the three properties of pastness, presentness, and futurity.

Thirdly, it follows from the above accounts that, if the actual world were to be a static world, then no events would be past, present, or future at any time, since all tensed statements imply that there is a time at which some state of affairs lies in the present, and this can only be so if the existence of any later state of affairs is indeterminate at that time. But if the world were static, no propositions would be indeterminate at any time.

Fourthly, all non-analytic statements about events that lie in the future at a given time are always indeterminate at that time, since they assert the existence of states of affairs at times that are later than the present, and events lie in the present at a given time only if the existence of later events is indeterminate at that time.

Finally, and on the assumptions, first, that, in our world, every momentary event or state of affairs lies in the present at some time, and, secondly, that for every moment of time there is a later moment, the above account entails that every momentary event or state of affairs first lies in the future, then is momentarily in the present, and then is forever after in the past. On the tensed approach being defended here, of course, this statement cannot be interpreted as saying that it is at first true that an event is future, then true that it is present, and then true that it is past, since no statement about any event can be true at any time prior to the time of the event's occurrence. What it means, rather, is that is true *simpliciter* that, for any instantaneous event, there is exactly one time at which it lies in the present, and that it is future at all earlier times, and past at all later times.

Thus, let E be any momentary event, and let t_0 be any time at which E lies in the present. Then it will be true *simpliciter* that E lies in the present at time t_0, but cannot be true that E lies in the present at any time that is distinct from t_0—for, as we saw earlier, an event cannot lie in the present at a given time unless it is simultaneous with that time.

Next, let t_p be any time that is earlier than t_0. Since we are assuming that the world is one where every momentary state of affairs lies in the present at some time or other, and since the existence of a temporal instant is a momentary state of affairs, there must be a time when t_p lies in the present, and that can only be time t_p itself. It then follows, since E occurs at a time that is later than time t_p, that E lies in the future at time t_p. Similarly, if t_f is any time that is later than t_0, it will follow that E lies in the past at time t_f. So every event first lies in the future, is momentarily present, and is then past forever after.

To sum up, then, there are various constraints that one might think should be satisfied by any satisfactory account of the meaning of statements about past, present, and future events. Some of these constraints are neutral with respect to what view of the nature of time is correct, while others presuppose a tensed account. Both sorts appear to be satisfied by the account offered above.

7.2 The Analysis of Indexical Tensed Statements

Let us now turn to the analysis of ordinary tensed sentences. To this point, I have confined my attention to tensed sentences that contain terms or expressions that refer to definite events or states of affairs. In this section I shall begin, accordingly, with the case of indexical tensed sentences that assign a temporal location to a specific event. I shall then go on to consider tensed sentences—like 'It is now snowing heavily'—that do not contain terms or expressions that refer to definite events.

7.2.1 Indexical Tensed Statements About Specific Events

Given the preceding account of the truth conditions of nonindexical tensed sentences about past, present, and future events, it is easy to give an analysis of the corresponding, indexical sentences. Since, however, the term that one is analysing—namely, the term 'now'—involves an indexical element, and this indexical element itself needs to be clarified, the required explanation cannot take the form of a translational analysis. The specification of the meaning of the term 'now' has to be given, instead, through a description of the conditions under which any given token of such a sentence will be true, false, or indeterminate at a time.

In the case of statements about the present, this can be done roughly as follows:

> Any utterance, or inscription, at time t^*, of the sentence 'Event E is now occurring' is true (false, indeterminate) at time t

if and only if

> It is true (false, indeterminate) at time t that E lies in the present at time t^*.

Similarly, truth conditions for indexical statements about past events and future events can be stated, in a precisely parallel fashion, as follows:

> Any utterance, or inscription, at time t^*, of the sentence ‘Event E has occurred’ is true (false, indeterminate) at time t

if and only if

> It is true (false, indeterminate) at time t that E lies in the past at time t^*.
> Any utterance, or inscription, at time t^*, of the sentence ‘Event E will occur’ is true (false, indeterminate) at time t

if and only if

> It is true (false, indeterminate) at time t that E lies in the future at time t^*.

But this account, even though satisfactory as far as it goes, is not quite complete, in view of the fact that there are relevant activities that one can engage in other than saying, or writing, that E is now occurring: one can believe that E is now occurring, doubt that E is now occurring, and so on. The reference to an utterance or inscription needs to be replaced, therefore, by something more inclusive that takes into account the fact that the proposition that E is now occurring may be the object of a propositional attitude without there being any token—or at least, any non-mental token—of the sentence in question.

Sometimes it is suggested that one should deal with this problem by talking about utterances, inscriptions, and thoughts. However, that is still not sufficiently comprehensive, given that a person can believe that E is now happening, without having the thought that it is happening, or can want it to be the case that E is now happening, without that desire being accompanied by any conscious thought.

How best to refine the above account is not, however, a question that we need to pursue here, since the question is not one that is peculiar to indexical tensed sentences. It is, rather, a general issue that arises in connection with any sentence containing an indexical.

Whatever appears to be the best answer to the general question will apply, in a perfectly straightforward fashion, to tensed sentences involving indexicals.

7.2.2 Other Indexical Tensed Statements

The preceding account provides truth conditions for sentences that refer to specific events—such as, 'The first trip to Mars lies in the future.' But there are also very simple sentences—such as, 'It is now snowing heavily', or 'The grass was very green in England'—that do not contain terms or expressions that refer to specific events, or states of affairs. How are the latter sorts of sentences to be analysed?

Given an analysis of statements that contain expressions that refer to events, or states of affairs, and that assign tensed, temporal location to such entities, it seems to be a straightforward matter to provide an account of statements that do not contain such expressions—such as 'It is now snowing heavily', or 'The grass was very green in England'. One very simple and natural approach is to view sentences of the latter sort as related, via existential quantification, to sentences in which an event is assigned a temporal location. Thus, for example, the sentence 'It is now snowing heavily' contains terms that specify a certain *type* of event—namely, an event which consists of its snowing heavily—and one can then interpret the sentence 'It is now snowing heavily' as saying that *there is* an event of that type, and that that event has the relevant temporal property. So we have the following, translational analysis:

It is now snowing heavily

means the same as

There is (tenselessly) an event, E, of the snowing heavily variety, and E lies in the present.

Similarly, in the case of the sentence 'The grass was very green in England', the sentence contains terms that specify a certain type of state of affairs. So, again, an analysis that treats the logical form of the sentence as involving existential quantification seems very natural. Thus one has:

The grass was very green in England

means the same as

> There is (tenselessly) an event, *E,* of the grass's being very green in England variety, and *E* lies in the past.

In short, given an ontology that includes states of affairs, it appears a straightforward matter to provide an account of tensed statements that do not involve any expressions that refer to specific events.

7.3 More Complex Tensed Statements

In the preceding two sections I have offered analyses of both indexical and non-indexical sentences about the past, the present, and the future. Those analyses cover most ordinary tensed sentences. But not all. The reason is that those analyses deal only with sentences that involve a single temporal operator, whereas some sentences—such as 'By the year 2000, the first unicorn will have been created'—involve nested temporal operators; for the latter sentence says that it will be the case that something was the case.

Can the accounts offered above of simple tensed sentences be extended to more complex sentences containing nested tensed operators? The answer is that this can be done, and in a very natural and straightforward way. Before setting out that account, however, I shall consider an alternative approach—an approach that has most commonly been advanced by advocates of a tensed approach to time, such as Arthur Prior, but which can also, as Hugh Mellor has shown, be formulated in tenseless terms. This alternative approach to sentences involving nested tensed operators is, I shall argue, unsatisfactory. But an understanding of why it is unsatisfactory will point very clearly, I believe, in the direction of a sound account.

7.3.1 An Alternative Account of the Truth Conditions of Sentences With Nested, Tensed Operators

To see the problem with the most familiar approach to sentences involving nested, tensed operators, let us consider Hugh Mellor's very clear formulation of tenseless truth conditions for such sentences. Mellor's approach is to start out from the sort of account that is typically advanced in tense logic, and then to show how that account can be altered to produce one that is compatible with a tenseless approach to time.

Mellor begins, accordingly, by pointing out that tense logic provides a standard recipe for dealing with sentences involving nested, tensed operators:

> First, put the tensed sentence to be assessed for truth-value into the standard form, i.e. with its complex tense expressed by a sequence of *A* series positions prefixed to a present tense core. Then take the first of these *A* series positions, and suppose the present moment shifted that amount from the date it now has. Starting again from there, repeat the exercise with each of the other *A* series positions in turn. Finally ask if the core sentence would be true if the present moment actually did have the date arrived at for it by this process. If it would, the original sentence is true; if not, not.[87]

Mellor then goes on to suggest that all that one needs to do is to replace this tensed recipe by a tenseless version in which references to the present moment are replaced by references to the appropriate dates:

> That is, start by seeing how far the first *A* series position is from the present, and take the date which is that far from the token's date. Then starting again from there, repeat the exercise for each of the *A* series positions in turn. Finally, ask if a token of the core sentence would have been true on the date arrived at by this process. If it would, the original sentence token is true; if not, not.[88]

Notice that, in setting out this tenseless account, it is necessary to replace reference to the core sentence by reference to a *token* of the core sentence. This has some unwelcome repercussions that Mellor fails to notice. First, consider the following sentence:

> There was a time when the universe was less than 10^{-100} seconds old.

According to Mellor's account, a present token of this sentence is true if there is a time when a token of 'The universe is less than 10^{-100} seconds old' would have been true. But the state of the universe when it was less than 10^{-100} seconds old may well have been such as nomologically to exclude the existence of any tokens

87 Mellor, *Real Time,* 45.

88 Ibid.

of sentences at that time, and, if so, what does it mean to say that a *token* of some sentence would have been true at that time?

Secondly, consider the following sentence:

> There was a time when there were no sentence tokens at all.

Given Mellor's tenseless recipe, a token of this sentence is true if and only if there is a time when a token of the core sentence 'There are no sentence tokens at all' would have been true. But a token of that sentence could never have been true.

What is the source of these difficulties? In particular, are they rooted in the fact that Mellor is attempting to offer a tenseless account of the truth conditions of tensed sentences? The answer is that they are not: tensed approaches to time can just as easily run afoul of these difficulties. The source of the problem does not lie in the thesis that it is possible to give a tenseless account of the truth conditions of tensed sentences. Its source is a very different one—namely, the idea that *all* tensed sentences involve indexicals. Any account of the nature of time—be it tensed or tenseless—will necessarily be exposed to difficulties of the above sort if it involves the latter thesis.

That this is so will be clear from the earlier discussion—in Section 6.1.2—of the typical tense-logical attempt to analyse the relation of temporal priority in tensed terms. The point needs to be explored a little more fully, however, because it lends important support to my own approach.

Suppose, then, that one assumes that all tensed sentences involve indexicals. It then follows that any complex sentence where a tensed sentence is embedded within a temporal operator will have truth conditions that depend upon the truth-value of a *token* of the embedded tensed sentence at some time. But now one is confronted with the problem, illustrated by the cases mentioned above, and those in Section 6.1.2, that it may very well be the case either that no sentence tokens can exist at the specific time in question, or else that the sentence in question is such that no token of it can exist at any time without thereby rendering itself false.

One way of trying to avoid this problem is to hold that *no* tensed sentences involve indexicals. This is not, of course, a solution that is open to an advocate of a tenseless approach to time, but it is a view that is quite frequently embraced by advocates of tensed accounts of the nature of time. If this view were tenable, moreover, it would provide a perfectly satisfactory solution. In the next chapter, however, I shall argue that the view that *no* tensed sentences involve indexicals is not, in fact, tenable.[89]

If this is right, then only one possibility remains, given that it cannot be the case either that all tensed sentences involve indexicals, or that no tensed sentences do so. Some tensed sentences must be indexical, but others are not, and any tensed sentences that occur within the scope of one or more tensed operators will always have to be of the non-indexical sort.

7.3.2 An Analysis of Sentences With Nested, Tensed Operators

The idea, accordingly, is to set out an account of sentences with nested, tensed operators according to which the correct view of the logical structure of such sentences is that they involve an indexical outer operator along with inner temporal operators, *none of which involves indexicals*. The advantage of this approach is that when sentences with nested temporal operators are viewed as having such a structure, the only sentence token—either actual or hypothetical—whose existence is needed for such a sentence to be true is the sentence token itself. Tokens of embedded sentences, actual or hypothetical, at other times past or future, are not required, and thus the problem discussed in the previous section does not arise.

A satisfactory account can be arrived at rather quickly, I think, if one begins by considering the truth conditions of tensed sentences that involve only a single tensed operator. In particular, consider the truth conditions for simple, non-indexical sentences about past and future events, where the concept of presentness has been left unanalysed. In Section 7.1.3 two analyses of such sentences were proposed, and shown to be equivalent within the context of the present approach to the nature of time. An account of more complex tensed sentences could be based on either account, but I shall focus upon the second approach, since it results in a slightly more elegant analysis.

According to that second approach, non-indexical sentences about past and future events can be analysed as follows:

Event E lies in the past at time t

[89] Sect. 8.3.1.

means the same as

> There exists a time, t^*, such that t^* is earlier than t, and E is present at time t^*.
> Event E lies in the future at time t

means the same as

> There exists a time, t^*, such that t^* is later than t, and E is present at time t^*.

What these analyses obviously suggest is that the past-tense operator functions to introduce a reference to a time that is earlier than the time that is referred to in the 'at time t' phrase, while, correspondingly, the future-tense operator functions to introduce a reference to a later time. This, in turn, suggests a simple recipe for analysing sentences with nested tensed operators. In setting out that analysis, however, it will make things more perspicuous if we shift from sentences of the form 'Event E lies in the past at time t'—where the grammatical form involves the application of temporal predicates to events—to sentences that are variants on the type of sentence standardly used in formulating tense logics—sentences such as 'It was the case that it will be the case that it is raining'—where temporal operators are prefixed to simpler sentences. The latter sort of sentence will not itself do in the present context, of course, since such sentences involve indexicals. What is needed are sentences—such as 'At time t, it was the case that it will be the case that it is raining'—where the relevant time is explicitly stated, rather than being picked out by the time of the utterance in question.

This shift gives us, then, the following:

> At time t, it was the case that E is present

means the same as

> There exists a time, t^*, such that t^* is earlier than t, and, at time t^*, E is present.
> At time t, it will be the case that E is present

means the same as

> There exists a time, t^*, such that t^* is later than t, and, at time t^*, E is present.

Given this way of formulating the earlier analyses, the analysis of non-indexical sentences where one has nested temporal operators is very straightforward, as can be seen if one considers the changes that are involved when one shifts from the fundamental, nonindexical, present-tense sentence

> E is present at time t

to the corresponding, non-indexical, past-tense sentence

> At time t, it was the case that E.

Given that the latter sentence is to be analysed as

> There exists a time, t^*, such that t^* is earlier than t, and, at time t^*, E is present.

one can see that three changes are involved in moving from the present-tense sentence to the past-tense sentence. First, an existential quantifier needs to be added to the original sentence, introducing reference to a new time. Secondly, a clause needs to be added, asserting that the new time is earlier than the time at which, according to the first sentence, E lies in the present. Finally, the time at which E lies in the present needs to be changed to the new time.

Precisely the same sorts of changes are involved when one shifts from a non-indexical, present-tense sentence to the corresponding non-indexical, future-tense sentence, the only difference being that the clause that needs to be added will assert that the new time, reference to which is introduced by the new existential quantifier, is later than, rather than earlier than, the time at which, according to the first sentence, the event in question lies in the present.

Let us see now whether this recipe works when one has embedded operators. Consider the following sentence:

> At time t, it will be the case that it was the case that E.

According to the above analysis of non-indexical, future-tense sentences, the first step in the analysis of this sentence gives one:

> There is a time, t_1, such that t_1 is later than t, and, at time t_1, it was the case that E is present.

Then, applying the recipe suggested for analysing sentences containing past-tense operators, we have:

> There is a time, t_2, and there is a time, t_1, such that t_2 is earlier than t_1, and t_1 is later than t, and, at time t_2, E is present.

Since the resulting analysis provides a satisfactory account of the truth conditions of the sentence 'At time *t,* it will be the case that it was the case that *E*', it would seem that we have a sound method of stripping off tensed operators, one by one, and, thereby, of analysing all non-indexical, tensed sentences.

Given this method of analysis, an account of the truth conditions of the corresponding indexical, tensed sentences can be set out in precisely the same way as in the case of the simplest tensed sentences. Thus, if 'At time *t*, Np*' is any non-indexical tensed sentence, where '*N*' represents a string of tensed operators, the truth conditions of the corresponding indexical sentence, *Np*', can be specified as follows:

> Any utterance, or inscription, at time *t*,* of the indexical sentence, '*Np*', is true (false, indeterminate) at time *t*

if and only if

> The corresponding, non-indexical sentence 'At time *t*, Np*' is true (false, indeterminate) at time *t*.

The conclusion, accordingly, is that more complex tensed sentences, with nested temporal operators, do not pose any difficulty. An analysis of non-indexical sentences can be given in terms of the concept of temporal priority, truth at a time, and existential quantification, and truth conditions for the corresponding, indexical sentences can then be handled in the standard way. The only thing that is required, then, in giving an analysis of more complex tensed sentences, beyond what is required for the simplest tensed sentences, is existential quantification over times. It is crucial to my programme, of course, that such quantification does not need to be analysed in terms of tensed quantifiers. But I have already argued, in Section 6.2, that, far from such an analysis being required, the reverse is true: tensed quantifiers must be analysed in terms of tenseless ones.

7.4 Tensed Statements: A Brief Retrospective View

The account of tensed language and of its relation to tenseless language that I have set out is, in some respects, closer to accounts offered by advocates of tenseless approaches to the nature of time than it is to accounts advanced by those who favour tensed approaches. First of all, I have argued against the claim that tenseless statements can be analysed in terms of tensed ones: temporal priority cannot be analysed in terms of the tensed concepts of past, present, and future, nor can tenseless quantifiers be analysed in terms of tensed ones. Secondly, I have also argued against the view that at least some tensed concepts are basic and unanalysable. All tensed concepts, without exception—including, as we have seen in this chapter, that of the present—are analysable. Thirdly, the analysis of tensed sentences set out above makes use of tenseless ones. So, contrary to virtually all tensed views on the nature of time, tenseless language turns out to be more basic than tensed language.

In addition, I also accept the claim, advanced by advocates of a tenseless view of time, but rejected by almost all defenders of a tensed approach, that the familiar tensed statements that one typically employs in everyday discourse involve indexicals. However, on the more general issue of whether indexicality is intrinsic to tensed statements, I part company with the tenseless camp, since I hold that there are other, and more basic tensed statements, that do not involve indexicals.

Most defenders of a tensed approach to time are, of course, anxious to repudiate the view that everyday tensed statements involve indexicals, since it might very well seem that this view entails that there are no tensed facts. But, as we shall see in Section 8.3.2, this is not so. The conclusion in question would follow only if familiar tensed sentences were representative in this respect, so that *all* tensed sentences were indexical. One can, accordingly, avoid being driven to the conclusion that there are no tensed facts by holding that there are more basic tensed sentences that do not involve indexicals.

The view that some tensed sentences involve indexicals, and others do not, represents a very important respect in which the present approach to the nature of time diverges from all other accounts, both tensed and tenseless. According to tenseless approaches, all tensed sentences involve indexicals; according to traditional tensed approaches, no tensed sentences do so. Against these views, I have maintained, first, that it is simply the presence of certain, tensed concepts that makes a statement a tensed one; secondly, that any statement where a tensed concept is applied to an event must contain a specification of the relevant time; but, thirdly, that this can be done in two very different ways—either indexically, or by means of an explicit reference to a time; and thus, fourthly, that there are two different types of tensed sentences—those that involve indexicals, and those that do not.

Other writers, by contrast, have generally held that the mere fact that a statement involves tensed concepts does not suffice to make it a tensed statement. In particular, if such a statement also involves an explicit, tenseless temporal reference associated with the tensed concept, that is usually taken as entailing that the statement does not express any tensed proposition. But why would one draw that conclusion? The explanation, it seems clear, is that it is generally thought that, if a tensed statement incorporates such an explicit temporal reference, then that statement, even though it contains tensed terms, can be translated without loss of meaning into a tenseless statement.

On this latter view, then, a statement such as 'In the year 1900, the birth of Bertrand Russell is an event that lies in the past' does not express a tensed proposition, in spite of the fact that it involves the tensed concept of occurring in the past, on the grounds that the sentence is equivalent in meaning to the tenseless sentence 'The birth of Bertrand Russell is earlier than the year 1900'. We have seen above, however, that, if the idea of a dynamic world is coherent, then there are excellent grounds for rejecting the claim that the above two sentences have the same meaning—for the first sentence entails something in a very immediate way that the second sentence does not, namely, the proposition that the world is a dynamic one in which what is actual as of the year 1900 does not include any states of affairs that are later than 1900. The idea that tensed sentences cannot involve an explicit specification of the relevant time is, therefore, simply wrong.

The failure to delimit correctly the class of tensed sentences has far-reaching consequences. In the first place, if one considers only tensed sentences that do not involve any explicit specification of the relevant time, one is liable to mistake a feature of that subclass for a defining feature of the class as a whole. Thus it is that many writers take it as constitutive of the distinction between tensed sentences, and non-indexical, tenseless sentences, that tokens of the former, occurring at different times, can have different truth- values, whereas tokens of the latter cannot. Once it is recognized, however, that tensed sentences can contain an explicit specification of the relevant time, it becomes clear this is a mistake, since tensed sentences that involve such a specification do not differ from nonindexical, tenseless sentences with respect to the possibility of having different truth-values at different times.

In the second place, the failure to recognize the existence of tensed sentences involving explicit specification of the relevant time makes it very difficult to avoid the view that indexicality is an essential characteristic of tensed sentences. But this in turn, as we have seen above, makes the idea that there are tensed facts very problematic indeed. The recognition of non-indexical, tensed sentences is crucial, therefore, to any satisfactory defence of a dynamic view of the nature of time.

8 Past, Present, and Future: Alternative Accounts

In Chapter 1 I argued that it is crucial, in the philosophy of time, not to run together the following two questions. First, is the world static, or dynamic? Secondly, are tensed facts logically supervenient upon tenseless facts, or are there irreducible tensed facts? Tenseless approaches to time hold that the world is static, from which it is inferred—correctly—that tensed facts are logically supervenient upon tenseless facts. Traditional tensed approaches to time, on the other hand, maintain that the world is dynamic, and they do so because they hold that there are irreducible tensed facts. The tensed approach that I am setting out, by contrast, involves the claim that, though the world is dynamic, there are no irreducible tensed facts: what tensed facts there are, as of any given time, is logically supervenient upon what tenseless states of affairs are actual as of that time.

In this chapter I shall consider the accounts of tensed statements that are offered both by tenseless approaches to time, and by traditional tensed approaches, and I shall attempt to show that none of those alternative accounts is satisfactory. My main support for this conclusion is the argument from causation, set out in detail in Chapter 4, and, in summary form, in Section 8.1. Indeed, in the case of tenseless approaches, this is the only argument to which I shall appeal—for it seems to me that objections traditionally directed against tenseless approaches to time probably cannot be sustained.

In the case of tensed accounts, however, I do not wish to rest my case upon the argument from causation alone, since I think that there are other, very strong objections that tell against alternative, tensed approaches to the nature of time. Before those objections can be set out, however, there are some important distinctions that need to be drawn, since traditional tensed accounts, while sharing the view that there are irreducible tensed facts, differ in ways that have a substantial bearing upon the objections to which they are exposed. Accordingly, I shall first describe, in Section 8.2, the main tensed alternatives, and then go on, in later sections, to set out what I take to be the most important objections to each.

8.1 The Argument from Causation

The most important objection to alternative accounts of the nature of time is the argument from causation. So before turning to a consideration of other objections, all of which are more limited in scope, I should like to recap briefly that central argument.

The basic conclusions of the argument from causation were, first, that a satisfactory account of the direction of causation requires a dynamic world, and, secondly, that not just any dynamic world will do: what is needed is one where—at least to a close approximation—only the past and the present are real. The argument in support of these conclusions, in turn, had two main parts, the first concerned with the question of how one can provide an adequate account of causation—and, in particular, of the direction of causation—and the second concerned with whether it is reasonable to believe that our world contains events that are causally related, in the relevant sense.

In outline, part one of the argument was as follows. First, there are very serious objections to any reductionist account of causation, and especially of the direction of causation. But, if only a realist approach will do, the question arises as to what form such a realist account should take. The second step in the argument, accordingly, focused upon that issue, and it involved the claim that a satisfactory account of the direction of causation could be developed if it were assumed that causal laws necessarily satisfy certain formal postulates concerning relationships between the probabilities of causes and the probabilities of their effects. This led, in turn, to the question of whether those formal postulates place any constraints upon the nature of the world. In response, I argued, thirdly, that the relevant postulates cannot be satisfied in a static world, and, fourthly, that the same is true of most dynamic worlds. What seems to be required is that the relation of causation be connected with what is actual as of a time in certain ways. In particular, it must be the case that, while a cause is actual as of the time of its effect, an effect is not actual as of the time of its cause. This in turn entailed that a world that contains causally related events must be either one in which the past and the present are real, but the future is not, or else a very close approximation to such a world.

Part two of the argument was then as follows. First, our world contains many types of events that prima facie, and in the absence of a certain type of explanation, are *extremely* improbable. Secondly, a natural response to this problem invokes the idea that the events are not really improbable, all things considered, because they have causal explanations. The question arises, however, as to *why* the existence of causal explanations should render otherwise improbable events probable, and my response was that this will be the case if and only if causal laws satisfy the postulates set out in the first part of the argument. If so, then it is reasonable to believe that our world does contain causal laws that satisfy those postulates, since the alternative is a world full of extremely improbable events.

In short, it is extremely likely that our world does contain causal laws, understood as laws that satisfy certain postulates, and those postulates can only be true in a certain sort of dynamic world. It is reasonable to conclude, therefore, that our world is a dynamic world of the relevant sort.

If this argument is basically sound, the range of accounts of the nature of time that may be tenable is narrowed dramatically. Not only are all tenseless approaches ruled out: the same is true of almost all tensed approaches as well. The only accounts left, among those that have been traditionally advanced, are ones that maintain that, while the past and present are real, the future is not.

8.2 Alternative Tensed Views of the Nature of Time

Traditional tensed approaches to the nature of time share the views, first, that there are irreducible tensed facts, and, secondly, that tenseless facts are reducible to tensed ones. In addition, the metaphysical thesis that there are irreducible tensed facts also gives rise to a shared semantical thesis, to the effect that ordinary tensed sentences do not involve indexicals—a thesis that I shall attempt to show, in Section 8.3, is unsound.

These significant agreements notwithstanding, traditional tensed approaches also exhibit substantial differences, with perhaps the most important being between those approaches that agree with tenseless accounts of the nature of time in holding that the past, the present, and the future are all equally real, and, on the other hand, those tensed approaches that deny that this is so. Within each of these two main alternatives, in turn, there are further important divisions. Thus, tensed approaches that affirm the reality of past, present, and future, while necessarily holding that there are *some* special, intrinsic, tensed properties that events can either acquire, or lose, or both, differ with regard to precisely which tensed properties one needs to postulate. Some hold that there is an intrinsic property of presentness; others, that there is also a tensed property of pastness; and still others, that there are at least three tensed properties—pastness, presentness, and futurity.

These accounts of the nature of time will be discussed in Sections 8.4 and 8.5. In the first of these sections, I shall set out an argument that tells against any position that postulates even a single, intrinsic, tensed property, and the thrust of the argument will be that it seems to be impossible for an instantaneous event either to have different intrinsic, tensed properties at different times, or to have an intrinsic, tensed property at one time, and to lack that property at some other time. Then, in Section 8.5, I shall offer a second argument against tensed views that affirm the reality of the past, the present, and the future. Unlike the first objection, however, it will be confined to those views that postulate two or more, irreducible tensed properties, for here I shall be arguing that there are serious difficulties concerning, first of all, necessary relations between different tensed characteristics; secondly, necessary relations between pairs of tensed characteristics on the one hand, and tenseless temporal relations on the other; and, thirdly, the explanation of the fact that there are fixed temporal relations between events with changing tensed characteristics.

In Section 8.6 I shall turn to a consideration of tensed views that deny that the past, the present, and the future are all equally real. Such accounts of the nature of time are of two main sorts, depending upon whether it is held that both the past and the present are real, but the future is not, or, more radically, that only the present is real. But there are also important options within each of these two alternatives. Thus presentism, for example—the view that only the present is real—comes in two very different varieties. First, there is what I shall refer to as classical, or austere presentism. This is the view that the sum total of reality as of any given time consists only of present-tense states of affairs—that is, states of affairs that are the truth-makers for present-tense statements that are true at the time in question. Secondly, there is what I shall refer to as tensed-facts presentism. According to this view, the states of affairs that exist at any given moment include not only present-tense states of affairs, but also past-tense and future-tense states of affairs. In Section 8.6 I shall consider these two different versions of presentism.

In the case of tensed approaches that hold that both the past and the present are real, but deny that the future is real, one important choice is between non-traditional approaches, such as the one that I am defending, which deny that there are irreducible tensed facts, and more familiar approaches, such as Broad's, according to which there are irreducible tensed facts, consisting of an event's having intrinsic tensed properties. Another crucial choice is that between two very different accounts of the unreality of the future. Section 8.7 will focus upon those two issues.

8.3 Tensed Sentences and Indexicality

Do tensed sentences involve indexicals? Advocates of static or tenseless accounts of the nature of time hold that they do, whereas defenders of traditional tensed accounts hold that they do not.[90] The analysis of tensed statements set out in the previous chapter implies that both of these views are mistaken: the correct view is, instead, that only some tensed statements involve indexicals.

8.3.1 Indexicals and Ordinary Tensed Sentences

In this first section, I shall argue that—contrary to what is claimed by traditional tensed accounts of the nature of time—*ordinary* tensed statements do involve indexicals. Then, in the next section, I shall show why this conclusion does not provide any reason for accepting a tenseless view of time.

8.3.1.1 Time and the Applicability of Tensed Concepts

One very intuitive way of supporting the claim that ordinary tensed sentences involve indexicals was briefly indicated in Section 7.1.1,

[90] For the latter view, see e.g Pavel Tichy, 'The Transiency of Truth', *Theoria,* 46 (1980,) 165–82, at pp. 166–70.

and may be put as follows. Consider any two ordinary tensed concepts, such as those of lying in the present, and lying in the past, and any event, such as the birth of David Hume. What is one to say about the relation between the event that is the birth of David Hume and the tensed concepts in question? The natural answer is that it depends upon the time. Thus there was a time, in the year 1711, when the concept of lying in the present did apply to the birth of David Hume, and the concept of lying in the past did not. But at every subsequent time, it is the concept of lying in the past that applies to the birth of David Hume, and not the concept of lying in the present.

If this is right, if a given tensed concept applies to a specific event at some time or times, and not at others, then one cannot express a definite proposition concerning the applicability of a tensed concept to an event unless one specifies, one way or another, the relevant time. But how can one do this? There would seem to be only two possibilities. The one is that the very meaning of the sentence in question specifies a time. In that case, which time is the relevant one is not a function of the time of any particular token of the sentence. The other possibility is that the meaning of the sentence does not itself suffice to specify a time, but the sentence contains an indexical element in virtue of which the context in which the sentence is uttered will serve to specify the relevant time.

Consider, then, the sentence 'The birth of David Hume lies in the past'. The meaning of that sentence—in contrast to that of the sentence 'The birth of David Hume lies in the past in the year 1992'—does not itself specify a time at which the concept of lying in the past applies to the event in question. But, since that concept applies to the event at some times, and not at others, a time must be specified if a definite proposition is to be expressed. Consequently, if an utterance of that sentence is to express a proposition, the time at which the concept is supposed to apply to the event must be fixed instead by the time of the utterance in question, and this can occur only if the sentence contains an indexical element.

8.3.1.2 Ordinary Tensed Sentences and Propositions

A second, and somewhat more complex argument against the view that ordinary tensed sentences do not contain indexicals focuses upon a certain consequence of this view—the consequence, namely, that different utterances of the same tensed sentence will then express the same proposition, and, *a fortiori,* will have the same truth-value.

The argument starts out from the observation that it might seem, at first sight, that the view that ordinary tensed sentences do not involve indexicals is open to a quick refutation, since surely one cannot deny, for example, that an utterance, in January, of the sentence ‘It is now winter in Canada’ will be true, while an utterance of that sentence in June will be false. So how can the two utterances possibly express the same proposition? But, as we have already seen, acceptance of the concept of truth at a time leaves room to manœuvre here, since a person who holds that a tensed sentence expresses the same proposition whenever it is uttered can then argue that the claim that the truth-value of a token of a tensed sentence depends upon the time of its occurrence, far from being an undeniable fact, is really the conclusion of an unsound argument—an argument involving the mistaken assumption that such tokens have fixed truth-values. For given the coherence of the concept of truth at a time, one can maintain, first, that what is undeniable is not that January tokens and June tokens of ‘It is now winter in Canada’ have different truth-values, but, rather, that a January token has a different truth-value in January than a June token has in June. Secondly, that this can be explained in two very different ways: either any token of a tensed sentence has a fixed truth-value that depends upon the time of occurrence of the token, or, alternatively, all tokens of a given tensed sentence, though their truth-values may vary from one time to another, have the same truth-value at any particular time. Thirdly, that the latter is the correct explanation.

The quick refutation therefore fails. This would not be so were the notion of truth at a time incoherent. But, once that concept is available, the apparently undeniable fact concerning the truth- values of tokens of tensed sentences can be redescribed in a way that does not preclude the view that every token of a given tensed sentence expresses the same proposition. That alternative description may, of course, be untenable. But to show that it is, some other argument is needed. The quick refutation does not itself provide any grounds for that conclusion.

Assume, then, that one does have the concept of truth at a time. Is it then possible for a statement such as ‘Event *E* lies in the present’ always to express the same proposition? One way to deal with this question is by focusing upon the idea of a truth-maker. In the case of truth at a time, this will be a matter of what is actual as of the time in question. Notice, however, that a truth-maker may then take two very different forms. First, what is actual as of a given time may contain a state of affairs that makes the proposition in question true. But, secondly, it may instead be the absence of a certain type of state of affairs—possibly in conjunction with some state of affairs that is actual as of that time—that is the relevant truth-maker. So we need to consider both possibilities.

Let us begin by assuming, then, that, for it to be true at time t_1 that event E lies in the present, there must be some state of affairs, P, that is actual as of time t_1, and that makes it true at time t_1 that E lies in the present. Then, let E and F be instantaneous events that take place at times t_1 and t_2 respectively, where t_1 is earlier than t_2. On the assumption that we are now making, there must be some state of affairs, P_E, that is actual as of time t_1, and that makes it true at time t_1 that E lies in the present, and, similarly, there must be some state of affairs, P_F, that is actual as of time t_2, and that makes it true at time t_2 that F lies in the present.

In addition, however, there is a temporal relation between E's lying in the present, and F 's lying in the present: the former is earlier than the latter. If temporal priority could be analysed in tensed terms, one could view this relationship as simply a matter of E's being past, and F's being present, at some appropriate time. But if, as I have argued earlier, temporal priority cannot be analysed in tensed terms, what one must have is instead a more complex state of affairs—involving an external relation between P_E and P_F—that is the truth-maker for the proposition that E's lying in the present is earlier than F 's lying in the present. No state of affairs can be real, however, unless it is either actual at some time t, or actual *simpliciter*. Suppose, then, that the former is the case. If t is distinct from time t_1, then P_E is actual as of some time other than t_1, and so there will be a truthmaker at time t—namely, P_E—for the proposition that E is now taking place, and so that proposition will be true at two distinct times. This, however, is impossible, since E is by hypothesis an instantaneous event. Similarly, if t is distinct from time t_2, a parallel problem will arise: the proposition that F is now taking place will be true at two distinct times. But time t must be distinct either from t_1 or from t_2. So, either way, a contradiction arises if the complex state of affairs in question is actual as of any time t.

The only alternative is that the state of affairs in question is actual *simpliciter.* But this is also unacceptable. First of all, it is not easy to see how a concrete state of affairs that is neither actual as of any specific time, nor a mereological union of elements that are actual as of specific times, can nevertheless be actual *simpliciter.* Secondly, if the complex state of affairs that consists of a certain relation between P_E and P_F is actual *simpliciter,* one has a truth- maker not only for the proposition that E's lying in the present is earlier than F's lying in the present, but also for the proposition that E lies in the present, and for the proposition that F lies in the present, since the complex state of affairs involves both P_E and P_F as constituents. Hence it would be true *simpliciter* that E lies in the present and F lies in the present—which would entail that E and F are simultaneous.

The assumption that what makes the proposition that E lies in the present true at time t is some state of affairs that is contained in what is actual as of time t leads, therefore, to a contradiction. Let us turn, then, to the other alternative—namely, that the truth-maker is instead the *absence* of a certain type of state of affairs—possibly together with some state of affairs that is actual as of that time. But how can the absence of a certain type of state of affairs, at a certain time, be part of the relevant truth-maker? Three possibilities that naturally suggest themselves are that the proposition asserts either, first, that the type of state of affairs in question is not actual as of any time; or, secondly, that there is some time as of which it is not actual; or, thirdly, that it is not actual as of some specific time. So let us consider each of these. First, if the statement that E lies in the present asserted that a certain type of state of affairs either was never actual as of any time, or was not actual *simpliciter,* it would then follow that the statement could not be true at any time without being true at every later time. So that interpretation will not do. Secondly, if the statement asserted that there was a time as of which a certain type of state of affairs was not actual, then the statement, if true at any time, would also be true at all later times, so that interpretation, too, is unsatisfactory. Finally, if the statement that E lies in the present asserted that there is no state of affairs of the type in question that is actual as of a specific time, then the statement would have to involve a reference to that time. Given that the statement contains no explicit reference to any time, this will be possible only if the term 'now' is indexical—in which case tokens of the sentence 'E lies in the present' will not express the same propositions at different times. As a consequence, it is not easy to see how one can interpret the sentence '*E* lies in the present' in such a way that not only is the absence of a certain type of state of affairs relevant, but, in addition, tokens of the sentence both have the right truth-values at different times, and always express the same proposition.

A slightly more concrete way of setting out the second stage of this argument is in terms of the account offered in the previous chapter of what it is for an event to be present at a time, namely:

> Event *E* lies (tenselessly) in the present at time *t*

means the same as

> *E* is an instantaneous state of affairs, *E* is actual as of time *t*, and no state of affairs that is later than *E* is actual as of time *t*.

Given this analysis, the truth-maker for the proposition that event *E* lies in the present at time *t* does involve the absence of any state of affairs that is later than *E*. So a natural approach is to try to modify the above analysis to produce a non-indexical account of what it is for an event to lie in the present. To get such an account, the two references to time *t* that occur in the analysans need to be eliminated. The first occasions no difficulty: it can simply be dropped. But what is to be done about the second? One possibility is to drop it as well, by replacing the reference to being actual as of a time by a reference to being actual *simpliciter*. Then one has:

> Event *E* lies in the present

means the same as

> *E* is an instantaneous state of affairs, and no state of affairs that is later than *E* is actual *simpliciter*.

But then—aside from the rare case where time comes to an end, and *E* occurs at the final moment—one has a proposition that cannot be true at any time: it is always either false, or indeterminate.

The outcome is the same if, instead, one replaces the reference to the specific time *t* by universal quantification over all times:

> Event *E* lies in the present

means the same as

> E is an instantaneous state of affairs, and, for every time *t*, no state of affairs that is later than E is actual as of time *t*.

Once again, one has a proposition that can never be true at any time.

A final possibility is to replace the reference to the specific time *t* by existential quantification over times:

> Event E lies in the present

means the same as

> E is an instantaneous state of affairs, and there is a time *t* such that no state of affairs that is later than E is actual as of time *t*.

But now the problem is that one has a proposition that, if it is ever true, must also be true at every later time.

There may, of course, be some more esoteric possibility that does work. But, since those considered above certainly seem to be the most natural ones, I think that there is good reason for concluding that the idea that an absence of a certain type of state of affairs is at least part of what makes the sentence 'E is now taking place' true at a time cannot generate an otherwise satisfactory analysis according to which different tokens of that sentence always express the same proposition.

If this is right, then the thesis that ordinary present-tense statements do not involve indexicals is incompatible both with the view that the truth-makers for such statements are states of affairs that are actual as of the time in question, and with the view that the truth-makers are, instead, certain absences, possibly together with states of affairs that are actual as of the relevant time. But these are, it would seem, the only possibilities. Any ordinary tensed sentence must, accordingly, involve an indexical, and thus it cannot be the case that all of the tokens of such a sentence always express the same proposition.

8.3.2 Is Indexicality a Threat to Tensed Views in General?

Some friends of tense would find this conclusion unappetizing, and their underlying reason can, I believe, be brought out as follows. Assume that there are tensed facts, and that at least some tensed facts can be expressed by ordinary tensed sentences. Assume further, for the sake of argument, that ordinary tensed sentences do involve indexicals. Do these assumptions pose any problem for a tensed approach to the nature of time?

Given any sentence containing an indexical, it seems very plausible that a corresponding, indexical-free sentence that will have the same general sort of content can always be constructed: one need merely replace every indexical term by a name, and such a replacement will surely not make a difference with respect to what *sorts* of fundamental facts are expressed. But, if this is right, and if, in addition, ordinary tensed sentences involve indexicals, then such sentences can express tensed facts only if there are corresponding indexical-free sentences that also express tensed facts. But what is an indexical-free, tensed sentence that corresponds, for example, to the sentence '*A* is present'? It is hard to see how it can be anything other than something like the sentence '*A* is present at time *t*'. So the conclusion, in short, is that, if tensed facts are expressed by ordinary tensed sentences, and if the latter involve indexicals, then sentences such as '*A* is present at time *t*' must also express tensed facts.

It is at this point that a problem appears to arise. The reason is that most advocates of a tensed view of time accept the view that sentences such as '*A* is present at time *t*' are *not* tensed sentences. George Schlesinger, for example, says that 'the property of "being in the future at time t_1" is exactly the same as "being later than t_1' ".[91] Similarly, Richard Gale, in discussing McTaggart's attempt to define temporal priority by means of tensed predicates, says that 'the predicates "—— *is* past at ——" and "—— *is* future at ——" are synonyms for "—— *is* earlier than ——" and "—— *is* later than ——" respectively'.[92]

If these claims were correct, so that sentences such as '*A* is present at time *t*' were not tensed sentences, then it would follow from the above conclusion either that ordinary tensed sentences do not express tensed facts, or else that ordinary tensed sentences do not involve indexicals. This, in turn, together with the conclusion of the preceding section, to the effect that ordinary tensed sentences must involve an indexical specification of a relevant time, would

[91] George N. Schlesinger, *Aspects of Time* (Indianapolis: Hackett Publishing Company, 1980,) 133.

[92] Richard M. Gale, *The Language of Time* (London: Routledge & Kegan Paul, 1968,) 90.

entail that ordinary tensed sentences do not express tensed facts. But, in addition, if sentences such as '*A* is present at time *t*' were not tensed sentences, then ordinary tensed sentences would be the only tensed sentences there were, and thus one would also be forced to conclude that no sentences at all express tensed facts. So it is not surprising that advocates of a tensed account of the nature of time have typically thought that it is crucial to hold that ordinary tensed sentences do not involve indexicals.

There is, in short, a very important line of argument which underlies the frequent contention, by advocates of a tensed approach to time, that ordinary tensed sentences do not involve indexicals. But that line of argument rests upon a belief which, as we saw earlier, there is good reason to reject—the belief, namely, that sentences such as '*A* is present at time *t*' are not tensed sentences—and, once that belief has been set aside, there is no longer any reason for holding that ordinary tensed sentences do not involve indexicals. Given that there are other tensed sentences that are clearly free of all indexicals, one can perfectly well adopt the very natural view that ordinary tensed sentences involve an indexical specification of the relevant time, without having to abandon the claim that they express tensed facts.

The upshot is that, while the intractable problem of finding a non-indexical interpretation of ordinary tensed sentences is a serious objection to traditional tensed approaches to time, it does not pose any threat to a dynamic view of the world as such, since the tensed view set out above itself involves the thesis that ordinary tensed sentences involve indexicals.

8.4 Instantaneous Events and the Problem of Intrinsic, Tensed Properties

The arguments set out in Sections 8.1 and 8.3 are very broad in scope: the argument from causation is directed against all approaches to the nature of time except for those that hold that the past and the present are real, but the future is not, while the indexicality argument applies to all traditional tensed approaches. By contrast, the objections that are set out in this section, and in later sections, are more limited in scope—and in some cases, much more so.

The primary focus in the present section is upon tensed accounts that maintain that time involves one or more irreducible, intrinsic, tensed properties. Such accounts are of two very different sorts. On the one hand, some tensed accounts agree with tenseless approaches to time in holding that the past, the present, and the future are all equally real, but maintain, in addition, either that there is a single tensed property—that of presentness—or, alternatively, that there are at least three special tensed properties—namely, pastness, presentness, and futurity. Other tensed views, however, hold that there are at least two special, intrinsic tensed properties—namely, pastness and presentness—but no property of futurity, since they deny that the future is real.

If one goes beyond the property of presentness, it may turn out that it is not possible to limit oneself to two or three tensed properties, for events differ not merely with regard to being past, present, or future, but also with regard to how far past, or future, they are. Consequently, various quantitative tensed properties may have to be postulated as well. Alternatively, rather than postulating additional tensed properties, one might prefer to hold that there are tensed relations—such as that of one event's being more past than another. But these complications can be ignored in the present context, for, with one exception, they will not bear upon the objections that we shall be considering in this section or the next.

8.4.1 The Basic Argument: The Case of Two or More Tensed Properties

The following objection to views that postulate one or more tensed properties is closely related to an argument advanced by Broad in the chapter on 'Ostensible Temporality' in his *Examination of McTaggart's Philosophy*.[93] The argument, as we shall see, turns upon the fact that the positions under consideration here maintain that the special tensed properties in question are *intrinsic* proper- ties of events.

At this point, let us confine our attention to accounts that postulate at least *two* intrinsic, tensed properties. The argument may then be put as follows. Can an event have different intrinsic properties

[93] C. D. Broad, *Examination of McTaggart's Philosophy*, ii, pt. 1 (Cambridge: Cambridge University Press, 1938,) 277–8.

at different times? Given a temporally extended event, there is certainly no problem: its having different intrinsic properties at different times is simply a matter of distinct temporal slices of it having different intrinsic properties. But what if the event is an instantaneous one? Then it would seem impossible for it to have different intrinsic properties at different times. For consider the ways in which what is true of any entity might be different from one time to another. There would seem to be only two possibilities. The first is that whether something is true of an object may depend upon how other parts of the world are, and these may be different at different times. The second is that the object itself may have temporal parts, with different properties at different times. But neither possibility is relevant here. First, the fact that one is dealing with *intrinsic* properties of an event means that the state of the rest of the world has no bearing upon whether the event possesses the properties in question; and, secondly, the fact that we are considering instantaneous events precludes any explanation in terms of distinct temporal parts.

Consequently, accounts that postulate at least two intrinsic, tensed properties would seem to give rise to a contradiction. If both the past and the present are real, then all events, including instantaneous ones, will be both past, and present, at different times. But then, if being past or present is a matter of having a relevant, intrinsic, tensed property, then all events, including instantaneous ones, possess, at different times, the intrinsic properties of pastness and presentness. This, however, is impossible, given that an instantaneous event cannot have different intrinsic properties at different times.

8.4.2 An Extension: The Case of a Single, Intrinsic, Tensed Property

Is the situation different if one postulates only a single, intrinsic, tensed property—that of presentness? It would seem not. If one cannot make sense of an instantaneous event's possessing an intrinsic property of presentness at one time, and then losing it, and acquiring an intrinsic property of pastness, then neither can one make sense of an instantaneous event's having an intrinsic property of presentness at one time, and then lacking that property at later times.

Initially, it might seem that this attempt to extend the argument to the case of tensed views that postulate only a single tensed property is suspect, for the following reason. If an instantaneous event is to have an intrinsic property of presentness at one time, and an intrinsic property of pastness at some other time, then it must exist at both times—and that makes no sense for an instantaneous event. But an event may have the property of presentness at one time, and fail to have it at other times, not because it exists at other times while lacking the property of presentness, but because it exists only at the time that it has the property of presentness. So no contradiction arises.

But this response will not do. A necessary condition of any account of the nature of time's being a tensed one is that it entail that the world is dynamic, rather than static. If the future is not real, or if neither the past nor the future is real, then one has a dynamic world. Alternatively, if the past, the present, and the future are all real, but events undergo change with respect to tensed properties, then the world is dynamic. The same is true if the past, the present, and the future are all real, but there is a special property of presentness, that events acquire, and then lose. But if what one has is a world where the past, the present, and the future are all real, and where presentness is simply a property that every event *has* at the moment that it exists, but *never acquires or loses,* then what one has is a static world, rather than a dynamic one.

In short, it is crucial, if one is to have a tensed view, that presentness be a property that events—including instantaneous events—have at some times but lack at others. But then, if presentness is an intrinsic property of events, one is exposed to the same objection that arises when one postulates two or more intrinsic, tensed properties.

8.4.3 Tensed Properties: Intrinsic Versus Relational

How does the present approach avoid this argument? The answer is that, if the future is not real, tensed properties can be viewed as relational properties of events, rather than intrinsic ones, and a solution to the problem is then at hand—for, if the future is not real, then it can be true at one time, but not at some other time, that there are objects standing in a certain relation to a given event. As a consequence, an event—even an instantaneous one—may have a relational property at one time, while lacking it at another time. In particular, it may be true at one time, but not at another, that there are events later than a given event. An instantaneous event may, therefore, possess the relational property of pastness at one time, and the relational property of presentness at another.

8.5 Tensed Accounts That Involve Two or More Intrinsic, Tensed Properties

In this section, I shall set out two further objections that apply only to tensed accounts that postulate at least *two* intrinsic, tensed properties.

8.5.1 Necessary Relations

The first objection focuses upon certain necessary relations, first, between tensed properties themselves, and, secondly, between tensed properties and tenseless temporal relations. The thrust of the objection is that, if tensed characteristics are intrinsic properties of events, then no satisfactory explanation of these relations can be given.

8.5.1.1 Necessary Relations Between Tensed Properties

In the first place, then, tensed properties are incompatible: an event cannot, for example, possess both the property of presentness, and that of pastness, at the same time. How can this incompatibility be explained? If one of those properties is analysable, providing a satisfactory account would appear to be a straightforward matter. Suppose, for example, and as was suggested in the previous chapter, that it is true by definition that E has the property of pastness at time t if and only if there is some time t^* such that t^* is earlier than t, and E has the property of presentness at time t^*. Suppose further that the concept of a temporal instant is such that, if an instantaneous event E has the property of presentness at time t and at time t^*, then t and t^* must be one and the same time. It would then follow that an event can possess both the property of pastness and the property of presentness at a given time only if it is possible for a time to be earlier than itself. If one could then go on to show that it was an analytic truth that no time is earlier than itself, this would serve to show that the incompatibility of pastness and presentness was logical incompatibility, in the broad sense.

But what if both pastness and presentness are unanalysable? Then it would seem that the proposition that an event cannot be both past and present at the same time must be viewed as a necessary truth that cannot be derived from logical truths in the narrow sense by the substitution of synonymous expressions. We would then be confronted with a non-analytic, necessary truth. Could it then be viewed as an a posteriori necessary truth, understood in Kripkeian fashion? That route does not seem satisfactory, both because such purportedly necessary a posteriori truths involve identities, and because the claim that an event cannot be both past and present at the same time certainly looks like an a priori truth, rather than an a posteriori one. So, if it is not analytically true, it would seem that no satisfactory explanation of its necessity can be given.

One's estimate of the force of this argument obviously depends upon one's views concerning the prospects of making sense of a priori truths that are not analytic. As I indicated earlier, my own view is, first, that there is some reason for believing that satisfactory accounts of synonymy, and hence of analyticity, can be developed; secondly, that there is much less reason for thinking that a clear account of non-analytic, a priori truths will be forthcoming; and therefore, thirdly, that, other things being equal, an account that implies that certain a priori necessary truths are analytic is preferable to one that does not.

8.5.1.2 Necessary Relations Between Tensed Properties and Tenseless Relations

In the second place, tensed properties stand in necessary, a priori relations to tenseless temporal relations. Thus, it is surely a necessary truth, and an a priori one, that, if event E is past and event F is present, then E is earlier than F. How is this necessity to be explained? If the property of pastness is a relational property, analysable in terms of presentness, plus the earlier-than relation, then it will be an analytic truth that, if E is past and F is present, then E is earlier than F. Alternatively, if the property of pastness could be analysed instead in terms of presentness, plus the relation of causation, and if one could, in addition, appeal to a causal analysis of temporal priority, this might also make it possible to explain the necessity in question. Or, finally, if one could analyse temporal priority in terms of tensed properties, that would also provide the basis for a satisfactory explanation.

Is there some other way in which one might show that the necessary truth in question is an analytic one? It is hard to see what it could be. To establish an analytic connection, it would seem that one must either analyse the notion of pastness—or both pastness and presentness—in a way that brings in the earlier-than relation—directly or indirectly—or else one must analyse the latter relation in terms of tensed properties. But, if this is right, then it follows, in view of the earlier conclusion that temporal priority cannot be analysed in tensed terms, that, while the necessary connection in question can be explained if pastness is a relational property of events, it cannot be explained if tensed characteristics are intrinsic properties of events.

8.5.2 Fixed Relations Between Changing Tensed Properties

The second objection focuses upon certain uniformities in the way that the tensed properties of events change with the passage of time. In contrast to the preceding objections, it presupposes that the tensed views under consideration cannot, in the end, make do simply with qualitative tensed properties like pastness, presentness, and futurity. An event that has taken place is not merely past: it lies a certain distance in the past, and, as time passes, it becomes more and more past. How are these properties to be explained? One possibility would be to analyse these quantitative tensed properties in terms of the qualitative tensed properties of pastness, presentness, and futurity, together with some quantitative, *tenseless,* temporal relation. Thus, for example, having the property of lying ten years in the past might be analysed in terms of being in the past and being ten years earlier than the present. But to do this would be to hold that quantitative tenseless temporal relations, rather than being based upon quantitative tensed ones, are analytically more basic, since they are to be used in analysing quantitative tensed properties. Would it then be plausible to maintain, at the same time, that the qualitative tensed property of pastness is not to be analysed in a very similar fashion—namely, in terms of the tensed property of presentness plus the qualitative tenseless relation of temporal priority? If not, then there is, at the very least, considerable pressure upon any view that postulates at least two qualitative tensed properties also to postulate quantitative tensed properties.

Let us suppose, then, that quantitative tensed properties are viewed as basic. Consider any two events, *A* and *B,* such that event *A* lies exactly five minutes and twenty-four seconds in the past when *B* occurs. Then, in view of that tensed fact, it is true at that time that *A* is earlier than *B,* and that it is a certain temporal distance before *B*—five minutes and twenty-four seconds. From that time on, both *A* and *B* lie in the past, and their quantitative tensed properties undergo constant alteration as they both move ever further into the past. But, though their tensed properties constantly alter, they do so in a rather striking way—for they remain perfectly in step, with *A* always exactly five minutes and twenty-four seconds earlier than *B*.

But why should the quantitative tensed properties change in precisely such a way that the temporal distance between *A* and *B* remains the same? Why should it be the case, for example, that, at the precise instant when *B* acquires the property of lying one minute in the past, *A* acquires the property of lying six minutes and twenty-four seconds in the past? This invariant relation between their tensed properties surely cannot be treated as a cosmic accident. But, if not, how is it to be explained?

The situation here appears to be the same as with the two preceding objections—namely, that an explanation is at hand if, and only if, the tensed properties in question are analysable, since then one can show that the invariant relation, rather than being a contingent one, is analytic.

8.6 Presentism

According to presentism, only the present is real. This involves two main claims: first, there is the ontological thesis that the only states of affairs that are actual *as of* a given time are states of affairs that exist *at* that time; secondly, there is the resulting and correlative semantical thesis that a statement is true at a given time if and only if some state of affairs that exists *at* that time makes it true.

Divergent views can be taken, however, regarding what types of tensed states of affairs exist at a given time, and these give rise to two very different versions of presentism—which I shall refer to as classical presentism, and tensed-facts presentism.[94]

8.6.1 Classical, or Austere Presentism

According to this first version of presentism, the only types of states of affairs that exist as of a given time are *present-tense* states of affairs—that is, states of affairs that serve as truth-makers for whatever present-tense statements are true at the time in question.

The question that immediately arises for any version of presentism is, of course, this: 'If only the present is real, where does that leave statements about the past?' How does presentism enable one to affirm, for example, that there were dinosaurs, while denying that there were unicorns? If presentism entails that the past existence of dinosaurs is no more a fact than the past existence of unicorns, then surely that is more than sufficient reason for rejecting presentism as unacceptable.

Does classical presentism have any response to this objection? On the face of it, the answer would seem to be no. In the first place, in asserting that the only states of affairs that are real as of a given time are present-tense states of affairs, classical presentism certainly implies that it cannot be true at the present moment that there were dinosaurs. But might not the classical presentist offer the following, two-part response? First, while it sounds bad to say that it is not now true that there were dinosaurs, when one reflects upon what is being asserted, it turns out not to be problematic, since all that is being said is that the states of affairs that exist at the present moment do not contain any truth-makers for the statement that there were dinosaurs—and this is surely true. This still leaves one, of course, with the problem of how one captures the idea of the past existence of dinosaurs. But—and this is the second part of the presentist's response—why will it not do to say that the past reality of dinosaurs is completely captured by the assertion that the statement 'There are now dinosaurs' *was* true?

[94] Neither of these versions of presentism coincides with the position that Quentin Smith refers to as 'presentism' in his book *Language and Time* (New York: Oxford University Press, 1993.) But Smith's usage seems very unfortunate, since presentism, so understood, is compatible with the existence of past states of affairs. See, esp., p. 165.

This may seem promising. I believe, however, that it will not work—for how, on the classical presentist's approach to time, is one to interpret the idea that a certain sentence *was* true? Is there any alternative to interpreting this as asserting that there is a past time at which the sentence in question is true? But then how is one to make sense of the idea of a past time? One possibility is to say that a past time is a moment that *now* possesses the property of *pastness*. But then the moment of time in question must be actual as of the present moment, whereas, according to classical presentism, only present-tense states of affairs now exist, so what is actual as of the present moment cannot include a state of affairs that consists of the possession, by some earlier time, of the property of pastness.

A second possibility is that the moment in question stands in the earlier-than relation to the present moment. But then one needs to ask whether the earlier-than relation is an internal relation, or an external one. If it is an internal relation, then it obtains in virtue of the two times having relevant intrinsic properties, and, in the case of the earlier moment, what could that intrinsic property be, other than the property of pastness? But then one is back to the idea that was just seen to be unsatisfactory. Alternatively, the earlier-than relation might be an external relation between moments of time. But then the difficulty is that such a state of affairs involving an external relation between two distinct times is neither a state of affairs that exists *at* any given moment, nor is it logically supervenient upon states of affairs that do exist at temporal instants. It therefore follows that, if classical presentism is true, such a state of affairs cannot be actual *as of* any time.

The problem, in short, is that introduction of the idea of a statement's having been true in the past merely shifts the difficulty from that of referring to enduring objects that, according to the classical presentist, are not now actual, to that of referring to moments of time that equally, according to the classical presentist, are not now actual.

A third possibility[95] is that the presentist might agree with my contention that a tensed view needs both the idea of being actual as of a time, and also that of being actual *simpliciter,* and then argue that, while it is not true as of the present moment that there were dinosaurs, it is true *simpliciter*. But this moderate version of classical

[95] This version of presentism was drawn to my attention by Colin Allen.

presentism also fails. The reason is that the classical presentist cannot define the idea of actuality in a way that will provide a truth- maker for the statement that there were dinosaurs, since, if what is actual as of any given time consists only of states of affairs that exist *at* that time, then the totality of states of affairs that are actual as of some time or other will not contain any states of affairs that involve two things standing in the relation of temporal priority. The totality will have to consist, instead, of a number of instantaneous states of affairs, without any temporal ordering. Thus, while it may contain dinosaur-slices, there will be no states of affairs that relate those slices either to one another, or to the present moment, and thus there will be no truth-maker for the proposition that there were dinosaurs.

It might well seem, then, that classical presentism must be hopeless. But there is a possible answer: if statements about the past could be analysed in terms of statements about the present, then the statement that there were dinosaurs could be true now, for then its truth-maker could consist, not of some past states of affairs, but, rather, of present-tense states of affairs—such as the present existence of certain fossils.

It was in virtue of their acceptance of such a view of statements about the past that philosophers such as Jan Łukasiewicz and Arthur Prior were able to embrace presentism.[96] But the price seems very high. Not only does the claim that statements about the past are analysable in terms of statements about the present seem immensely implausible in itself, it also has some rather unusual consequences. One of these, which was noted by Łukasiewicz—though he viewed it as a welcome consequence—is that the past is not fixed, at least in an indeterministic world, since in such a world there may be evidence, at one time, for the occurrence of some earlier event, but then no evidence at all at some later time:

> Facts whose effects have disappeared altogether, and which even an omniscient mind could not infer from those now occurring, belong to the realm of possibility. One cannot say about them that they took place, but only that they were *possible.* It is well that it should be so. There are hard moments of suffering and still harder ones of guilt in everyone's life. We should be glad to be able to erase them not only from our memory but also

[96] Jan Łukasiewicz, 'Determinism', in Storrs McCall (ed.), *Polish Logic 1920–1939* (Oxford: Oxford University Press, 1967,) 19–39; see pp. 21, 38–9. Arthur Prior, *Past, Present, and Future* (Oxford: Oxford University Press, 1967).

> from existence. We may believe that when all the effects of those fateful moments are exhausted, even should that happen only *after* our death, then their causes too will be effaced from the world of actuality and pass into the realm of possibility. Time calms our cares and brings us forgiveness.[97]

One might be able to overcome the implausibility of this reductionist thesis if one could make out a strong case for a verifi-ability theory of meaning. For familiar reasons, which I shall not consider here, the prospects of doing that do not seem very promising. But, in addition, not just any verifiability theory would suffice: it would have to be one in which verifiability was verifiability *now;* and such a theory is even more implausible than verifiability theories in general.

8.6.2 Tensed-Facts Presentism

There is a way of trying to avoid the problem that past-tense statements pose for classical presentism, and which we need to consider. The idea is to hold that past-tense statements have truth- makers, and that those truth-makers lie in the present, rather than in the past, without holding that statements about the past can be analysed in terms of statements about the present. But how can this be done?

The idea of tensed-facts presentism is that the present contains not only present-tense states of affairs, but past-tense states of affairs—and perhaps future-tense states of affairs—as well. But can it not be argued, in the following straightforward way, that this view is simply incoherent? Consider any fact concerning some person or thing that no longer exists—such as the fact that Caesar crossed the Rubicon. According to tensed-facts presentism, that past state of affairs belongs to the present. But, if a state of affairs exists *at* a given time, then all of its constituents must exist at that time as well. So it follows that Caesar exists at the present moment. But this is impossible, since an enduring entity can exist at a time only if either it is wholly present at that time, or a temporal part of it exists at that time. But Caesar is not wholly present at this

97 Łukasiewicz, 'Determinism', 38–9. A slightly different translation of this passage is quoted by Prior, *Past, Present, and Future,* 28, and by Anthony Kenny in his obituary of Prior in the *Proceedings of the British Academy,* 56 (1970), 321–49, at p. 349.

moment, nor is any temporal part of him simultaneous with events that are now happening. So the state of affairs which is Caesar's having crossed the Rubicon cannot be part of what presently exists.

A defender of tensed-facts presentism might respond, however, that this argument involves an unsound assumption concerning states of affairs, namely, ‘existentialism’—where this is the view that particulars that are constituents of a state of affairs must be *part* of that state of affairs, and so must exist at the time that the state of affairs exists.[98] Therefore, though there now is a state of affairs that is Caesar's having crossed the Rubicon, it would be an error to suppose that Caesar is a part of that state of affairs, and thus it does not follow that Caesar now exists. So there is no absurdity here.

But this response fails to take seriously the notion of a state of affairs: a state of affairs consists of—in the sense of being identical with—an individual's having a genuine property, or of two or more individuals' standing in some relation (or of some more complex combination of such atomic states of affairs). But if this is what a state of affairs is, such an entity can no more exist at a time when its constituents fail to exist than an individual can have a genuine property at a time when the individual does not exist.

In thinking about this matter, it is crucial not to confuse states of affairs with propositions. The constituents of propositions are not, in general, parts of propositions: Caesar, for example, is not part of the proposition that Caesar crossed the Rubicon. Because of this, if there are propositions, they can exist at times when their constituents do not exist. But—Popperian third worlds aside—reality is made up, not of propositions, but of the truth-makers for propositions—that is, states of affairs—and the latter do have their constituents as parts: Caesar is part of the state of affairs that is Caesar's crossing the Rubicon. So states of affairs cannot exist at times when their constituents do not exist.

Tensed-facts presentism is also exposed to many of the objections advanced above against other tensed views. First, tensed-facts presentism is committed to viewing tensed concepts, such as those of the past and the future, as basic and unanalysable. The reason is that there is no room, in any presentist ontology, for basic, temporally extended states of affairs. So one event's being earlier than

98 I am indebted to George Bealer for drawing my attention to this line of thought.

another must be treated as a state of affairs that is logically supervenient upon the relevant pair of tensed states—for example, the one event's lying in the past, and the other event's lying in the future. It is not possible, accordingly, to analyse an event's being past as its being earlier than the present, or an event's being future as its being later than the present. So tensed-facts presentism must embrace the implausible view that the concept of lying in the future is basic and unanalysable.

Secondly, and as a consequence of this, tensed-facts presentism cannot give any account of the incompatibility of different tensed properties: this must be treated as a brute fact.

Finally, and as a further consequence, tensed-facts presentism cannot explain the systematic way in which the world changes. At one time, according to tensed-facts presentism, the present contains the present-tense state of affairs that is E's now occurring, along with the past-tense state of affairs that is F's having occurred five minutes in the past. Two minutes later, the present contains the past-tense state of affairs that is E's having occurred two minutes in the past, along with the past-tense state of affairs that is F's having occurred seven minutes in the past. And, in general, according to tensed-facts presentism, the sum total of reality changes from moment to moment in a very systematic way, so that, in every successive world, event F always lies five minutes further in the past than event E, and similarly for all other pairs of events. These exceptionless regularities constitute a very striking fact, and one that surely demands an explanation. But, because tensed-facts presentism must treat tensed concepts as analytically basic, it can offer no account of this.

8.7 Only the Past and the Present Are Real

The final group of tensed views that I wish to consider are those that hold that the past and the present are real, but that the future is not. Within this general family, however, there are significantly different alternatives. These arise out of disagreements concerning two main issues. First, what exactly is involved in the unreality of the future? Secondly, are there irreducible, tensed properties?

8.7.1 Modal Realism and the Indeterminateness of the Future

How should one interpret the claim that the future is unreal? One very natural interpretation involves the idea of a dynamic world in which the present is the point at which states of affairs come into existence. But there is a second, and very different type of dynamic world that might also be described as one where the future is not real, in an important and relevant sense—namely, the branching type of world favoured by Storrs McCall, which was briefly discussed in Chapter 1. For while such a world does contain future states of affairs, the fact that those states of affairs encompass absolutely all future possibilities, and that the states of affairs that will turn out to be part of the actual future are not marked out in any way from those that will turn out to be unrealized possibilities, means that the future is not real in any sense which implies that statements about the future must be either true, or false, at the present moment.

I argued in Chapter 1—in connection with the question of whether indeterminism is a necessary condition of a dynamic world—that, if McCall's branching, dynamic world is logically possible, then so is Broad's non-branching, dynamic world—for, if McCall's idea of states of affairs dropping out of existence is intelligible, Broad's idea of states of affairs coming into existence can hardly be less so. But, if this is right, then Broad's model of a dynamic world seems preferable to McCall's, for at least two reasons. First, it allows one to make sense of the idea of dynamic worlds that are deterministic, and this seems desirable, since deterministic worlds can, no less than indeterministic ones, be worlds where states of affairs come into existence. Secondly, given that a world containing no future states of affairs at all is rather more austere than one that contains states of affairs corresponding to all future possibilities, Broad's model is also to be preferred on grounds of simplicity.

We need to ask, however, whether there may not be countervailing considerations that tell in favour of McCall's alternative. Let us turn, then, to the defence that McCall offers in *A Model of the Universe*. His basic line of argument there is that the branching conception of a dynamic world does a better job than any competing theory of providing solutions to a number of otherwise intractable philosophical problems:

> The argument to the best explanation is complete. If the world really does possess the dynamic treelike structure of the branched model, then accounts become available of temporal direction and temporal flow; of the ontological basis of laws of nature; of the interpretation of quantum mechanics including quantum non-locality, state vector reduction, and measurement; of the definition of probability; semantics for counterfactuals and other conditionals; transworld identity of individuals; essential properties; and finally deliberation, decision, and free will.[99]

How much force do these considerations have? In the first place, alternative solutions are available in many cases—including solutions that are compatible with the view that the world is static. Thus, for example, while the branched model does make it possible to offer a very simple and straightforward account of transworld identity according to which the very same individual can exist in different possible worlds, one can avoid accepting counterpart theory without holding that alternative futures are ontologically on a par with past and present states of affairs. Similarly, while McCall's appeal to branch selection does provide an explanation of non-locality in quantum mechanics, and one that is compatible with the relativistic exclusion of causal processes that propagate at a speed greater than that of light, other accounts that do this are also available.

In the second place, some of the above considerations, while they may represent an advantage that McCall's account has over *static* conceptions of the world, do not bear upon the choice between McCall's model and Broad's. Thus, Broad's idea that the future is not yet real both provides at least as satisfactory an account of the direction and flow of time, and leaves as much space for deliberation, decision, and free will as McCall's view that alternative, possible futures are made of the same ontological stuff as the past and the present.

What about the considerations that remain? The most basic, I suggest, concern objective probabilities, and laws of nature, since the other two considerations seem to be parasitic upon McCall's claims concerning the correct account, either of probabilities, or of

99 Storrs McCall, *A Model of the Universe* (Oxford: Oxford University Press, 1994,) 287–8.

laws of nature. Thus, for example, McCall analyses an essential property of an individual as 'one that it possesses at all times on all branches from the moment of its origin'.[100] But why should this account be superior to the view that an essential property of an individual is one that the individual possesses at the time of its origin, and that it is nomologically impossible for it to lack at any later time? McCall's account cannot, it would seem, have an advantage here unless the notion of nomological impossibility cannot be adequately explained without appealing to a branched conception of the world.

Similarly, although McCall's branching model provides the basis for an account of the semantics of subjunctive conditionals, familiar, alternative accounts are available. The alternatives will, it is true, have to employ the concepts of probability, and of laws of nature, and so one can press the question of what accounts are to be offered of those notions. But, once again, that will not provide any ground for preferring McCall's approach to the semantics of conditionals unless it turns out that the accounts that he offers of laws of nature and of objective probability are not only satisfactory, but superior to alternative accounts.

The crucial considerations, accordingly, appear to involve McCall's accounts of objective probability, and of laws of nature. In the case of the former, the central idea underlying his approach is that the objective probability of an event at a given time is equal to the proportion of future branches that contain that event. The immediate obstacle confronting this type of account is that, on the one hand, if the number of future branches is infinite, it would seem that the proportion that contain a given event is undefined, while, on the other, if there are only a finite number of branches, then it would seem to be impossible for probabilities ever to take on any irrational values. McCall points out, however, that there is a way around this difficulty. The idea—which is modelled on the fact that any real number between zero and one can be represented by an infinite decimal—is that the assumption that only finite branching takes place at any given time does not entail that the probability that a given event will occur cannot be equal to an irrational number, provided, first, that the probability of a given event depends on the branching that occurs, not just at an instant, but

[100] Ibid. 287.

throughout some interval, and, secondly, that branching can occur an infinite number of times within some interval. Thus, suppose that the question concerns the probability that an event of type E will occur within a temporal interval of one second. If ten branches are formed at the beginning of the interval, on six of which an event of type E occurs, and on three of which an event of type E is precluded, then the probability of an event of type E is between 0.6 and 0.7. Then, if, half a second later, the branch on which it is not yet settled whether an event of type E will occur divides into ten more branches, four of which involve an event of type E, and five of which preclude an event of that type, the probability of there being an event of type E within the interval is then between 0.64 and 0.65. Finally, if the branching continues ever more quickly, and in such a way that it happens an infinite number of times within the one-second interval, the result will be a process in which the relevant probability is represented by an infinite sequence of finite branchings, in a finite interval of time, and, as a consequence, the probability may take on any value between zero and one.

This is an ingenuous solution to the difficulty. It is, however, open to at least three objections. In the first place, it is essential to this solution that the relevant branching occurs ever more quickly, and in such a way that it happens an infinite number of times within a finite interval. This is surely a very unusual hypothesis about the nature of the world, and, given that there is no independent reason for accepting it, I think it is fair to characterize it as *ad hoc*.

In the second place, while this solution allows one to assign precise probability values, including irrational ones, to the occur- rence of a certain type of event within an appropriate interval, it does not allow one to do this with regard to the probability that a given type of event will occur at some instant: the latter probability must either be undefined—if there is infinite branching at that instant—or else be equal to some rational number. Nor is it just probabilities concerning events at instants that suffer from this shortcoming. If probabilities are defined by infinite sequences of branchings within finite intervals, in the way described above, it is also impossible for probabilities to take on irrational values for intervals that are too short.

Thirdly, it is crucial to the above account that the branching at any point be finite. But, if space is infinitely divisible, it would seem that, for example, an electron might strike a screen, at a given time, at any one of an infinite number of points. In such cases, the future possibilities will involve an infinite number of branches at the relevant time, with the result that the relevant probabilities will be undefined, given McCall's approach.

Finally, let us consider McCall's account of laws of nature. Here McCall argues that the realist approach to future possibilities which he embraces enables him to offer an attractive account of laws of nature, and one that reverses the usual view of the relation between laws and physical possibilities. His idea is that, rather than laws of nature being primary, and fixing what possibilities there are at any time, the possibilities that exist at different times are primary, and they fix what laws there are.[101]

There are, however, at least two reasons why such an approach to laws of nature is unsatisfactory. First, even if one confines oneself to the possibilities for branchings that there are at a single instant, what makes it the case that a law obtains will be an extremely complex state of affairs—possibly infinitely so—involving an enormous number of possibilities. By contrast, if laws of nature are irreducible second-order relations among universals, a law consists of a single atomic fact.

Secondly, it would seem that, in general, the possibilities that there are at any single instant will suffice to delimit what laws of nature there are. But then, if the future involves non-denumerably many instants, it seems likely that there will be infinitely many sets of possibilities that suffice to pick out the same set of laws. One has, then, infinitely many exact correspondences with respect to what laws of nature are fixed by the possibilities that there are at different times, and the question arises as to how those correspondences can be explained. If laws are more basic than physical possibilities, there is no mystery here. But if possibilities are more basic, then it would seem that no explanation of the correspondence can be forthcoming. One is left with a cosmic coincidence that far outstrips that associated with regularity approaches to laws of nature.

The upshot is that none of the considerations that McCall cites in support of his model of a dynamic world provides one with a reason for preferring that model to the one advanced by Broad. Indeed, two aspects of McCall's approach—namely, his treatment of objective

[101] Storrs McCall, 'Objective Time Flow', *Philosophy of Science,* 43 (1976,) 337–62, at pp. 360–1, and *A Model of the Universe,* 55–60.

probabilities, and his account of laws of nature—appear to be exposed to decisive objections, and thus, rather than supporting his approach, turn out to provide additional grounds for rejecting it.

8.7.2 Future States of Affairs Are not Real

Let us now turn to the view that, while the past and the present are real, the future is not, and where, in contrast to McCall's approach, the unreality of the future is a matter of there not being any future states of affairs. According to the argument from causation, the correct account of the nature of time must be some variant on this general view.

Traditional formulations of this approach—as advanced by C. D. Broad and others—have invariably combined the view that only the past and the present are real with other quite substantial propositions, especially the theses, first, that there are basic and irreducible tensed characteristics; secondly, that ordinary tensed sentences do not involve indexicals; thirdly, that tenseless temporal concepts can be analysed in terms of tensed concepts; and, fourthly, that tenseless facts are logically supervenient upon tensed ones.

All of these additional propositions are, I believe, mistaken. Thus, in Chapter 6, I argued that attempts to analyse the relation of temporal priority in terms of tensed concepts are unsatisfactory, while, in Chapter 7, we saw that there is no need to postulate basic and irreducible tensed properties, since tensed concepts, including that of the present, can be analysed in terms of the relation of temporal priority together with the idea of what is actual as of a time. In addition, we have also seen, in this chapter, that the postulation of basic and irreducible tensed properties, besides being unnecessary, generates a number of very serious difficulties, including the problems of explaining, first, how an instantaneous event can have different tensed properties at different times; secondly, how there can be necessary relations, both between tensed properties, and between tensed properties and tenseless temporal relations; and, thirdly, why it is that the tensed properties of events necessarily alter in precisely such a way that the temporal distance between any two events never changes.

On the view being defended here, by contrast, none of these problems arises. The moral, therefore, seems clear: if a dynamic view of the nature of time is to be accepted, one should embrace the view that only the past and the present are real, but reject the idea that there are basic and irreducible tensed properties.

8.8 Tenseless Accounts of Past, Present, and Future

Finally, what about opting instead for a static view of the world? Here my discussion will be very brief, for, though a multitude of objections to such an approach have been advanced by other philosophers who favour tensed accounts, all of those objections strike me as, at best, very much open to challenge, and, in most cases, as simply unsound. The argument from causation constitutes, I believe, the only decisive refutation of tenseless accounts of the nature of time.

8.8.1 Dubious Objections to Tenseless Accounts?

Many objections have certainly been urged against tenseless accounts of the nature of time, but, because those standard objections all seem to me to be problematic, I shall confine myself in this section to simply mentioning, very briefly, some of the more important lines of argument that have been advanced, and then indicating why I believe that they are suspect.

One common criticism focuses upon the truth conditions that are offered, on tenseless approaches, for tensed sentences. Here the thrust of the objection is typically that, first of all, according to tenseless accounts of tensed sentences, such sentences are token- reflexive, but, secondly, that this is not so, since the propositions expressed by such sentences could perfectly well be true even if there were no tokens of the relevant sentences.

Often, such a criticism rests upon the misconception that an advocate of a tenseless approach is offering a translational analysis of tensed statements into tenseless ones, rather than simply a truth- conditional analysis. Recently, however, Quentin Smith has argued that what he refers to as the 'new token-reflexive theory'[102] of tensed

[102] Smith, *Language and Time,* 71. Smith says that this sort of theory 'was inaugurated by J. J. C. Smart in his 1980 essay, "Time and Becoming' " (p. 11). In fact, it was set out at least as early as 1967, for it is found in J. J. C. Smart's article 'Time', in the *Encyclopedia of Philosophy* (New York: Macmillan, 1967), viii. 126–34, at p. 127.

sentences 'reduces to a version of the *old* token-reflexive theory of A-sentences, that tokens of these sentences are translated by tokens of tenseless token-reflexive sentences'.[103] Smith's support for this contention seems to me clearly unsound. Perhaps the basic point, however, is that there is a rejoinder that renders irrelevant all such objections, for one can hold that, while ordinary tensed sentences do involve indexicals, such sentences are nevertheless not token-reflexive, since what the indexicals in question refer to are not sentence-tokens, but times.

A second objection claims that tenseless accounts of the truth conditions of tensed sentences involving nested temporal operators are unsound. Thus Quentin Smith, for example, argues that the truth conditions that Mellor and others have offered generate the wrong truth-values in certain cases.[104] Smith is certainly right that there is a problem here that needs to be addressed, for, as we saw earlier, in Section 7.3, the recipe that Mellor proposes for handling sentences with nested temporal operators does not work. But, in the end, there is nothing in this objection, since, as we also saw, it is a straightforward matter to set out an acceptable account of the truth conditions of such sentences, and an advocate of a tenseless approach to time could, for example, simply modify the analysis offered earlier, in Section 7.3, by replacing sentences of the form 'E lies in the present at time t' by tenseless sentences of the form 'E is simultaneous with t'.

Some famous objections to tenseless accounts of the nature of time concern our attitudes towards past, present, or future facts. One that has been much discussed is due to Arthur Prior,[105] and may be put as follows. Suppose that you have been having an intensely painful experience, and, when it stops, you say, 'Thank goodness that's over.' What is it that you are thankful for? According to the tenseless account of present-tense sentences, a token of 'That's over' is true if and only if it is later than the event in question. So it would seem that, on this account, you are grateful that a certain token is later than your painful experience. But surely the location of a token, in this case, is not really of any interest! So do we not have to conclude that what you are grateful for is a tensed fact that cannot be captured by the tenseless approach to tensed sentences?

[103] Smith, *Language and Time,* 71.

[104] Ibid. 72–7.

[105] Arthur N. Prior, 'Thank Goodness That's Over', *Philosophy,* 34 (1959,) 12–17.

This criticism seems to me to rest upon a mistaken view—namely, that a sentence such as 'That's over' is token-reflexive. I have suggested that, while a token of an ordinary tensed sentence—such as 'That's over'—does contain an indexical, the indexical refers, not to the token, but to the time of the token. When this view is adopted, what is happening in the sentence 'Thank goodness that's over' is that a certain time is being picked out by its being simultaneous with the utterance, and one is saying, of that time, that one is glad that it does not involve a continuation of an earlier pain. What one is glad about, therefore, does not itself involve any relation between an event and a token. Consequently, a tenseless account can avoid the problem to which Prior thought such an account was necessarily exposed.

A final objection focuses upon differences in our attitudes towards past events and future events, and contends that, given a tenseless view of time, it is impossible to make sense of these differences. This criticism has been advanced by, among others, George Schlesinger:

> Consider the difference in our attitude toward a very unpleasant experience, such as a painful operation, which was performed on our body in the past, and our attitude toward the same kind of event which we know we are going to experience at some given time in the future. In the first case thinking about the harrowing experience is accompanied by a feeling of relief; in the second case contemplating the experience arouses in us a feeling of anxiety and dread. Now why the relief in the first case? Obviously, because the highly disagreeable experience is 'over', that is, it is receding from us and we are escaping from it rather than still experiencing it or moving toward it. On the other hand the feeling of dread in the second case is explained by the fact that the agonizing experience is seen to be approaching us and is known to be about to overtake us.
>
> On the Russellian view, however, there is no room for such talk, because no events are receding from us, and none is approaching us.[106]

A natural response to this is that, given the fact that causes precede their effects, concern about future events is useful, since it increases our chances of avoiding those states that are bad, and of realizing those that are good. A comparable concern about past events would not have that function. Accordingly, the adoption of a tenseless view of time does not preclude perfectly satisfactory

[106] Schlesinger, *Aspects of Time,* 34–5.

explanations both of the fact that we have different attitudes towards past events and future events, and of the rationality of those attitudes.[107]

8.8.2 The Need for Metaphysical Argument

I have argued that some common objections to tenseless accounts of the nature of time are either simply unsound, or at least open to plausible rejoinders. There is, however, a more basic point that needs to be made—namely, that, even if the above arguments were impeccable as far as they went, they would not be of the type needed to establish the conclusion that the world is dynamic rather than static. Suppose, for the sake of argument, that some very widely held attitudes towards past, present, and future events could not possibly be rational unless there were tensed facts. This would still leave one with the question of whether the attitudes were in fact rational, and this in turn could only be answered by determining whether the world is dynamic or static. Or suppose that there was some decisive objection to any tenseless analysis of tensed sentences. It would then follow that everyone who used tensed sentences, and interpreted them in the standard way, was expressing the belief that the world is dynamic. But this does not take one very far, since, while the fact that a belief is widely shared provides one with some reason, other things being equal, for thinking that there may well be good reasons to accept that belief, one still has to ask whether the belief is really justified, and if so, how.

This last point probably needs to be stressed, for it is very common for defenders of tensed approaches to time to think that conceptual analysis alone can provide a satisfactory basis for a tensed view.[108] Conceptual analysis, however, tells one only about the conceptual framework that one possesses; it provides no grounds for concluding that the world in fact conforms to that framework.

Metaphysical argument is inescapable, therefore, if one wishes to justify the view that the world is dynamic. Why, then, have defenders of tensed accounts of the nature of time tended to focus instead

[107] Cf. J. J. C. Smart's remarks in his article 'The Reality of the Future', *Philosophia,* 10 (1981,) 141–50, at pp. 149–50.

[108] Quentin Smith's discussion in *Language and Time* is a recent illustration of this type of argument.

upon conceptual analysis? Part of the reason, I think, is that it has not been easy to see what form the required metaphysical argument could take. But the argument from causation provides, I believe, the answer to that question.

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Part IV Temporal Relations

9 Causation and Temporal Relations

The account of the nature of time that has been developed to this point could be combined with the view that the concepts of simultaneity and temporal priority are basic concepts, not susceptible of analysis into more fundamental notions. In this chapter I shall argue, however, that those concepts are not analytically basic, and that a satisfactory analysis can be given.

As causation will play a central role in the analysis to be offered, I shall begin by discussing different conceptions of the nature and scope of a causal theory of time, and by setting out some preliminary considerations in support of a causal analysis of temporal concepts. I shall then address three important issues: first, whether a causal theory of time is best combined with a relational view of space and time, or with an absolute or realist account; secondly, whether what is wanted is a causal theory of non-relativistic temporal relations, or, instead, one of relativistic space-time; and, thirdly, whether a causal theory is best formulated in terms of the modal notion of causal connectibility, or non-modally, in terms of actual causal connections.

With these preliminary issues out of the way, I shall turn to the task of setting out an account of temporal relations, focusing first upon the central qualitative relations of simultaneity and temporal priority, and then, secondly, upon quantitative temporal relations. I shall then conclude by examining a number of important objections that have been advanced against causal theories of time, and by offering one final consideration in support of the theory that I have advanced.

9.1 Different Conceptions of a Causal Theory of Time

Causal theories of time maintain that temporal relations are in some sense reducible to causal relations, or, alternatively, to causal relations plus other non-temporal relations, such as spatial ones. But such theories can vary considerably with regard to the nature and the scope of the reduction, and the relevant reduction base.

First of all, then, consider the question of the nature, or the logical status, of the reduction in question. Some philosophers, when they speak of a causal theory of time, have in mind a theory according to which the relevant temporal relations can be *contingently identified* with certain causal relations. Thus Philip Von Bretzel, for example, says:

> The causal theory of time is a species of the relational theory of time which asserts that the temporal order of the events of the universe is given by their causal order. As I construe it this is not a claim about the meanings of terms but a theory about the nature of time.[109]

What is more commonly meant, however, by a causal theory of time is a theory according to which the relevant temporal relations are *necessarily identical* with causal relations, and are so, moreover, because the former are to be analysed in terms of the latter. It is this second sort of account that I shall be advancing here.

Secondly, as regards scope, causal theories of time differ in at least two important respects. First, some causal theories of time attempt to offer analyses of all temporal relations, whereas others are more limited, and claim only that at least some temporal relations can be given a causal analysis. These almost always include, however, the crucial concepts of the direction of time, and of temporal order. But why might one hold that some temporal concepts, but not all, can be analysed in causal terms? My own reason for opting for a more limited theory is that quantitative temporal relations, as we shall see later, pose a serious problem for a causal theory of time.

A second difference among causal theories of time with regard to scope is that some theories deal with temporal relations, while others are concerned, instead, with spatiotemporal relations. The earliest theories were of the former sort. But with the advent of Einstein's Special Theory of Relativity—which has been taken by many philosophers as showing that there is no absolute distinction between temporal relations and spatial relations—recent causal theories of time have typically been of the second sort.

[109] Philip Von Bretzel, 'Concerning a Probabilistic Theory of Causation Adequate for the Causal Theory of Time, *Synthese,* 35 (1977,) 173–90, at p. 173.

Thirdly, there is the choice between analyses of temporal relations that involve only causal relations, and analyses that also incorporate reference to one or more non-causal, non-temporal, relations. The choice here is obviously closely related to the second of the scope questions just mentioned. If one's goal is to set out a causal theory of all spatiotemporal relations, it would seem that the analysis will have to be in causal terms alone, since it is hard to see what non-causal, non-spatiotemporal relations could be relevant. On the other hand, and as we shall see later, if one's goal is, instead, to provide an account of temporal relations, then it may be not only very natural, but also necessary, to formulate the analysis in terms of causal relations plus spatial relations, rather than in terms of causal relations alone.

9.2 Preliminary Considerations in Support of a Causal Analysis of Temporal Concepts

What reasons are there for thinking that at least those tenseless temporal relations that suffice to fix the order of events, and the direction of time, can be analysed in a broadly causal fashion? In this section I shall mention four considerations. The first is that there appear to be striking structural similarities between the relations of temporal priority and causal priority. Both, it would seem, are necessarily irreflexive: an event cannot be earlier than itself, nor can it be causally prior to itself. Both are asymmetric: if A is earlier than B, then B cannot be earlier than A; if A is causally prior to B, then B cannot be causally prior to A. Both are transitive: if A is earlier than B, and B is earlier than C, then A is earlier than C; if A is causally prior to B, and B to C, then A is causally prior to C. Finally, one of the two directions associated with each of these relations has a special significance: it is *the* direction of time, or *the* direction of causation.

It is true that some philosophers have questioned whether temporal priority does have the properties just mentioned. Adolf Grünbaum,[110] for example, has contended that it is possible for time

[110] See e.g. Adolf Grünbaum's discussion on pp. 614–19 of his article, 'Carnap's Views on the Foundations of Geometry', in Paul A. Schilpp (ed.), *The Philosophy of Rudolf Carnap* (La Salle, Ill.: Open Court, 1963,) 599–684.

to be circular, and the argument that he has offered, if sound, would show that neither temporal priority nor causal priority need be asymmetric or irreflexive. Grünbaum's argument, however, rests on the principle of the identity of indiscernibles, against which there appear to be sound objections. In addition, there would seem to be a fairly firm, and quite widely shared intuition, that time cannot be circular. And, finally, any claim that causal priority need not be asymmetric or irreflexive is exposed both to the argument against the possibility of oppositely directed causal processes that was advanced earlier, in Chapter 4, as well as to other arguments against causal loops, set out by Mellor and others.

If causal priority and temporal priority do share these formal similarities, how can that fact be explained? A causal theory of time that postulates a merely contingent reduction of temporal relations to causal ones will not suffice, since the similarities would not then be a matter of logical necessity. What is needed, rather, is some sort of analytical connection between temporal and causal concepts.

That connection could run, of course, in different directions. Perhaps the formal similarities arise because causal concepts involve temporal ones, rather than because temporal concepts are analysable in causal terms? Or perhaps they arise not because causal concepts presuppose temporal concepts, nor vice versa, but because both causal and temporal concepts are analysable in terms of more fundamental concepts? In the absence of some concrete suggestion, I think that the latter possibility can be set aside. The former suggestion, however, certainly needs to be taken seriously, since many accounts of causation, such as Hume's, certainly involve reference to the relation of temporal priority. It seems to me, however, that a correct account of causation will not involve any temporal concepts.[111] If this is right, then the most likely way for temporal and causal concepts to be analytically related is if the relevant temporal concepts presuppose causal ones. This, in turn, would seem to require either an analysis of temporal concepts in causal terms, or, at least, an analysis in which causal concepts play a crucial role.

A second, and related consideration is this. When a relation has certain formal properties, such as transitivity and asymmetry, one

[111] Michael Tooley, *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) ch. 7, sect. 1, and ch. 8.

would like to be able to show why the relation has those formal properties. If one can analyse temporal concepts in terms of causal ones, one will *ipso facto* be providing at least a partial explanation of the formal properties of temporal relations. And if, as I have argued elsewhere,[112] one can then go on to show why it is that causal relations have the formal properties that they do, the result will be a complete explanation of the formal properties of temporal relations.

A third consideration is that some statements that involve both causal and temporal concepts are widely regarded as expressing necessary truths—such as, 'A cause is always earlier than its effect'. If this is a necessary truth, what account of its necessity can be given? The most natural answer, it would seem, is that it is analytically true, and that this in turn is so because either causal concepts, when analysed, involve temporal concepts, or vice versa. So, once again, provided that the former alternative can be rejected, there is a reason for concluding that the relevant temporal concepts can be analysed in causal terms.

The fourth and final consideration arises when one asks what account is to be given of the direction of time. Many answers have been proposed, of course, most of them reductionist accounts, according to which the direction of time is given by certain patterns exhibited by events in time—such as the direction in which entropy increases, or the direction of the propagation of order in nonentropic, irreversible processes, or the temporal direction of the expansion of the universe. But there are strong reasons for thinking that the most that these answers can provide is a contingent identification of the direction of time with a direction defined in some other way, and not an analysis of the concept of the direction of time, since, given any reductionist account, one can describe possible worlds—including those I appealed to earlier in arguing against reductionist approaches to causation—where the account would fail to give the right answer. Thus, in the case of very simple worlds, for example, any account that defines the direction of time in terms of some pattern exhibited by events will entail, incorrectly, that time has no direction in such worlds, while, in the case of inverted worlds, such reductionist

[112] Ibid., ch. 8, sects. 4 and 5, and appendix. A different, and more general explanation of the formal properties of causation is provided, in effect, by the argument from causation set out earlier.

accounts will generate the wrong answer concerning the direction of time.

If such reductionist accounts are untenable, what alternatives are left? One possibility is a realist view, according to which the direction of time is an ultimate fact, not susceptible of any further explanation. But the problem with realism in this area is that it seems to provide no answer to the question of how one can have justified beliefs concerning the direction of time, since it gives one no reason for holding that the sorts of things that we normally take as relevant evidence—such as information about the direction of the propagation of order in non-entropic, irreversible processes—are indeed evidence. So this sort of account must, I believe, be rejected on epistemological grounds.

If a realist approach is unacceptable, and if the same is true for reductionist accounts that define the direction of time in terms of some pattern exhibited by events, it is not easy to see what possibility remains other than that of analysing the direction of time in terms of the direction of causation, and then adopting a realist account of causation. But this alternative seems perfectly satisfactory, since, provided that one can have justified beliefs concerning the direction of causation, one will be able to have justified beliefs about the direction of time, while avoiding the objections which tell against reductionist accounts that identify the direction of time with a direction defined in terms of some pattern in the world.

9.3 An Absolute, or a Relational Account?

One important issue that needs to be addressed before setting out a causal theory of time concerns the choice between an absolute, or realist, or substantival view of space and time (or space-time), and a relational, or reductionist view. According to the former, talk about space and time (or space-time) cannot be reduced to talk about the spatial and temporal relations between physical objects and events. The totality of space-time points is itself a substance—that is, an entity that is logically capable of independent existence. Therefore, either that totality is something over and above physical objects and events and their spatiotemporal relations, or alternatively, as some absolute theories maintain, physical objects and events are themselves simply portions of space, or of space-time, possessing certain properties.

On the relational view, by contrast, talk about spatial and temporal relations is primary, and talk about space and time can be replaced, without loss, by reference to spatiotemporal relations between physical objects and events. Space and time, therefore, are nothing over and above physical objects and events, and their spatial and temporal interrelations.

Causal theories of time have almost invariably been relational in form. The reason, I think, is probably this. On the one hand, to accept an absolute view of space and time is to hold that space and time might exist even if there were no physical objects or events, while, on the other, to accept a causal theory of time is to hold that at least some tenseless temporal relations are analysable in terms of causal relations. This means that, if one accepts both views, one has to hold that spatiotemporal regions can stand in causal relations to one another, since otherwise one will not be able to make any sense of the idea of a possible world in which space and time exist, but where there are no physical objects or events.

It is certainly true that there are conceptions of space and time that do involve the idea that spatiotemporal regions enter into at least some causal relations. According to the General Theory of Relativity, the curvature of space-time is determined by the matter present, and it, in turn, determines how bodies will move. But, if one considers instead the Newtonian picture, or an ordinary person's view of space and time, the situation is quite different. Spatiotemporal regions are thought of as not interacting at any time, either with physical objects, or with other spatiotemporal regions. And it is natural to conclude from this that spatiotemporal regions do not themselves enter into any causal relations. Accordingly, if one is concerned with the problem of making sense of our ordinary notions of space and time, it might seem that one cannot accept both a substantival view of space and time, and a causal theory of time.

But is this not a decisive objection to the idea that one can offer a causal analysis of temporal concepts? For, can it not be argued that we do believe that empty space and time is a logical possibility, that space and time could exist even if there were no matter or energy at all, so that our ordinary conception of space and time, like the Newtonian, is substantival, and thus that, if a causal theory of time and an absolute view of space and time cannot be combined, our ordinary temporal concepts cannot be analysed in causal terms?

How can an advocate of a causal theory of time respond to this difficulty? The only satisfactory reply, I believe, involves showing that a substantival view of space and time is not in fact incompatible with a causal theory of time. But how can that be done? The answer seems clear: one must show that it is possible for spatiotemporal regions to stand in causal relations to one another, for then the logical possibility of a world devoid of matter poses no objection to a causal theory of time.

But is it really possible for there to be causal relations between spatiotemporal regions? One place to start, in thinking about this question, is by asking whether there are any conceptual constraints upon when it is logically possible for two contingent, non-simultaneous states of affairs to be causally related. The answer, I suggest, is that Hume was right on this matter: anything can cause anything. But, if this is right, if the concept of causation places no restrictions at all upon what types of contingent, non-simultaneous states of affairs can be causally related, then, given that the existence of a spatiotemporal region is a contingent state of affairs, it follows that it is logically possible for spatiotemporal regions to enter into causal relations.

Secondly, it is crucial here that one not equate the very general notion of causal *relationship*s with the more specific idea of causal *interactions*. This is, I think, a real danger, since, when one talks about causal relations, what often springs to mind are causal interactions. Then, since it is not part of our ordinary concept of substantival space that parts of it interact with other things, the idea that there can be causal relations between spatiotemporal regions naturally seems unacceptable. But the situation changes, I suggest, when one keeps in mind the fact that relations of causal dependence are also present in cases where there is no interaction, or change, taking place. Consider, in particular, the relation of identity over time. If that notion is analysable, causation will surely play a crucial role. But the causal dependence of later temporal parts of an enduring entity upon earlier temporal parts is clearly not a matter of causal interaction. And once one focuses upon this sort of situation, the idea that spatiotemporal regions can be causally related ceases, I suggest, to be problematic, since, if one accepts a substantival view of space and time, space itself is an enduring entity, and thus the idea that later temporal parts of space are causally dependent upon earlier ones is no more strange than the idea that later temporal parts of an electron are causally dependent upon earlier ones.

In short, if one focuses upon causal relations of the sort involved in the persistence of enduring objects, it becomes clear that spatiotemporal regions can stand in causal relations, and thus that there is no a priori objection to combining a causal theory of time with an absolute view of space and time. But are there any reasons for preferring such a formulation of a causal theory of time? At least three, it seems to me. First, if there are good reasons for accepting a realist, or substantival view of space-time, rather than a relational conception, one needs an account of temporal relations that will apply not merely to events, but to spatiotemporal regions as well. There appear to be, however, good reasons for accepting a realist conception of space-time. One involves Newton's famous thought experiments of the rotating bucket containing water, and of the two globes connected by a cord.[113] Consider, for example, the latter. Newton's argument was that, if the two globes were rotating about the centre of mass of the system, the cord joining them would be under tension. Yet the globes would not be in motion relative to one another. Moreover, the situation would not be changed by the supposition that no other objects existed beyond the two globes and the cord. So the tension could not be caused by the motion of the globes relative to one another, or relative to other material things. It could be caused only by the absolute rotation of the system—that is, its rotation relative to absolute space.[114]

Newton himself thought that this argument, in establishing the need for the idea of absolute rotation, and thus of acceleration relative to space itself, also showed that one had to accept the ideas of absolute velocity, and absolute location. The inference here is certainly a very natural one. However, as present-day philosophers such as John Earman have pointed out, it is mistaken: one can set out mathematical models of space-time that, while allowing for absolute acceleration, do not involve absolute velocity

[113] Sir Isaac Newton, *Mathematical Principles of Natural Philosophy* (Berkeley and Los Angeles: University of California Press, 1934,) 10–12.

[114] Ibid. 12.

or absolute location.[115] But, while Newton's argument does not establish the conclusion that he thought it did, it does provide a good reason for holding that a relational account of space-time is unsatisfactory.[116]

The other reason why one must, I believe, adopt a realist view of space-time involves the need to provide an account of certain empirical possibilities. In particular, consider the fact that there are locations where there *could,* at a given time, be a physical object, even though, as a matter of fact, this is not the case. The possibility involved here is not that of a mere logical possibility. Our everyday experience of the motion of objects, for example, makes it reasonable to believe that there are locations where there are no physical objects, but where the existence of such objects is *empirically* possible. But then if, as I believe, such modal facts cannot be taken as ontologically primitive, one is confronted with the question of the categorical basis of these empirical possibilities. Accounts are certainly possible, of course, that do not involve a substantival view of space. It might, for example, be the presence of some physical field in an otherwise empty location which is the ground of the empirical possibility of there being an object at that location. Or perhaps the empirical possibility is somehow grounded in the categorical properties of physical objects, events, or fields that exist at other locations than the one in question. However, I think it is fair to say that both of these hypotheses are extremely speculative. The question, therefore, is whether there is any plausible alternative to the view that the categorical properties that are the basis of the empirical possibilities in question are properties of the locations themselves, and thus in no way dependent upon the properties of physical objects, or events, or fields—there or elsewhere. If not, then the rejection of a relational account in favour of a substantival one is necessary if there is to be any categorical basis for the empirical possibilities in question.

A second reason for embedding a causal theory of time in a substantival theory of space-time is connected with a serious problem confronting all causal theories of time—a problem posed by the issue of whether temporal relations are to be analysed in terms of actual causal connections alone, or whether reference must also

[115] John Earman, 'Who's Afraid of Absolute Space?', *Australasian Journal of Philosophy,* 48/3 (1970,) 287–319, pp. 296–7.

[116] Cf. Earman, ibid. 312.

be made to the causal connections there would have been if things had been different. The difficulty here is that neither answer seems satisfactory. On the one hand, if one frames the analysis only in terms of actual causal connections between events, there may very well be possible cases where those relations will not suffice to fix, logically, the temporal relations between the events in question. On the other hand, appealing to hypothetical causal connections gives rise to the issue of the truth-makers for the relevant counterfactuals. This question would pose no problem, of course, if one could refer to spatiotemporal relations between events. But in a context of setting out a causal theory of time, such reference threatens to generate a circularity in the analysis, and, as a consequence, the question of the truth-makers for the relevant counterfactuals may become very difficult indeed.

A causal theory of time that is combined with a relational view of space and time lacks the resources, I believe, to handle this problem. But, if one adopts, instead, an absolute view of space and time, and holds, as seems reasonable, that every complete temporal slice of space is causally connected with every other, then those actual causal relations between temporal slices of the world, together with spatial relations within temporal slices, will suffice for the assignment of a temporal location to every event. There will therefore be no need to appeal to possible causal connections, and the serious problem of providing truth-makers for such hypothetical connections will be completely avoided.

The final consideration involves a number of familiar objections to causal theories of time, among them the following. First, it has been argued that causal theories of time cannot make sense either of the possibility of space-time points where there are no events, or of the more dramatic possibility of times at which nothing exists. Secondly, it has also been objected that causal theories of time cannot allow for the possibility of events in space-time that are uncaused, and that have no effects. Thirdly, there is the objection that causal theories of time are incompatible with a possibility that is allowed by the General Theory of Relativity—namely, that of totally empty spatiotemporal worlds.[117] Directed against relational causal theories, these are, I believe, very damaging objections. But,

[117] These objections are set out in J. J. C. Smart, 'Causal Theories of Time', in Eugene Freeman and Wilfrid Sellars (eds.), *Basic Issues in the Philosophy of Time* (LaSalle, Ill.: Open Court, 1971,) 61–77.

by contrast, and as we shall see later, they pose no problem for substantival versions of the causal theory of time.

9.4 A Causal Theory of Time, or of Space-Time?

The analysis of temporal concepts in causal terms, rather than being a recent idea, dates back at least to Leibniz and Kant.[118] Both the content of the theory and the underlying impetus have, however, undergone considerable change. Initially, the appeal of the causal theory of time was purely philosophical: it seemed like a promising way of illuminating concepts that are, in some respects, dark and difficult. In the present century, however, much of the interest in the development of a causal theory of temporal concepts has been stimulated by Einstein's Theory of Relativity, and this, in turn, has affected the form in which the theory is typically expressed. Whereas Leibniz, Kant, and other early writers advocated causal theories of time, current writers usually favour a theory that covers, in a sense, both temporal relations and spatial ones: a causal theory of space-time.

Which sort of causal account should be offered? It might be argued that, given the strong scientific support for at least the Special Theory of Relativity, it is quite unlikely that there are pure temporal relations, and thus that one ought to focus upon a causal theory of space-time. But this route is problematic if one is defending a dynamic account of the nature of time, since, as we shall see in Chapter 11, the fact that the Special Theory of Relativity does not involve any reference to a relation of absolute simultaneity poses a potentially serious difficulty. In the case of some tensed views, it may be possible, as some writers have suggested, to shift to modified theories that avoid any commitment to a relation of absolute simultaneity. But that does not appear to be a very satisfactory option in the case of tensed views which deny that the future is real. A defence of the latter sort of view appears to require a non- relativistic conception of time.

[118] G. W. Leibniz, 'The Metaphysical Foundations of Mathematics', in *Philosophical Papers and Letters,* trans. and ed. Leroy E. Loemker, 2nd edn. (Dordrecht: D. Reidel, 1969,) 666–74; Immanuel Kant, *Critique of Pure Reason,* bk 2, ch. 2, sect. 3, of the 'Transcendental Analytic'.

That must sound, of course, like bad news indeed, for the life of a philosophical theory that is on a collision course with a well- confirmed scientific theory, though not necessarily nasty or brutish, does tend to be on the short side. I shall be arguing, however, both that it is possible to modify the Special Theory of Relativity to produce a theory that does entail the existence of absolute simultaneity, and that the resulting theory is superior, since it has greater predictive and explanatory power. That line of argument requires, however, a chapter on its own. In the remainder of this chapter, accordingly, I shall simply proceed on the assumption that the above claim can be made good, and so I shall confine myself to the task of setting out an account of non-relativistic temporal relations.

9.5 Modal Versus Non-Modal Analyses

Some causal theories of time involve the modal notion of two events being causal *connectible,* while others are formulated instead in terms of the non-modal notion of two events being causally *connected.* Are there reasons for preferring one of these approaches over the other?

If one wanted to set out either a causal theory of spatiotemporal relations in general, or a theory of temporal relations that referred to nothing other than causal relations, then it seems clear that one would have to go with causal connectiblity, rather than causal connectedness, for surely there are pairs of events where one is earlier than the other, but which are not causally connected. Faced with such events, there would seem to be only two possible ways to formulate a causal theory: either one must refer not only to causal relations, but to spatial relations as well—as in the account set out below—or one must refer to possible causal relations, as well as to actual ones. The first of these, however, is not an option if one's goal is to set out either a purely causal theory, or a theory covering absolutely all spatiotemporal relations.

Let us begin by considering, then, the idea of an account that is formulated in terms of causal connectibility, rather than in terms of actual causal connections. The basic line of thought involved in such an approach to temporal relations might be put as follows. If two events are causally related, then one is earlier than the other.

But what if they are not causally related? It will not do, in that case, to say that they are simultaneous, for it may be that, although they are not causally related in the world as it is, they would have been if the world had been slightly different, and surely one does not want to allow that, had the world been different in that way, the two events would have stood in a different temporal relation. Accordingly, in a case where two events are not causally related, one has to ask whether they *could* have been so related. If they could have been, then one is earlier than the other, whereas, if it would have been impossible for them to have been causally related, then neither is earlier than the other.

The idea of shifting from actual causal connections to causal connectibility, or accessibility, is certainly a very natural one. A crucial question needs to be answered, however, before a connectibility account can be accepted—namely, what is it *in the world* that makes it the case that two events are, or are not, causally connectible?

Why is this question a pressing one? The answer turns upon a certain view concerning empirical possibilities, to the effect that, first, empirical possibilities are to be cashed out in terms of the truth of relevant subjunctive conditionals, and, secondly, that those subjunctive conditionals require truth-makers that consist of *categorical* facts, possibly together with laws of nature. If this view of empirical possibilities is right—so that it will not do to treat empirical possibilities as simply ultimate facts, not capable of further explanation—the question is what sorts of categorical facts constitute the basis of the causal connectibility of two events. One answer, of course, is that the categorical facts are a matter of spatiotemporal relations between the two events. So, for example, if one considers a relativistic case where E and F are two events that are not causally connected, but where F lies within the forward light cone of E, then the two events are causally connectible in virtue of that geometrical fact. But, if one's goal is to show either that all spatiotemporal relations are reducible to causal relations, or that temporal relations are reducible to causal relations alone, it obviously will not do to hold that the categorical facts that underlie causal connectibility involve spatiotemporal relations between events. The question then is: what alternative is there? What other type of categorical state of affairs can serve as the relevant truth- maker? I do not believe that there is any. But, if this is right, then a connectibility account cannot provide either a satisfactory analysis of spatiotemporal relations in general, or an analysis that reduces temporal relations to causal ones.

Does this mean that no connectibility account can be sound? Not quite. If one's goal is simply to show that temporal relations are reducible to causal relations *plus spatial relations,* one will not be involved in any circularity if one holds that the categorical facts that ground the relevant empirical possibilities involve spatial relations between events. But, if this is the sort of causal theory that one has in mind, is there any advantage in formulating things in terms of causal connectibility? Might it not be better to formulate the theory in terms of actual causal connections, together with spatial relations, thereby making it clear from the beginning exactly what the reduction base for temporal relations is?

To sum up. Causal theories of temporal or spatiotemporal relations that are formulated in terms of the modal idea of causal connectibility may seem very natural and appealing, given that actual causal connections are not sufficient for defining the relation of temporal priority. But those who have put forward connectibility theories have failed to address a crucial issue—that of the categorical facts that ground the relevant empirical possibilities—and, once this issue is raised, it becomes clear that any connectibility theory that seeks to reduce either temporal or spatiotemporal relations to causal relations alone, either actual or possible, cannot succeed.

9.6 Qualitative Temporal Relations: Simultaneity and Temporal Priority

9.6.1 The Analysis of Simultaneity and Temporal Priority

A satisfactory account of tenseless temporal relations needs to cover both qualitative and quantitative relations. In the present section I shall focus upon the qualitative relations of simultaneity and temporal priority, and, for reasons that emerged in the preceding section, the analysis will be in terms of actual causal relations plus spatial relations. The treatment of quantitative temporal relations will then be taken up in Section 9.7.

According to our ordinary, non-relativistic conception of time, two relations suffice to order events in the universe: simultaneity and temporal priority. The former is, by definition, reflexive, symmetric, and transitive, while the latter is transitive, but asymmetric and irreflexive. In addition, those two relations are mutually exclusive, and, together with the inverse of temporal priority, exhaustive. So, given any two instantaneous events,[119] *A* and *B,* it cannot be the case both that *A* and *B* are simultaneous, and that *A* is earlier than *B,* while, on the other hand, it must be the case that either *A* and *B* are simultaneous, or *A* is earlier than *B,* or *B* is earlier than *A.* It follows from these assumptions that the temporal ordering of events is a total ordering: absolutely all events in the universe are part of a single, linear order.

I now want to consider what happens when a certain very weak assumption concerning the connection between causation and time is conjoined with our ordinary conception of time. First, however, notice that one consequence of that conception, as characterized above, is this:

(*P*) If *A* is earlier than *B,* and *B* is simultaneous with *C,* then *A* is earlier than *C.*

The reason is that, in view of the exhaustiveness assumption, either (*a*) *C* is earlier than *A,* or (*b*) *A* and *C* are simultaneous, or (*c*) *A* is earlier than *C.* But, (*a*) is excluded, since it, together with the fact that *A* is earlier than *B,* would entail that *C* is earlier than *B,* and that, in turn, in view of the fact that simultaneity and temporal priority are mutually exclusive, would entail that *B* and *C* are not simultaneous. And, (*b*) is also excluded, since it, together with the fact that *B* and *C* are simultaneous, would entail that *A* and *B* are simultaneous, and the latter is precluded by the fact that *A* is earlier than *B.* So, if *A* is earlier than *B,* and *B* is simultaneous with *C,* then *A* must also be earlier than *C.*

A precisely parallel argument would establish that the following is also entailed by the above characterization of our ordinary conception of time:

(*Q*) If *A* is simultaneous with *B,* and *B* is earlier than *C,* then *A* is earlier than *C.*

Suppose now that one introduces the following assumption:

(*R*) If *A* causes *B,* then *A* is earlier than *B.*

[119] Throughout the following discussion, events are restricted to *instantaneous* states of affairs.

This is an assumption that would be accepted in the vast majority of causal theories of time—with the exception of some more holistic theories which, in order to allow for the purported possibility of backward causation, identify the direction of time with something like the dominant direction of causal processes. But, if the argument of Chapter 4 is correct, backward causation is not logically possible, and, accordingly, *R* should lie at the heart of any causal theory of time.

R specifies one condition under which one event is earlier than another. Clearly, however, there must be other conditions that are also sufficient, since *A* can be earlier than *B* even if they are not causally connected. It is at this point, as was noted earlier, that the idea of shifting from talk of causal connections to talk of causal connectibility naturally arises. But, if that move is, as I argued, unsatisfactory, how should the case of causally unrelated events be handled? The answer emerges very quickly, I think, if one begins by noticing that acceptance of *R,* in the context of our ordinary conception of time, commits one to further propositions concerning conditions that are sufficient to ensure that one event is earlier than another. In the first place, *R,* when conjoined with *P* and *Q,* entails, respectively:

(*S*) If *A* causes *B,* and *B* is simultaneous with *C,* then *A* is earlier than *C*;
(*T*) If *A* is simultaneous with *B,* and *B* causes *C,* then *A* is earlier than *C.*

So we now have two other conditions that suffice to ensure that one event is earlier than another. But, in the second place, these two conditions, in conjunction with the fact that temporal priority is a transitive relation, entail another, much more encompassing condition:

(*U*) If $A_1, A_2, \ldots A_i, \ldots A_{n-1}, A_n$ is a set of n instantaneous events such that, for every $i < n$, either A_i causes A_{i+1}, or A_i is simultaneous with A_{i+1}, and if, in addition, there is some $i < n$ such that A_i causes A_{i+1}, then A_1 is earlier than A_n.

Principle *U,* entailing, as it does, principles *R, S,* and *T,* and more as well, is a very comprehensive principle relating causation to temporal priority, and the fact that it follows from the conjunction of our ordinary conception of time with the very modest claim involved in *R* shows how strongly any causal theory of time is constrained by assumption *R*.

Principle *U,* however, like principles *S* and *T,* suffers from a certain obvious defect, if one's goal is to formulate a causal theory of time, since its specification of the conditions under which one event is earlier than another is not done in terms of causal and other non-temporal notions alone: the description involves the concept of simultaneity. What is needed, accordingly, is a principle that is comparable to U in power, but which does not involve, in the characterization of the conditions under which one event is earlier than another, any temporal notions.

Given an account of simultaneity, *U* could be transformed in the way desired. But what account can be offered of simultaneity? One natural answer is to analyse simultaneity in terms of causal unconnectibility: two events are simultaneous if and only if they are not causally connectible. But what possibility is there if causal connectibility cannot be employed? The only possibility, I think, is an account that connects simultaneity with spatial relations.

Does that mean that the concept of simultaneity is to be analysed in terms of the idea of spatial relations? Perhaps. But, for the purposes of transforming *U,* it is not really necessary to advance a claim about the analysis of simultaneity. A weaker proposition will suffice, concerning only a sufficient condition for the simultaneity of two events, namely:

(*V*) If events *A* and *B* are spatially related, instantaneous events, then they are simultaneous.

But is *V* acceptable? Events that are not simultaneous can, after all, certainly happen, say, five miles apart. The answer is that, when one speaks of spatial relations between things or events that do not exist at the same time, one must always bring in, implicitly or explicitly, the idea of being in the same place at different times, and so the question arises as to what account is to be given of that notion. In the next chapter I shall argue that sameness of place is to be analysed in terms of the presence of appropriate causal relations connecting spatiotemporal regions. If this is right, then, when one speaks of spatial relations between things or events that exist at different times, the relation being attributed, rather than being a pure spatial relation, involves a combination of pure spatial relations plus causal relations. Principle *V,* accordingly, must be viewed as being formulated in terms of pure spatial relations.

Given principle *V,* it is possible to derive a principle which, like *U,* specifies a very wide range of conditions under which one event is earlier than another, but which, unlike *U,* characterizes those conditions *in non-temporal terms.* For the conjunction of *U* and *V* entails:

(*W*) If $A_1, A_2, \ldots A_i, \ldots A_{n-1}, A_n$ is a set of *n* instantaneous events such that, for every $i < n$, either A_i causes A_{i+1}, or A_i is spatially related to A_{i+1}, and if, in addition, there is some $i < n$ such that A_i causes A_{i+1}, then A_1 is earlier than A_n.

To recap briefly. I have argued that two quite modest principles—namely, *R* and *V*—in conjunction with our ordinary conception of non-relativistic time, entail principle *W*. The first of those principles asserts that, if one event causes another, then it is also earlier—a proposition that, unless backwards causation is possible, would certainly appear to be true. The other principle asserts that spatially related, instantaneous events must be simultaneous—a claim that also seems very plausible. Accordingly, any account of our ordinary temporal notions would appear to be subject to the very strong constraint that is embodied in principle *W*.

W formulates a very comprehensive sufficient condition for one event's being temporally prior to another. But could the condition in question also be a necessary condition? In that case, the converse of *W* would also be true:

(*W**) If A_1 is earlier than A_n, then there is a set of instantaneous events $A_1, A_2, \ldots A_i, \ldots A_{n-1}, A_n$ such that, for every $i < n$, either A_i causes A_{i+1}, or A_i is spatially related to A_{i+1}, and, in addition, there is some $i < n$ such that A_i causes A_{i+1}.

Does *W** express a necessary truth? If not, then I think that it is not easy to see how an analysis of temporal priority can be formulated in terms of actual causal connections, rather than in terms of causal connectibility. But then, given the difficulty that confronts the latter sort of account, it seems that a causal analysis of the earlier-than relation may very well stand or fall with the tenability of the claim that *W** is necessarily true.

Let us assume, then, that both *W* and *W** express necessary truths. This allows us to formulate the following definition of temporal priority:

> *A* is earlier than *B*

means the same as

> For some number *n,* there is a set of *n* instantaneous events $A_1, A_2, \ldots A_i, \ldots A_{n-1}, A_n$ such that, first, *A* is identical with A_1, and *B* is identical with A_n; secondly, for every $i < n$, either A_i causes A_{i+1}, or A_i is spatially related to A_{i+1}; and, thirdly, there is some $i < n$ such that A_i causes A_{i+1}.

Similarly, the simplest way of extending principle *V* into an analysis of simultaneity is by assuming that the condition for simultaneity specified by it is necessary as well as sufficient, so that one can offer the following definition:

> *A* is simultaneous with *B*

means the same as

> *A* is spatially related to *B*.

9.6.2 Some Consequences of This Account

To determine whether these analyses are satisfactory, we shall need to consider—as I shall in a later section—how they fare in the face of objections. Two preliminary matters, however, can profit- ably be addressed at this point: first, whether simultaneity and temporal priority, thus defined, have the appropriate formal properties; secondly, whether propositions which involve both temporal and causal concepts, and which seem to express necessary truths, turn out to do so given the above accounts.

First, then, let us consider the formal properties of simultaneity and temporal priority. The case of simultaneity is straightforward. First, it is surely a necessary truth that the inverse of any spatial relation is also a spatial relation, so, if *A* stands in some spatial relation to *B,* then *B* must stand in some spatial relation to *A*. The relation of simultaneity, defined as above, is therefore symmetric. Secondly, it is surely also a necessary truth that, if *A* is spatially related to *B,* and *B* to *C,* then *A* is spatially related to *C*. So the transitivity of simultaneity is ensured.

What about temporal priority? First of all, there is no problem about transitivity. If *A* is earlier than *B,* and *B* than *C,* then there must be two chains of the appropriate sort—one from *A* to *B,* and the other from *B* to *C*—and then the combination of those two chains will make it the case that *A* is earlier than *C.*

Next, what about the asymmetry of temporal priority? At this point, a distinction drawn in Chapter 3 is crucial—namely, that between cases of backward causation involving at least the possibility of causal loops, and cases of causal processes running in opposite directions, but not involving the possibility of causal loops—for what that distinction shows is that, although one cannot establish the asymmetry of the relation of temporal priority, as defined above, unless one can show that causal loops are logically impossible, the latter by itself will not suffice. One must be able to show that oppositely directed causal processes are also impossible. The argument that was offered in Chapter 4 in support of the latter claim is therefore crucial.

Secondly, what about propositions—such as the proposition that a cause is always earlier than its effect, or the proposition that an effect never precedes its cause—which involve both causal concepts and temporal ones, and which it seems plausible to view as expressing necessary truths? Do they turn out to do so, given the above analyses? The answer is that they do. Thus, the proposition that a cause is always earlier than its effect is an immediate consequence of the analysis of temporal priority. In the case of the proposition that an effect never precedes its cause, one also needs to appeal to the proposition that oppositely directed causal processes are logically impossible. Given that proposition, however, the result follows very quickly, since, if it were the case both that *C* causes *E,* and that *E* is earlier than *C,* it would follow from the analysis of temporal priority that there were oppositely directed causal processes. So an effect can never precede its cause.

In short, the situation seems promising, since we have seen that the qualitative relations of temporal priority and simultaneity can be analysed in terms of actual causal relations, together with spatial relations, in a way that does not, at least initially, seem to be counterintuitive, that generates the appropriate formal properties, and that seems to entail necessary truths that involve both causal and temporal concepts.

9.7 Quantitative Temporal Relations

The relations of simultaneity and temporal priority suffice to fix temporal order and direction. There are, however, other tenseless, temporal relations between events—relations that are a matter, at least in part, of the *temporal distance* between events. Two events may be five years apart, or one event may be ten minutes later than another. What account is to be given of such relations?

Some quantitative temporal relations—such as that of being ten minutes later than—involve both temporal distance and direction. Others—such as that of being five years apart—involve only temporal distance. The natural idea here, of course, is to analyse relations of the former sort in terms of relations of the latter sort plus the relations of simultaneity and temporal priority, thus reducing the problem to that of giving an account of quantitative temporal relations that are a matter of temporal distance alone.

What account can be given, then, of temporal distance? One possibility would involve holding that moments of time, rather than forming a dense series, are discrete, for then the temporal distance between any two events would be simply a matter of the number of intervening moments. But this is a drastic solution, especially if one is offering an *analysis* of temporal notions—for then one has to claim not merely that moments of time do not form a dense series, but that it is logically impossible for them to do so.

A more moderate approach involves analysing the temporal distance between events in terms of the patterns exhibited by intervening events. This approach would be attractive if one were advancing a relational view of space and time. But I wish to set out an absolute, or substantival account, of space and time, rather than a relational one, and this means that an approach is needed that allows for the possibility of quantitative temporal relations even in an empty world, where there are no patterns that can serve to define the distance between different times.

Before I explain the approach that I shall pursue, it will help to notice that the problem of providing an account of relations of temporal distance can be reduced to a much more limited problem. For as work in the theory of measurement has shown, the possession of quantitative properties such as having a mass of 7 pounds, or a length of 2 metres, etc., can be analysed in terms of certain corresponding *comparative* relations between objects. Thus, given the relation that holds between two objects when one is at least as long as the other, together with the definition of a metre, one can explain what it is for any object to be of any length whatever, such as π metres. Similarly, in the temporal case, given the relation that holds between two stretches of time when the one is at least as great as the other, together with the definition of some appropriate unit, such as a second, one can explain what it is for the temporal distance between two events to be any specific length.

The problem of giving an analysis of quantitative temporal relations reduces, therefore, to that of giving an account of a single relation, of a comparative sort, between temporal distances. The relation in question might be the one just indicated—namely, that which holds between two temporal distances when the one is equal to, or greater than, the other. Alternatively, one might also start, instead, from the relation that obtains between two temporal distances when they are equal, since, although the former relation cannot be defined in terms of the latter alone, a definition can be given if one also makes use of some other resources—namely, the relations of simultaneity and temporal priority, plus the part/whole relation. Given those relations, one can proceed as follows. First, one needs to introduce the idea of a temporal interval. Suppose that *A* and *B* are any two events, or spatiotemporal locations. Then if *A* and *B* are simultaneous, the temporal interval *AB* consists of all space-time points that are simultaneous with *A* and *B*. Alternatively, if *A* is, say, earlier than *B,* then the temporal interval *AB* consists of all space-time points that are either simultaneous with *A* or simultaneous with *B,* or else both later than *A* and earlier than *B*. Secondly, given the idea of a temporal interval, what it is for one temporal distance to be equal to or greater than another can be defined in terms of the part/whole relation plus the relation of equality between temporal distances: the temporal distance between events *A* and *B* is equal to or greater than that between *C* and *D* if and only if there is a temporal interval that is either a proper or an improper part of *AB* and that is equal to the temporal interval *CD*.

The question we are left with, then, is what account can be given of relations that involve comparisons of temporal distances. The view that I shall advance involves the idea that these relations are theoretical ones that must satisfy three sorts of constraints: first, they must have certain formal properties; secondly, they are necessarily related in certain ways to the relations of simultaneity and temporal priority; and, thirdly, they must enter into causal laws in such a way as to explain certain correlations between causal sequences.

The formal properties are straightforward. Consider, for example, the relation of equality with respect to temporal separation. It must be a directionless relation: the temporal distance between any two points or events, *A* and *B,* must be equal to the temporal distance between *B* and *A*. It must be a symmetric relation: if the temporal distance between *A* and *B* is equal to that between *C* and *D,* then the temporal distance between *C* and *D* must be equal to that between *A* and *B*. Finally, it must be a transitive relation: if the temporal distance between *A* and *B* is equal to that between *C* and *D,* while the latter is equal to that between *E* and *F,* then the temporal distance between *A* and *B* must also be equal to that between *E* and *F*.

Next, there are constraints that arise because of connections between the comparative relations and those of simultaneity and temporal priority. To formulate these constraints, we need to assume that the world is one where temporal distance is defined for any pair of events. Or, to put things in terms of one of the comparative relations, the world must be such that, given any four events—*A, B, C,* and *D*—either the temporal interval *AB* is at least as great as the temporal interval *CD,* or vice versa. This assumption is needed, since, as we shall see, it seems that there could be temporal worlds where events did not stand in quantitative temporal relations.

Given this assumption, a number of constraints can be formulated. One constraint is that, given any two events, *A* and *B,* the temporal distance between them must be equal to the temporal distance between any events that are simultaneous, respectively, with *A* and with *B*:

(1) If *A* is simultaneous with *C,* and *B* with *D,* then the temporal distance between *A* and *B* is equal to that between *C* and *D*.

A second constraint is that, if two events are simultaneous, the temporal distance between them must, so to speak, be zero. The concept of a temporal distance equal to zero has, of course, not yet been defined. But the idea can be captured through the postulates, first, that the addition of a temporal interval whose end points are simultaneous events adds nothing to any adjacent temporal interval, either in the case where the end points of the adjacent interval are not simultaneous events, or in the case where they are, and, secondly, that all temporal intervals defined by simultaneous end points have the same width:

(2) If *A* is earlier than *B,* and *B* is simultaneous with *C,* then the temporal distance between *A* and *B* is equal to that between *A* and *C*;
(3) If *A* is simultaneous with *B,* and *B* is earlier than *C,* then the temporal distance between *A* and *C* is equal to that between *B* and *C*;
(4) If *A* is simultaneous with *B,* and *B* with *C,* then the temporal distance between *A* and *B* is equal to that between *A* and *C*;
(5) If *A* is simultaneous with *B,* and *C* with *D,* then the temporal distance between *A* and *B* is equal to that between *C* and *D.*

A final constraint is that, if one event is earlier than another, the temporal distance between them must, so to speak, be non-zero. This can be expressed by means of the postulates, first, that the addition of any two temporal intervals, neither of which involves simultaneous end points, must always result in a greater interval, and, secondly, that any interval whose end points are not simultaneous is always greater than any interval whose end points are simultaneous:

(6) If *A* is earlier than *B,* and *B* is earlier than *C,* then the temporal distance between *A* and *C* is greater both than that between *A* and *B,* and than that between *B* and *C*;
(7) If *A* is earlier than *B,* and *C* is simultaneous with *D,* then the temporal distance between *A* and *B* is greater than that between *C* and *D.*

As a consequence of these analytical connections, what quantitative temporal relations obtain between events and/or space-time points is seriously constrained by the relations of simultaneity and temporal priority between events and/or space-time points. This in turn implies that, if a causal account of those qualitative temporal relations is sound, then quantitative temporal relations are also constrained by the causal connections present in the world. But do those constraints generate, in effect, implicit definitions of quantitative temporal relations? The answer is that they do not. As we shall now see, a crucial element is still lacking.

To see what the missing element is, try to imagine a world where events are temporally ordered by the relations of simultaneity and temporal priority, but where they do not stand in any quantitative temporal relations to one another. What would such a world be like? At the very least, presumably, it would have to be a world where reliable clocks were not possible. But how could this ever be so? If events in the world are temporally ordered, and if a causal account of temporal order is correct, then such a world must contain causal processes. But if this is so, will not those causal processes mean that clocks are possible? For what are clocks, after all, but certain causal systems?

The answer is that the mere presence of causal processes does not by itself suffice to ensure that clocks are possible: causal processes must also be correlated in certain ways. For imagine that the world were like this. Given a pendulum, if the bob is pulled to one side and then released, the path that it traverses is the same as in our world. Moreover, as in our world, there is a gradual reduction in the amplitude of successive swings, until the bob finally comes to rest. So far, a world just like our own. But now the differences. When two pendulums, of identical construction, have their bobs raised the same amount, and then released simultaneously, it turns out that, although they go through the same states, in the same order, they do not go through them in step. Thus, by the time that the amplitude of the one pendulum has decreased by 10 per cent, the amplitude of the other may have decreased by only 7 per cent. Later, however, this situation may reverse itself, so that the amplitude of the first pendulum may, overall, have decreased by less than the second. And so the process may continue, with first one pendulum, and then the other, taking the lead in the progression from a state of enjoying swings of wide amplitude, to a state of rest.

If only pendulums exhibited such variable behaviour, events could still stand in quantitative temporal relations, since any number of other sorts of causal systems could provide reliable clocks. But suppose that pendulums were not the odd man out, that *absolutely all* causal systems exhibited the same absence of any correlations whatever, with causal systems both of the same sort, and of different sorts. The world would then be one where reliable clocks could not exist. But it is not merely that one would have no way of measuring time. It is rather that, given the lack of correlations between causal processes both of the same and of different types, the causal laws in that world would differ in a very important respect from the causal laws in our world. They would be laws of *pure succession*: they would involve relations that fixed the order of events, and the direction of time, but not the temporal distance between events.

The basic proposal, in short, is that all quantitative temporal relations can be analysed in terms of some basic temporal relation that involves simply a comparison of temporal distances between events, and that the latter relation, in turn, can be defined as that unique relation among events and/or space-time points that satisfies three sorts of conditions: first, it has certain formal properties; secondly, it is related to simultaneity and temporal priority, and thus to causation, in the ways indicated above; thirdly, its involvement in causal laws is what makes it the case that such laws, rather than being merely laws of causal succession, are such as entail potential correlations among causal processes.

According to this approach, there is a very close relation between the existence of quantitative temporal relations between events, and the existence of at least potential correlations between causal processes. The account is not, however, reductionist, since it does not equate the one with the other. The idea, rather, is that quantitative temporal relations are conceived, realistically, as relations among events, but they are characterized, in part, as relations whose involvement in causal laws is required if the laws are to entail the existence of potential correlations between relevant causal processes. The presence of quantitative temporal relations in the world is not, therefore, being analysed in terms of the existence of potential correlations between causal processes. Rather, it is the fact of the existence of such relations, and their involvement in causal laws, that explains potential correlations between causal processes.

But is there any reason for preferring this account to a reductionist alternative? Why not hold that the existence of quantitative temporal relations, rather than entering into the explanation of the existence of potential correlations between causal processes, is to be identified with the existence of such correlations?

One way of trying to defend the realist approach would be by arguing, first, that, if the world does not contain quantitative temporal relations between events, realistically conceived, then the only causal laws will be laws of pure succession, and, secondly, that such laws cannot provide a basis for potential correlations between causal processes. But that line of thought does not seem promising, as the second step appears unsound. For imagine that the world contains no causal laws, beyond those of pure succession. It may have laws, then, one of which ensures that a state of affairs of type A_1 causally gives rise to one of type A_2, which in turn gives rise to one of type A_3, and so on, and another of which ensures that a state of affairs of type B_1 causally gives rise to one of type B_2, which in turn gives rise to one of type B_3, and so on. But, in addition to laws of this sort, it might also have laws relating more complex states of affairs. In particular, there could be a law of causal succession to the effect that a complex state of affairs involving two simultaneous states of affairs of type A_1 causally gives rise to two simultaneous states of affairs of type A_2, and so on. Similarly, it could be a law that any complex state of affairs consisting of a state of affairs of type A_1 simultaneous with one of type B_1 causally gives rise to a complex state of affairs consisting of one of type A_2 simultaneous with one of type B_2, and so on. These more complex causal laws would still be ones of pure succession, but their existence would nevertheless ensure the existence of potential correlations between causal processes—both of the same type, and of different types.

A coherent reductionist account of quantitative temporal relations is, therefore, possible. But considerations of simplicity provide, I suggest, strong grounds for preferring the realist alternative. This is perhaps especially clear in a world containing a number of basic causal laws. Suppose, for example, that, if one takes a realist view of quantitative temporal relations, it turns out that there are five basic causal laws. If one shifted to a reductionist account, and viewed those five laws as simply laws of pure succession, one would have to postulate other causal laws to explain the correlations between causal processes. Since each of the five laws concerning simple states would govern at least one distinct causal process, one would, at a minimum, need to postulate fifteen additional causal laws—five to provide a basis for correlations between causal processes of the same type, and ten to account for correlations between causal processes of different types. So the choice would seem to be between, on the one hand, postulating a relation of equality of temporal distance, plus five basic causal laws involving that relation, and, on the other hand, avoiding that relation, but at the cost of postulating at least twenty basic causal laws.

In fact, however, the reductionist is forced to buy into much greater complexity than this. To see why, consider a case where the reductionist might seem, initially, not to be badly off. Imagine a world where, given a realist view of quantitative temporal relations, there would be only a single, basic causal law. It might seem that, in such a world, a reductionist would need to postulate only one additional law. But that is not so, for two reasons. In the first place, consider any sequence of events, falling under the law, where the sequence exhibits at least some change over time. That sequence will contain events of different types—say, A_1, A_2, A_3, A_4, etc. The reductionist will need to postulate a law that explains the correlation that exists in the sequences that result when two events of the same type—A_i—are simultaneous. But, in addition, correlations will also exist when one has two sequences that are of the same type, but which do not commence at the same time—as, for example, when a state of affairs of type A_1 is simultaneous with a state of affairs of type A_3. As a consequence, many more causal laws will have to be postulated. Indeed, if the causal sequence is a continuous one, then it may well be that it contains an unlimited number of different types of states of affairs, in which case the reductionist will have to postulate an infinite number of causal laws to explain the potential correlations that exist even for a single sort of causal process.

In the second place, the existence of a single causal law does not mean, of course, that the world can contain only one sort of causal sequence. Indeed, if the distance between objects can vary in a continuous fashion, there will be unlimited possibilities for the arrangements of objects, and this may well generate an unlimited number of distinct causal sequences. So in a world where there is, given a realist view of quantitative temporal relations, only a single causal law, involving the relation of equality with respect to temporal distance, the reductionist may very well be forced to postulate an infinite number of causal laws of pure succession, in order to provide a basis for the unlimited number of potential correlations between causal sequences of different types.

In view of these considerations, I conclude that the existence of correlations between causal processes provides grounds both for holding that the world contains quantitative temporal relations, and for adopting a realist view of those relations.

9.8 Objections to Causal Theories of Time

Causal theories of time are exposed to a number of important objections, most of which fall into two groups. First, many philosophers have argued that, even if the analytical equivalences advanced by causal theories do obtain, those analytical truths do not provide satisfactory *analyses* of temporal concepts. Secondly, potential counterexamples have been offered to the claimed analytical connections between temporal concepts and causal concepts.

Most of this section will be devoted to addressing these two types of objection. In my response to objections of the second sort, the reader will notice that I make extensive use of the fact that the causal theory of time that I have advanced involves both an absolute view of space and time, and the idea that spatiotemporal regions can be causally related. It might be argued, however, that this enables me to avoid some standard objections to causal theories of time only at the cost of new difficulties. I shall therefore conclude my discussion in this section by addressing one argument of that sort which may seem especially damaging.

9.8.1 The Analytical Equivalences Do not Provide Analyses

A number of reasons have been advanced for holding that, even if the definitions proposed by causal theorists are analytically true, they do not provide satisfactory definitions. Two of the more important are that the analyses are implicitly circular, and that they involve intensional contexts.

9.8.1.1 Causal Priority Presupposes Temporal Priority

One of the main arguments offered for the view that causal theories do not provide satisfactory analyses of temporal concepts involves the claim that such theories are implicitly circular: when the proposed analyses are carefully scrutinized, it turns out that the concepts involved in the analysans presuppose temporal concepts.

One version of the circularity objection—mentioned by J. J. C. Smart in his paper 'Causal Theories of Time'—is directed against accounts that employ an asymmetrical causal relation: 'In the absence of a prior notion of earlier and later how can we distinguish cause from effect, especially in view of the time-symmetry of the laws of nature?'[120]

Some advocates of a causal theory of time—such as Grünbaum, Mehlberg, and others—have tried in effect to finesse this objection by formulating the analysis in terms of a *symmetrical* causal relation, such as that of causal connectedness.[121] I do not believe, however, that this strategy is satisfactory. The crucial issue here is whether the most basic causal relations are symmetrical or asymmetrical. If a reductionist account of the direction of causation were sound, then it might well be possible to view asymmetrical causal relations as definable in terms of underlying symmetrical relations plus the relation that defines the direction of causation. But, since reductionist accounts of the direction of causation appear to be exposed to decisive objections, I believe that this approach is untenable. Analysis here must run in the opposite direction, with symmetrical causal relations, such as causal connectedness, being analysed in terms of the fundamental, and asymmetrical, relation of causation. So the idea of formulating a causal theory of time in terms of a relation such as causal connectedness cannot really provide a satisfactory answer to the present charge of circularity.

It would seem, then, that only a direct response will do: one needs to argue that a sound account of causation, and, in particular, of the direction of causation, will not involve any appeal to temporal relations. But, as will be clear from the discussion in Chapter 4, I believe that such an account can be offered.

9.8.1.2 Modal Concepts and Categorical Facts

A second and, I believe, much more forceful type of circularity objection focuses upon modal concepts such as causal connectibility,

[120] Smart, 'Causal Theories of Time', 62.

[121] Adolf Grünbaum, *Philosophical Problems of Space and Time,* 2nd edn. (Dordrecht: D. Reidel, 1973), ch. 7, and Henryk Mehlberg, 'Essai sur la théorie causale du temps', *Studia Philosophica,* i (1935,) 119–258; ii (1937), 111–231.

and causal accessibility. Here the thrust is, first, that the relevant causal concepts are modal ones; secondly, that modal facts require a categorical basis; and, thirdly, that the relevant categorical basis for the causal facts in question will involve, in some way, spatiotemporal relations.

One version of this objection, for example, turns upon the idea that whether two events that are not in fact causally connected are causally connectible depends not only upon what laws there are, but also upon how the events are spatiotemporally related. But then one cannot understand what it is for two events to be causally connectible, unless one first has the concept of a spatiotemporal relation. Consequently, any analysis of spatiotemporal relations that involves notions such as causal connectibility must be circular.

A somewhat different, though closely related version of the present objection focuses upon the laws that enter into the states of affairs in virtue of which events are causally connectible. Thus Smart, after observing that the modal concept of causal connectibility presupposes reference to laws of nature, points out that 'if these laws of nature themselves presuppose the very structure of space-time which we are seeking to elucidate by means of the notion of causal connectibility we are clearly involved in a vicious circularity'.[122]

Both of these objections tell, I believe, against many formulations of a causal theory of time. But they have no force against the account set out above, since it is formulated in terms of actual causal connections—including connections between spatiotemporal regions—rather than in terms of the modal notion of causal connectibility.

9.8.1.3 Intensional Contexts

A third important consideration offered in support of the contention that causal theories of time cannot provide satisfactory analyses of temporal notions turns upon the claim that such theories involve modal, or, at least, intensional, concepts. The thrust of this objection is that, since, for example, truth is not necessarily preserved by the substitution of co-extensive expressions in sentences involving intensional contexts, the truth conditions of such sentences are very far from perspicuous, and, as a result, any analysis

[122] Smart, 'Causal Theories of Time', 62.

couched in terms of such concepts cannot be acceptable. To analyse temporal concepts in terms of causal ones is, accordingly, to analyse the less obscure in terms of the more obscure.[123]

The claim that modal and intensional notions cannot be taken as analytically basic seems right to me, and so, for example, in the case of causal theories of time based upon the idea of causal connectibility, I would insist that it is crucial to show that that idea can be explained in purely extensional terms. Moreover, given that the concept of causal connectibility involves the idea of laws of nature, this in turn means that one would need to show that one can provide a satisfactory, purely extensional account of the truth conditions of statements expressing laws of nature.

But how does this objection bear upon a causal theory of time that is formulated in terms of actual causal connections, rather than in terms of causal connectibility? The answer is that some writers, such as Smart, have suggested that the idea of causal connectedness is itself an intensional notion,[124] and, given that some causal statements do involve intensional contexts, that claim is not without some initial plausibility. But there is a perfectly satisfactory response to this version of the objection—namely, that one can formulate a purely extensional language to talk about properties and relations, and, if one uses that language to describe causally related states of affairs, the resulting causal statements will be completely extensional. Non-extensional contexts occur in causal statements only if one confines oneself to a nominalistic language—where there are no terms that refer to properties and relations.

9.8.2 Possible Counterexamples

Objections of the second sort involve attempts to show that it is logically possible for there to be temporally related events that do not stand in the relevant causal relations. These objections do refute, I believe, most causal theories of time, but not the version advanced above.

9.8.2.1 Empty Spatiotemporal Regions

The thrust of this objection is that there could be space-time points that are not occupied by any events, but that, given a causal theory

[123] Ibid. 63–6.

[124] Ibid. 63.

of time, there will be no way of assigning temporal location to such space-time points, since there will be no events at such points to stand in causal relations to anything.[125]

A closely related objection, mentioned to me by J. J. C. Smart, concerns the more dramatic possibility of times at which nothing at all exists. That this is indeed a possibility needs to be argued, of course. But I believe that this can be done by arguing that action at a temporal distance is logically possible. In particular, if one can establish that temporally gappy causal laws are logically possible, then it would seem that one can show that there could be a universe that, although it contained objects at most times, was sometimes completely devoid of objects, since, by choosing an appropriate set of temporally gappy causal laws, plus initial conditions, one could describe a universe in which, on occasion, the temporal gaps in all of the laws would happen to coincide, with the result that absolutely nothing would exist at those times.[126]

Both of these possibilities pose a serious problem for relational versions of the causal theory of time. Neither has any force at all, however, against causal theories formulated in terms of causal relations between space-time points, rather than merely between events in space and time.

9.8.2.2 Events That Are not Causally Connected to Other Events

A second objection, also due to J. J. C. Smart, focuses upon the possibility of 'points of space-time which are occupied by events which are neither effects nor causes of other events'.[127] This possibility also constitutes a very serious problem for any relational version of the causal theory of time, since, while initially it might seem that such events could be handled by appealing to possible causal relations, the earlier discussion of causal connectibility makes it clear, I think, that an advocate of a relational view will not, in general, have resources that will suffice to supply categorical truth-makers for the relevant modal statements in the case of events that are, by hypothesis, causally completely isolated. But, once again, if one opts instead for a causal theory of time that is formulated in terms

[125] Cf. ibid. 62.

[126] This argument is very closely related to one advanced by Sydney Shoemaker in 'Time without Change', *Journal of Philosophy*, 66 (1969,) 363–81.

[127] Smart, 'Causal Theories of Time', 63.

of causal relations between space-time points, no difficulty is presented by the possibility of causally isolated events.

9.8.2.3 The Logical Possibility of Empty Space-Time

A third objection appeals to the extreme possibility of spatiotemporal worlds in which no events take place at any space- time point. If such totally empty spatiotemporal worlds are logically possible, then all relational versions of the causal theory of time are ruled out. But are such worlds really possible? In support of the claim that they are, some philosophers have appealed to the fact that there are solutions to the equations of General Relativity that describe worlds possessing a space-time structure, but devoid of all matter and energy.[128] It might very well be argued, however, that such an appeal needs, at the very least, to be supplemented by a consideration of the arguments which advocates of a relational view of space-time have advanced for thinking that the idea of empty space-time is, in the final analysis, incoherent.

Is there is a good reason for thinking that a totally empty spatiotemporal world is not logically possible? I do not believe that there is, and I shall shortly attempt to provide support for this claim. For the moment, however, let us simply assume that a totally empty spatiotemporal world is logically possible. The present objection will then be a decisive argument against relational versions of the causal theory of time. But it poses no difficulty for theories that are formulated in terms of causal relations between space-time points, since such theories are perfectly compatible with the possibility of a world where space-time is totally empty.

9.8.2.4 Continuous Causal Processes and Quantum Mechanics

A fourth objection, also raised by J. J. C. Smart, turns upon the fact that causal theories of time need to postulate the existence of continuous classes of events in space-time. The problem is that, while it is true in classical physics that between any two genidentical events there will be a continuous class of genidentical events, the situation is quite different in the case of quantum physics, where it is hard even to make much sense of the assumption

[128] Ibid. 67–8. Also Henryk Mehlberg, 'Relativity and the Atom', in Paul Feyerabend and Grover Maxwell (eds.), *Mind, Matter, and Method—Essays in Philosophy of Science in Honor of Herbert Feigl* (Minneapolis: University of Minnesota Press, 1966,) 449–91. See esp. pp. 484–6.

that there are such continuous classes of events. The absence of definite trajectories, for example, points to 'an uncertainty as to just what is supposed to be the set of events which would make up a genidentical causal chain'.[129]

Can this objection be brought to bear upon the causal theory advanced above? To do so, one would have to show that quantum physics is compatible with a discrete space-time. But, as Smart emphasizes, the latter idea is very dubious:

> Quantum mechanics uses continuous mathematics and continuous geometry, like any classical theory. Indeed it is not at all clear what a physical geometry based on a discrete space-time would look like, especially in view of the well known incommensurability of certain geometrical ratios and in view of Zeno's paradox of the stadium.[130]

It would seem, therefore, that the world as described by quantum mechanics does not constitute an objection to theories of time that invoke causal relations between space-time points themselves.

9.8.2.5 The Possibility of Eternal Recurrence

A fifth objection to causal theories of time centres upon the possibility of a universe involving eternal recurrence—that is, which consists of an unending sequence of qualitatively indistinguishable temporal segments. Why does this possibility pose a problem for causal theories of time? The reason is as follows. Suppose that such a world contains events *S, T,* and *S** such that, first, *S* causes *T*; secondly *S* and *S** are corresponding events in distinct, but qualitatively indistinguishable temporal segments, so that *S* and *S** are indistinguishable with respect to all of their properties, both intrinsic and relational; and, thirdly, *S** is later than *T,* and does not cause *T.* The question, then, is how it can be the case that *S* causes *T,* whereas *S** does not. If one is not committed to a causal theory of time, this question presents no problem, for then what makes it the case that *S* causes *T,* while *S** does not, can be simply the fact that *S* is earlier than *T,* while *S** is later than *T.* But, if one holds that temporal relations are analysable in terms of causal relations, this answer is unavailable, since it would render the analysis circular.

This objection is perfectly general, and applies to all causal theories of time, including the one advanced here. It is also a very

[129] Smart, 'Causal Theories of Time', 67.

[130] Ibid.

serious objection, and rather desperate countermeasures have sometimes been taken. Consider, for example, Adolf Grünbaum's discussion. His response to the apparent possibility of 'a universe consisting of a platform and one particle constantly moving in a circular path without friction' is that it is 'inadmissible' to interpret this as a case where 'the same kind of set of events (circular motion) keeps on recurring eternally . . . '—a contention he supports by appealing to the Leibnizian principle of the identity of indiscernibles: 'if two states of the world have precisely the same attributes, then we are not confronted by distinct states but merely by two different names for the same state at one time.'[131] Grünbaum's answer, in short, is that the supposed possibility is not genuine.

I do not think that Grünbaum's response is the right one, for it seems to me that familiar objections to the Leibnizian principle of the identity of indiscernibles—such as that of the possibility of a world that consists of an infinite number of qualitatively indistinguishable objects, spaced an equal distance apart—are decisive. But what is the alternative? The answer is that one can reject the fundamental assumption concerning causation upon which the argument rests—namely, the following principle of Humean supervenience:

> Whether or not *E* causes *F* is logically fixed by the non-causal properties of *E* and *F,* plus the non-causal relations between *E* and *F,* together with what causal laws exist.

Given this principle, the argument is clearly sound. First of all, *S* and *S** are, by definition, the same with respect to all of their properties, both intrinsic and relational. Secondly, though *S* is earlier than *T,* while *S** is later than *T,* if temporal priority is analysed causally, there is no non-causal relation, *R,* such that *S,* but not *S**, stands in relation *R* to event *T.* Finally, we are dealing with a single possible world, so there is no difference with respect to what causal laws there are. Consequently, if Humean supervenience obtains, it follows that *S* can cause *T* if and only if *S** also causes *T*—contrary to the description given of the possible world in question.

This argument collapses if the above thesis of Humean super- venience is rejected. But, given how widely accepted Humean supervenience

[131] Grünbaum, 'Carnap's Views on the Foundations of Geometry', 614.

is, a rejection of it may well seem no less desperate than Grünbaum's appeal to the principle of the identity of indiscernibles. I believe, however, that there are decisive arguments against Humean supervenience, one of which—the argument from the possibility of indeterministic laws—was set out in Chapter 4.[132] The correct response to the present objection, accordingly, is simply that the thesis of Humean supervenience is false.

9.8.2.6 The Possibility of Global Causal Loops

A final objection appeals to the possibility of universes containing a global causal loop, with an event at one time giving rise to a sequence of causally linked events such that the original event is itself a later member of that sequence. But what reason can be offered for thinking that such worlds are really possible? Sometimes the appeal is an 'innocent until proven guilty one', and it is argued that the attempts that have been made to show that global causal loops are impossible are not in fact sound.[133] But appeals are also frequently made to the fact that such a spatiotemporal world involving a global causal loop 'can be given a description internally consistent and consistent with the field equations of general relativity'.[134]

Why does the possibility of such a world present a difficulty for causal theories of time? The basic thrust of the argument is that the analytical connections between temporal concepts and causal ones postulated by a causal theory of time generate absurd consequences when applied to such a world. Thus it will follow, for example, that some events occur after themselves, or that some pairs of events are such that each is both before and after the other. One is forced, therefore, to reject the alleged analytical connections between temporal concepts and causal ones.[135]

Even if one were to grant the possibility of such causally cyclical universes, I think that the force of the present objection would be

[132] For a statement of the other arguments, see pp. 222–33 of my 'Causation: Reductionism versus Realism', *Philosophy & Phenomenological Research,* suppl. 50 (1990,) 215–36.

[133] See e.g. Susan Weir, 'Closed Time and Causal Loops: A Defence against Mellor', *Analysis,* 48 (1988,) 203–9.

[134] Lawrence Sklar, *Space, Time, and Spacetime* (Berkeley and Los Angeles: University of California Press, 1974), 303.

[135] Cf. Sklar, ibid. 335.

far from clear, since, if one thought that such a world were possible, would not one also think that temporal priority was not an asymmetric relation, and thus that there was no absurdity in the conclusion that an event could be earlier than itself? But there is no need to pursue this issue. If, as I have argued, oppositely directed causal processes are impossible, then the world described, however consistent it may be with the field equations of General Relativity, is not a logically possible world.

9.8.3 Objections to a Realist View of Space and Time

In responding to many of the objections set out above, I appealed to a realist conception of space and time, and one in which spatiotemporal regions themselves stand in causal relations. This strategy has made it possible to avoid a number of difficulties, many of which would otherwise be decisive objections to a causal theory of time. One might well view this manœuvre, however, as a case of buying into even more serious problems. In the present section, accordingly, I shall consider some objections to realist views of space and time in general, and to the specific version that I have advanced.

9.8.3.1Leibnizian-Style Arguments Against Absolute Space

What objections can be mounted against a realist, or substantival, view of space and time? In his book *Space, Time, and Spacetime,* Larry Sklar suggests that there are three main types of argument—all deriving from Leibniz's correspondence with Samuel Clarke: (1) epistemic or verificationist arguments; (2) arguments based upon some version of the principle of the identity of indiscernibles; and (3) arguments based upon the principle of sufficient reason.[136] Given the implausibility of the principle of sufficient reason, I shall ignore the third type of argument. The other two types, however, need to be considered.

Sklar formulates the verificationist argument as follows:

> The meaningful assertion of the existence of some entity or feature of the world requires that the presence or absence of that entity or feature, or a change in that feature, have some observational consequences. To affirm the existence of features of the world with no detectable consequences is

[136] Ibid. 173–80.

> not to espouse some kind of meaningful skepticism, but rather to affirm the intelligibility of the unintelligible. Now suppose space itself were a substance. It would then make sense to ask what the position of the whole of the material world in space is, how fast the world as a whole is moving with respect to this substantival space, etc. But we can only observationally determine the spatial relations of material objects relative to one another, the motions of material objects relative to one another, etc. There are no observations that could conceivably determine the position of the world as a whole in substantival space, nor its velocity with respect to substantival space, etc., assuming of course that, for example, in changing its position in substantival space the internal spatial relations of material objects relative to one another remain constant. So now we see that: (a) Belief in substantival space requires the intelligibility of assertions about the position of the world as a whole in substantival space and its motion with respect to substantival space; but (b) such assertions are clearly meaningless by the verificationist principle. Therefore, there can be no such thing as substantival space.[137]

There is not much to be said about this argument, since it stands or falls with the verificationist principle. But, given that there are very good reasons for thinking that the verifiability principle is unsound—including the fact that it implies that realism with regard to theoretical entities is an unintelligible position—I believe that the above argument can justifiably be set aside.

The final type of argument rests upon a version of the principle of the identity of indiscernibles. Consequently, this second type of argument might seem unpromising, given that standard formulations of the principle of the identity of indiscernibles are exposed to familiar, and apparently quite convincing, counterexamples. Sklar points out, however, that the usual formulations of the principle deal with the identity of objects, and that there is another version of the principle that deals, not with the identity of objects, but with the identity of possible worlds:

> P.3.*Suppose we have* possible worlds A *and* B *such that they are the same with regard to every purely qualitative feature. Then* A *is the same possible world as* B.[138]

Sklar suggests that this principle is much more promising than standard formulations of the principle of the identity of indiscernibles in that, first, it is not exposed to the usual counterexamples,

[137] Cf. Sklar, 173–4.

[138] Ibid. 176.

and, secondly, it is possible to 'offer some reasons for believing that P.3 might be logically true . . . '.[139]

Given this principle, the argument against a substantival view of space then runs as follows:

> Consider the two possible worlds that consist of (1) the actual world and (2) the actual world displaced five feet to the north in substantival space. It seems as though there are two possible worlds being talked about here, but the worlds are identical with respect to every purely qualitative feature. So they are, by P.3, the same possible world. So substantival space does not exist.[140]

If principle P.3 were correct, I think that this would be a sound argument. However, I believe that it is possible to construct a counterexample that shows that P.3 is false. Consider a world that, throughout all past time, has contained nothing except an infinite number of motionless, equally spaced, qualitatively indistinguishable billiard balls, all in a straight line. Pick out one of the balls, and call it '*X*'. Now imagine that only one change occurs in this world throughout all of time, namely, at some moment, every other billiard ball vanishes without a trace. This could happen in one of two ways, since *X* might or might not be among the billiard balls that disappear. Let us call these two possible worlds '*A*' and '*B*'. It is clear that *A* and *B* are distinct worlds, since one contains *X* throughout its history, while the other contains *X* only during its initial stages. Yet worlds *A* and *B* are the same with regard to all purely qualitative features. So principle P.3 is false.

9.8.3.2 Causation, Absolute Space, and Humean Supervenience

The thrust of this final objection is that the idea of causal relations between spatiotemporal regions is incompatible with the thesis of Humean supervenience mentioned earlier. To see why, consider a completely empty, spatiotemporal world that contains three space- time points *P, Q,* and *R* such that *P* is earlier than *Q,* and simultaneous with *R,* and the existence of *Q* is caused by the existence of *P,* but not by the existence of *R.* If spatiotemporal regions and points can be causally related, the above must surely be a logically possible world. But is it? The problem here is that, if the principle of Humean supervenience is true, then the existence of *Q* can be caused by that of *P,* but not by that of *R,* only if either *P* differs

139 Ibid. 177.

140 Ibid. 178.

from *R* with respect to its non-causal properties, or else *Q* stands in some non-causal relation to *P* that it does not stand to *R*. But space- time points do not differ with regard to their intrinsic properties, and, given that we are considering an empty universe, neither can they differ with respect to their relational properties. So the only way that the existence of *P* can be a cause of the existence of *Q,* while the existence of *R* is not, is if there is some non-causal relation that obtains between *P* and *Q,* but not between *R* and *Q*. What could that relation be? Since *P* and *R* are simultaneous, it cannot be any temporal relation. It is hard to see what possibility there is, then, other than that *P* stands in a different spatial relation to *Q* than *R* does. But this involves the postulation of absolute spatial relations holding between things that exist at different times, and the claim that there can be such relations is widely held to be unintelligible—as is shown by the almost universal rejection of Newton's idea of location in absolute space. It seems, then, that any spatial relation that holds between *P* and *Q* must also hold between *R* and *Q*. Consequently, *P* and *R* neither differ with respect to any non-causal properties, either intrinsic or relational, nor stand in any different non-causal relations to *Q*. The principle of Humean supervenience then implies that it is impossible for the existence of *Q* to be caused by the existence of *P,* while not being caused by the existence of *R*.

This argument does appear to me to establish an interesting conclusion—namely, that, if the principle of Humean super- venience is true, there cannot be causal relations between spatio- temporal regions or points. For, although the argument, as it stands, does involve an assumption that I believe is incorrect—the assumption, namely, that one cannot make sense of Newton's idea of location in absolute space—the way in which, I would argue, one can make sense of this notion is in terms of causation: two space- time points are in the same location if and only if they are causally connected. Consequently, the above argument will not really be undercut by this point, since, although it implies that *Q* can stand in a different spatial relation to *P* than it does to *R,* that difference will not be a non-causal one.

In short, it seems that we have here a sound argument for a conditional conclusion, and, if one adds the additional premiss that the principle of Humean supervenience is true, it will follow that there cannot be causal relations between spatiotemporal regions.

But, as will be clear from earlier discussion, that additional premiss is, I believe, untenable.

9.9 The Pervasiveness of the Direction of Time

I have argued that there are positive considerations that point in the direction of a causal theory of time, and that such a theory, when properly formulated, does not succumb to standard objections. I shall now conclude my defence by mentioning a feature of causal theories of time that seems to be an important and attractive one, and which competing theories of time virtually never possess.

The point has to do with the basis of the direction of time, and it can be developed by considering a property that the direction of time has on a number of non-causal analyses—such as that of Popper, on the one hand, and those of Reichenbach and Grünbaum, on the other—but which it does not possess given a causal analysis. The property in question is the dependence of the direction of time upon initial or boundary conditions. Consider, for example, Grünbaum's description of his own approach to the problem of the direction of time:

> We must first describe certain features of the physical world having the character of initial or boundary conditions within the framework of the theory of statistical mechanics. The sought-after basis of a statistical anistropy of time will then emerge from principles of statistical mechanics relevant to these *de facto* conditions.[141]

This dependence of the direction of time upon initial or boundary conditions has struck a number of philosophers as unsatisfactory. Thus Henryk Mehlberg, for example, commenting on the idea that the direction of time can be defined by reference to such things as the fact that the incidence of expanding optical spheres far exceeds that of contracting ones, says:

> Once more, however, the decisive point seems to be that the asymmetry between the two types of light waves depends on factual initial conditions which prevail in a given momentary cross section of cosmic history or at the 'boundaries' of a finite or infinite universe rather than on nomological considerations concerning this history: any other ratio of the incidences of

[141] Grünbaum, 'Carnap's Views on the Foundations of Geometry', 651.

> expanding and shrinking light waves would also be in keeping with the relevant laws of nature contained in Maxwell's theory of electromagnetic phenomena.[142]

Mehlberg is not very explicit as to exactly why he thinks it is objectionable to explain the direction of time in such a way that it is dependent upon factual, initial conditions. His feeling seems to be, however, that, if time has a direction, it must be a pervasive feature of the whole physical universe, rather than something that would have been radically altered by a change in a momentary cross-section of the world.

This feeling about the pervasiveness that the direction of time ought to possess leads Mehlberg, in turn, to conclude that time has no direction, that it is isotropic. His reason is, first, that he apparently believes that the only way in which the direction of time can be a pervasive feature of the world is if it is grounded in laws of nature, and, secondly, that it appears to be the case that the laws of nature are, as a matter of fact, invariant under time reversal.

Both Mehlberg's insistence upon the idea that the direction of time must possess a pervasive quality, and his view that this feature is not compatible with the idea that the direction of time is dependent upon initial or boundary conditions, seem plausible. By contrast, however, his contention that the direction of time can have the desired quality only if it is grounded in the existence of laws of nature that are not invariant with respect to temporal reversal seems to me to be mistaken, in view of the features that the direction of time will have, given the approach developed above. First, time's having a direction is perfectly compatible with all the laws of nature being invariant with respect to temporal reversal. Secondly, the direction of time is nevertheless not dependent upon initial or boundary conditions. Thus, in contrast to what is the case given the approaches of Popper, Reichenbach, Grünbaum, and others, the direction of time would not be changed, for example, by an alteration in the distribution and/or velocities of particles in some momentary cross-section of the physical universe. Nor is the direction of time a statistical property. If there is a direction to time, it is identical with the direction of causation in absolutely every causal process, including not only those involved in the

continued

[142] Henryk Mehlberg, 'Physical Laws and Time's Arrow', in Herbert Feigl and Grover Maxwell (eds.), *Current Issues in the Philosophy of Science* (New York: Holt, Rinehart & Winston, 1961,) 105–38, at pp. 123–4.

existence of fundamental particles, but those involved in the continued existence of space-time itself. As a consequence, the direction of time is about as pervasive a fact as there could possibly be—involving, as it does, *every* causal relation between states of affairs.

It is possible, in short, to set out an account of the direction of time according to which it is not dependent upon initial or boundary conditions, without appealing, as Mehlberg believes one must, to laws of nature that are not invariant with respect to time reversal. Causal theories of time, including the one advanced here, do precisely this. They also imply that the direction of time is an extraordinarily pervasive fact about the world. This combination of features is, I suggest, a very strong consideration in support of a causal theory of time.

9.10 Summing Up

The causal analysis of temporal concepts advanced above has a number of desirable features. First, the analysis entails that temporal relations do possess the formal or structural properties that they are normally believed to have: the relation of simultaneity is transitive, reflexive, and symmetric, while the relation of temporal priority is transitive, irreflexive, and asymmetric.

Secondly, there are striking structural similarities between the relations of temporal priority and causal priority, and, in providing a derivation of the formal properties of temporal relations on the basis of corresponding properties possessed by causal relations, causal theories of time provide an explanation of those similarities.

Thirdly, there are propositions involving both causal concepts and temporal ones—such as the proposition that a cause is never later than its effect—which it seems plausible to view as being necessarily true. Causal theories of time provide a straightforward explanation of that necessity: the propositions in question are analytically true.

Finally, many non-causal theories of temporal direction entail that the direction of time depends upon initial or boundary conditions. This feature seems undesirable, for it seems very natural to view the direction of time as an extremely pervasive feature of the world, rather than as a feature that would disappear if the initial conditions were changed in certain ways. A causal theory of time, by contrast, ensures that the direction of time is such a pervasive fact, for, wherever there is causation, there is temporal direction. This pervasiveness is accentuated, moreover, if one adopts the view that I have urged here, according to which spatiotemporal regions themselves stand in causal relations to other spatiotemporal regions, since then the direction of time is part of the very fabric of space-time itself.

Part V Objections

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10 Philosophical Objections

The present approach to the nature of time is exposed to a number of objections, which I shall consider in this chapter and the next. In the present chapter the focus will be on purely philosophical objections. Some can be dealt with very quickly, having been discussed in earlier chapters; others raise new points, and will require more detailed consideration.

In Chapter 11 I shall turn from philosophical objections to a crucial scientific objection—namely, that the postulation of an ontological gulf between the future, on the one hand, and the past and the present, on the other, is rendered implausible by a very well-established scientific theory—the Special Theory of Relativity.

10.1 Semantic Objections

10.1.1 Propositions, Propositional Functions, and Truth at a Time

In Section 5.1, I considered an objection, advanced by Ducasse, to the concept of truth at a time, to the effect that the idea that a proposition can have different truth-values at different times rests upon a failure to distinguish between propositions and propositional functions. This criticism has also been put forward by other philosophers. Thus Donald Williams, in his article 'The Sea Fight Tomorrow', says:

> The common man is as sure as anybody that a proposition, once true, is always true. His thoughts range the past and future as freely as the east and the west, and he is as accustomed to diagrams of songs, dynasties, or baseball series, spread out in time, as of carburetors, house floors, or mountain ranges, spread out in space. It is clear enough to him that what is true *of* one time is generally different from what is true of another time;

> and that different men, and the same man at different times, may have different opinions about the truth. But he regards with healthy abhorrence the sophist who would trap him into admitting that what is true *at* one time may not be true at another.[143]

Propositional functions (of a common sort) are true *of* a time; propositions *at* a time. So Williams, too, appears to be suggesting that the idea that what is true at one time can be false at another involves a confusion of propositions with certain propositional functions.

As I noted earlier, this objection is a natural one, especially given some potentially misleading statements by advocates of tensed accounts of the nature of time, such as Prior. But there is more to the matter than this. In the case of *some* tensed approaches, the objection is not merely natural, but, I believe, sound. In particular, given any approach that accepts the reality of past, present, and future, the truth-values of tenseless sentences cannot vary. It is only tensed sentences, and only a certain subclass of them, that can have different truth-values at different times—namely, tensed sentences that do not involve any explicit references to times. Advocates of traditional tensed views typically maintain that the tensed sentences in question express propositions, and then, since a tensed sentence of that sort—such as 'The four-colour problem has not yet been solved'—may not always have the same truth-value, they naturally appeal to such sentences in support of the conclusion that a proposition can have different truth-values at different times. Earlier, however, I argued that ordinary tensed sentences involve indexicals, and that different tokens of such a sentence, occurring at different times, will express different propositions. To appeal to such sentences in support of the idea of truth at a time is, accordingly, to appeal to sentences that express propositional functions, rather than propositions. So the tensed positions in question do involve, at this point, a confusion between propositions and propositional functions.

The situation is very different, however, given a tensed view that denies the reality of the future. Then sentences that do express propositions—such as tenseless sentences that are free of all indexicals—can have different truth-values at different times. So the idea that propositions can have different truth-values at

[143] Donald C. Williams, 'The Sea Fight Tomorrow', in Paul Henle, Horace M. Kallen, and Suzanne K. Langer (eds.), *Structure, Method and Meaning* (New York: Liberal Arts Press, 1951,) 282–306, at pp. 283–4.

different times need not involve a failure to distinguish between propositions and propositional functions.

10.1.2 The Unreality of the Future: The Incoherence Objection

A number of philosophers have suggested that the denial of the reality of the future leads to contradictions. Consider, for example, the following passage from an article by J. J. C. Smart:

> conceive of a soldier in the twenty-first century likewise cold, miserable and suffering from dysentery, and being told that some twentieth century philosophers and non-philosophers had held that the future was unreal. He might have some choice things to say, and if he were at all interested in abstract thought, I doubt if he would be mollified by the view that his sufferings were real then, but not real now (in the twentieth century). If so, I think that his philosophical instincts would be right. Reality is not a property which anything can acquire. To be real is to be part of the universe, and if the universe in the twenty-first century contains a certain thing or event then that thing or event is surely real. To say 'an F is real' is just to say '$(\exists\, x)(Fx)$' with tenseless 'Fx'. (It is of course the case also that the quantifier 'there is an x' has to be read tenselessly.)[144]

Smart's argument is that to be real is simply to be part of the universe, part of the totality of what exists (tenselessly). The twenty-first century, however, is part of that totality. So the twenty- first century is real. But the twenty-first century also lies in the future, so, if one denies that the future is real, one is denying that the twenty-first century is real. The denial of the reality of the future leads, therefore, to a contradiction.

My response to this objection is that it is essential, if one is embracing a dynamic view of the world, to distinguish between being actual as of a given time, and being actual *simpliciter*. The future is part of the totality of reality, and so is actual *simpliciter*. But the future is not actual as of the present moment, and it is the latter proposition that one is expressing—or should be expressing—when it is said that the future is not real.

What is, I believe, essentially the same argument as Smart sets out using tenseless sentences, and the idea of being real, can be formulated instead in terms of tensed sentences, plus the notion of truth. Consider, for example, the following statements:

[144] J. J. C. Smart, 'The Reality of the Future', *Philosophia,* 10 (1981,) 141–50, at p. 142.

(1) It will be true that there are (tenselessly) unicorns;
(2) There will be unicorns;
(3) It is true that there will be unicorns.

Even someone who denies the reality of the future will want to make some assertions of the form illustrated by statement (1). But (1) entails (2), and (2) in turn entails (3). Statement (3), however, entails that the future is real. Hence, unless one rejects all statements of the form of statement (1), the denial of the reality of the future will lead to contradictions.

Thus formulated, the argument may seem very appealing. But notice that statement (3) is ambiguous. It might be interpreted either as

(3*a*) It is (tenselessly) true that there will be unicorns

or as

(3*b*) It is now true—i.e. true at the present moment—that there will be unicorns.

These different readings will not matter, of course, if the concept of truth at a time is to be rejected. Then statement (3*b*) differs from (3*a*) only in containing a reference to the present which does no work: any occasion on which an utterance of (3*a*) would be true is also one where an utterance of (3*b*) would be true. But if, on the contrary, the truth-values of propositions are not invariant, then the reference to the present in (3*b*) ceases to be a superfluous one. There is then a very substantial difference between (3*a*) and (3*b*). The former says that a certain proposition is (tenselessly) true *simpliciter,* while the latter says that that proposition is true at the present moment. Thus interpreted, (3*b*) is not entailed by (3*a*). So one cannot get from (1) to (3*b*) by means of (3*a*). Nor is there any other route from (1) to (3*b*). The above argument therefore collapses, since, while (3*b*) is incompatible with the claim that the future is not real—i.e. not actual as of the present moment—(3*a*) is not.

10.1.3 The Primacy of Tenseless Quantification

As we saw earlier, many advocates of a tensed approach to time hold that tenseless existential quantification, rather than being basic, is to be analysed in terms of tensed quantification: to say that there is (tenselessly) an *x* is to say that either there was an *x,* or there is now an *x,* or there will be an *x*. This view must, of course, be rejected by anyone who accepts a tenseless view of time. Thus we find Quine saying that 'the only tenable attitude toward quantifiers and other notations of modern logic is to construe them always, in all contexts, as timeless'. Further:

> It would be hard to exaggerate the importance of recognizing the tenselessness of quantification over temporal entities. The precept has been followed as a matter of course by anyone who has been serious about applying modern logic to temporal entities. I see no reason to expect a coherent application of quantification theory to temporal matters on any other basis.[145]

Tensed accounts of the nature of time, by contrast, almost invariably view tensed quantification as basic. But, as I argued earlier, attractive though such an approach may initially seem to those who favour a tensed account, it is simply untenable. Quine's claim that tenseless quantification is fundamental must be accepted, regardless of one's views on the nature of time.

Most tensed approaches are therefore unsound, involving, as they do, an explicit rejection of the primacy of tenseless quantification. But is it possible for a dynamic approach to the nature of time to grant—as the present one does—that tenseless quantification is fundamental, without thereby running afoul of that concession? Is it not true, as Smart says in 'The Reality of the Future', that the notion of tenseless quantification 'presupposes the reality of the future'?[146]

The answer, once again, turns upon the crucial point that a dynamic view of the world requires both the concept of being actual *simpliciter,* and the concept of being actual as of a time. Tenseless quantification does presuppose that the future is actual *simpliciter*. But it does not presuppose that the future is actual as of the present moment. As a consequence, the acknowledgement that tenseless quantification is logically fundamental generates no problem for a properly formulated tensed account.

10.1.4 Inescapable Truths About the Future?

The thrust of this next objection, which has been advanced by Donald Williams, is that those who maintain that the future is

[145] W. V. O. Quine, 'Mr Strawson on Logical Theory', *Mind,* 62 (1953,) 433–51, at pp. 442–3.

[146] Smart, 'The Reality of the Future', 147.

unreal are not consistent on this matter, since even they concede that some statements about the future are true. In support of this contention, Williams cites two sorts of statements. First, there are instances of the law of excluded middle, such as 'Either there is a sea fight tomorrow or there is not a sea fight tomorrow'. Since Aristotle held that such statements were true, and since such statements explicitly refer to the future, Williams concludes that 'it is a peculiarity of the Aristotelian argument to allow some reality to the future'.[147]

This first formulation of Williams's argument is unsound—for, although analytically true statements such as 'Either there is a sea fight tomorrow or it is not the case that there is a sea fight tomorrow' might be described as being about the future, in virtue of containing expressions such as 'a sea fight tomorrow', they are not about the future in a sense which entails that the future is actual as of the present moment, since they do not entail that there is any state of affairs that is later than the present.

Williams's second formulation of his argument involves statements to the effect that the truth-values of propositions about what now lies in the future will change with the passage of time:

> But now, even if we accept Broad's reediting of our meanings, he seems to have truth about the future left on his hands anyhow. *There will be a sea fight tomorrow* or, as he prefers, *It will rain tomorrow* is not either true or false now, he tells us, but '*It will rain tomorrow* will become true or false' is not merely either true or false now; it is true now. . . . So also the pragmatist or the Aristotelian scholastic has to grant that it is true that a judgment about the future 'becomes true or false at the appropriate time'. Having confessed to this much truth about the future, one would think, they might better confess to it all.[148]

The correct response to this version of Williams's argument depends upon how sentences such as '*It will rain tomorrow* will become true or false' are being interpreted. If this sentence is interpreted as saying that *tomorrow will exist,* and that the proposition that it will rain tomorrow will then be either true or false, then the answer to the argument is that the sentence, so interpreted, is not now true, for no past or present state of affairs is a truth-maker for the proposition that tomorrow will exist. If, on the other hand, the sentence '*It will rain tomorrow* will become true or

[147] Williams, 'The Sea Fight Tomorrow', 294.

[148] Ibid. 298.

false' is interpreted instead as saying only that, *if tomorrow exists,* then the proposition that it will rain tomorrow will then be either true or false, then the answer to the argument is that this statement, just like the statement 'Either there is a sea fight tomorrow or it is not the case that there is a sea fight tomorrow', is analytically true, and therefore does not entail that the future is actual as of the present moment, because it does not entail that there is any state of affairs later than the present.

The basic flaw in Williams's argument, in short, is that the only statements about the future that are now true are ones that are analytically true, and thus such that their being true now does not entail the existence of future states of affairs.

10.1.5 Bivalence and Truth-Functionality

One of the most important objections to the thesis that the future is not actual as of the present moment is that this view seems to entail that the familiar truth-functional connectives are not truth- functional. In addressing this objection, however, it will be useful to consider four other objections that may appear, initially, to be independent of the truth-functionality criticism, but whose force can, I believe, be shown to be dependent upon their connection with it.

First, then, there is the bivalence objection. The principle of bivalence asserts that every proposition is either true or false, and the objection is then that the view that the future is not real involves the abandonment of the principle of bivalence.

As it stands, this objection is easily answered. If, as I argued earlier, a tensed account of the nature of time needs both the concept of truth at a time and also the concept of truth *simpliciter,* then one can simply agree that every proposition is either true or false *simpliciter*—for truth *simpliciter,* in contrast to truth at a time, is bivalent. Perhaps, however, the objection should be taken as claiming that *any* acceptable concept of truth should be such that every proposition is either true or false. Then it will conflict with the present view, given that a proposition may very well be neither true at a time nor false at a time. But the question then is what reason there is for thinking that any acceptable concept of truth must be bivalent.

It might be contended that it is a defining characteristic of propositions that they are either true or false. However, it would seem to be a perfectly satisfactory response that what is essential to a proposition is that it has some truth-value or other. If there are only the two truth-values—truth and falsity—then the principle of bivalence will be true. But if there are more than two truth- values—as in the case of the concept of truth at a time—that principle will be false. On the surface, then, it may well seem that appeal to the principle of bivalence is simply question-begging. We shall see shortly, however, that there is more to it than this.

A second objection focuses upon the fact that, if the future is not real, then neither a proposition nor its negation need be true. This idea has been widely held to be completely unacceptable. Donald Williams, for example, says that this 'would appear to be as nearly incredible as any proposition could be'.[149]

This objection is obviously very closely related to the first objection—since, if, as is surely very plausible, it is analytically true that a proposition is false if and only if its negation is true, it follows that the principle of bivalence is true if and only if every proposition is such that either it, or its negation, is true.

Here, as in the case of the previous objection, the principle is one that holds in the case of the concept of truth *simpliciter,* but not in the case of truth at a time. So the question is whether there is any reason for thinking that any acceptable concept of truth, including that of truth at a time, must be such that, for every proposition, either it or its negation is true in the relevant sense.

One line of argument might be that the negation of any proposition is by definition a proposition that is true when, and only when, the original proposition fails to be true. But this, like the previous argument, would appear to be question-begging. If one holds that, given the concept of truth at a time, there are more truth-values than truth and falsity, what one will want to say is that the negation of a proposition is to be defined, not as a proposition that is true when, and only when, the original proposition fails to be true, but as a proposition that is true when, and only when, the original proposition is false. And there will then be no reason, it would seem, for holding that the concept of truth at a time cannot be acceptable because it is not the case that every proposition is such that either it, or its negation, is true at every time.

[149] Williams, 284.

The third objection is related to the first two, but it involves an additional assumption—namely, that any statement of the form '*p* or not *p*' is true. Given that assumption, together with the assertion that there can be cases where neither a proposition, nor its negation, is true, it follows that '*p* or not *p*' may be true even though neither '*p*' nor 'not *p*' is true. But this, the third objection contends, is absurd: 'To say that it is true that either there is a sea fight tomorrow or there is not, but that it is not true that there is and it's not true that there's not, is a sheer contradiction.'[150]

But why does Williams think that there is any contradiction here? The answer emerges, I suggest, if we turn to a fourth objection, the thrust of which is that the meaning of disjunction is such that a disjunctive statement cannot be true unless at least one of its disjuncts is true. Quine, for example, has referred to '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*" '.[151] But, then, if it is part of the very meaning of disjunction that a disjunctive statement cannot be true unless one of its disjuncts is true, then '*p* or not *p*' certainly cannot be true unless either '*p*' is true or 'not *p*' is true.

But what grounds are there for holding that a disjunctive statement, by definition, cannot be true unless one of its disjuncts is true? In the case of a concept of truth that is known to be two- valued, one can appeal to the fact that, in the two-valued truth- table for disjunction, a disjunctive statement is true only in cases where at least one of its disjuncts is true. So it is certainly the case that, for the concept of truth *simpliciter,* a disjunctive statement cannot be true unless one of its disjuncts is true. The concept of truth at a time, on the other hand, is not two-valued, and so it will not do to appeal to the two-valued truth-table for disjunction. What one will need to do, rather, is to show that, even though there is a third truth-value that a proposition can have at a time, the more extended truth-table that results will not involve any cases where a disjunctive statement is true at a time, even though neither of its disjuncts is true at that time.

How might that be argued? A plausible line, I suggest, involves the following two claims. First, if a proposition is true at one time,

[150] Ibid. 290.

[151] W. V. O. Quine, 'On a So-Called Paradox', *Mind,* 62 (1953,) 251–2. See p. 251.

it is also true at every later time. Truth, in contrast to indeterminacy, is a stable truth-value. Secondly, the three-valued truth-tables for the logical connectives must agree with the two-valued truth- tables with respect to all cases that do not involve component propositions that have the third truth-value. Given these assumptions, the question is whether, if there are three truth-values, there can be cases where a disjunction is true at a time, even though neither of the disjuncts is true at that time.

The argument proceeds in two stages. The first involves showing that, if one has a disjunction satisfying the following two conditions—(1) neither of its disjuncts is true at time *t*; (2) both disjuncts could be simultaneously false at some time after *t*—then the disjunction cannot be true at time *t*. The second stage consists of moving from this conclusion to the stronger result that no disjunction, neither of whose disjuncts is true at time *t,* could possibly be true at time *t*.

Let '*p* or *q*', then, be any disjunction, and let *t* be any time such that, first, neither '*p*', nor '*q*', is true at time *t,* and, secondly, it is possible for both disjuncts to be simultaneously false at some later time *t**. (Thus if *t* is 1980, '*p* or *q*' might be 'Either there are unicorns on earth in the year 2000, or dinosaurs never existed', since neither of the disjuncts is true in 1980, and both disjuncts could be simultaneously false at some later time. But '*p* or *q*' could not be 'Either there are unicorns on the earth, in the year 2000, or there are no unicorns on earth in the year 2000', for then the two disjuncts could not be simultaneously false at any later time.) The argument now runs as follows. If '*p*' and '*q*' were both to be false at some later time *t*,* then, in view of the assumption that three- valued truth-tables and two-valued truth-tables agree with respect to all cases that do not involve component propositions that have the third truth-value, it follows that the disjunctive statement '*p* or *q*' would also be false at that time. Therefore, since it is possible for both '*p*' and '*q*' to be simultaneously false at a later time, it must also be possible for '*p* or *q*' to be false at a later time. But, if this is possible, then '*p* or *q*' cannot be true at time *t,* for if '*p* or *q*' is true at time *t,* it follows, given the assumption that truth is a stable truth- value, that '*p* or *q*' is true at any later time, *t**.

This first stage of the argument makes use of the assumption that it is possible for *p* and *q* to be simultaneously false at some later time, so the general conclusion that it is impossible for a disjunction to be true at a time unless at least one of its disjuncts is true has not yet been established. But this stronger conclusion can now be established very quickly as follows. Let '*r* or *s*' be any disjunction such that neither '*r*' nor '*s*' is true at time *t,* and where it is impossible for '*r*' and '*s*' to be simultaneously false at any later time. Then, regardless of whether '*r*' is false or indeterminate at time *t,* and similarly for '*s*', there will always be '*p*' and '*q*', such that, first, the truth-values of '*p*' and '*q*' at time *t* agree, respectively, with those of '*r*' and '*s*' at time *t,* and, secondly, it is possible for '*p*' and '*q*' to be simultaneously false at some later time. But then, since '*r*' has the same truth-value as '*p*' at time *t,* and '*s*' the same truth-value as '*q*', it follows that '*r* or *s*' must have the same truth-value at time *t* as does '*p* or *q*'. But we have just seen that '*p* or *q*' cannot be true at time *t.* Hence neither can '*r* or *s*' be true at time *t.* Therefore a disjunction can never be true at a time unless at least one of its disjuncts is true at that time.

As noted above, this argument involves the following two assumptions. First, that truth is a stable truth-value, and, secondly, that the three-valued truth-tables for the familiar logical connectives must agree with the two-valued truth-tables with respect to all cases not involving component propositions that have the third truth-value. Are these two assumptions defensible? I believe that they are. In support of the first, I would appeal to the dynamic view of the world, and the accompanying correspondence theory of truth, set out earlier—since, given the correspondence theory with its requirement that, for a contingent proposition to be true, there must be states of affairs that are truth-makers for it, a proposition could be true at one time, and not true at a later time, only if what facts existed diminished with the passage of time, and the latter is precluded by the reality of the past.

As for the second assumption, it seems reasonable simply to say that, if a three-valued truth-table fails to agree with a two-valued table with respect to cases that do not involve the third truth-value, then the tables cannot be tables for the same logical connective.

Do these two assumptions then suffice to establish Quine's claim that 'It is true that *p* or *q*' is a sufficient condition for 'It is true that *p* or it is true that *q*'? Not quite. The argument also involves a third assumption that has not yet been made explicit—the assumption, namely, that there is a *complete,* three-valued truth-table for disjunction, i.e., that there are no possible assignments of truth-values to the disjuncts of a disjunctive statement for which the truth-value of the disjunctive statement is not uniquely defined. But, if there were such assignments, that would imply that disjunction is not a truth-functional connective. The third assumption, accordingly, is simply that disjunction *is* truth-functional.

This third assumption enters into the argument at the second stage. To see why this is so, consider the statement 'Either there will be a sea battle tomorrow or it is not the case that there will be a sea battle tomorrow', and let us suppose that this statement is now true, even though neither disjunct is now true. This supposition is perfectly compatible with the assumptions that truth is a stable truth-value, and that three-valued truth-tables must agree with two-valued ones with respect to the cases they have in common. But trouble arises once one adds the further assumption that disjunction is a truth-functional connective, since there are other disjunctive statements with indeterminate disjuncts—such as 'Either there will be a sea battle tomorrow or there will be an air battle'—that are *not* now true, and this implies that there is no complete truth-table for disjunction, since when 'p' and 'q' have the third truth-value at a given time, 'p or q' will sometimes be true at that time, and sometimes not.

The conclusion, in short, is that Quine's claim that 'It is true that p or q' is a sufficient condition for 'It is true that p or it is true that q' can be established, but only by appealing to the assumption that disjunction is a truth-functional connective.

We are now in a position to understand the real force of the four objections mentioned in this section. First, given the following assumptions:

(1) Disjunction is a truth-functional connective;
(2) Truth is a stable truth-value: a proposition cannot be true at one time and not true at some later time;
(3) The two-valued and three-valued truth-tables for logical connectives must agree with respect to all cases not involving the third truth-value;

it follows that:

(*a*) 'It is true at time t that p or q' is a sufficient condition for 'It is true at time t that p or it is true at time t that q'.

Then, as an immediate corollary, one also has:

(*b*) It is impossible for '*p* or not *p*' to be true at time *t* if neither '*p*' is true at time *t,* nor 'not *p*' is true at time *t*.

The further assumption—

(4) '*p* or not *p*' is always true at time *t*

—then leads to the conclusion that

(*c*) For every proposition '*p*', either '*p*' is true at time *t* or 'not *p*' is true at time *t*.

Finally, given the assumption:

(5) It is an analytic truth that '*p*' is false at time *t* if and only if 'not *p*' is true at time *t*;

we also have, as a consequence, the principle of bivalence:

(*d*) For every proposition '*p*', either '*p*' is true at time *t* or '*p*' is false at time *t*.

To reject (*d*), then, means that one must reject at least one of (1) through (5). To reject (*c*), one must reject at least one of (1) through (4). And, finally, to reject either (*a*) or (*b*), one must reject at least one of (1) through (3). But, it seems to me, (2), (3), (4), and (5) are correct. If this is right, then, in the end, there is no satisfactory answer that can be given to the above four objections unless one can maintain that disjunction is not a truth-functional connective.

At this point, the situation may well seem utterly hopeless. Thus, even such a vigorous defender of a tensed view of time as Prior, in commenting upon Aristotle's view that a disjunctive statement of the form 'Either *p* or not *p*' is always true, concludes by saying:

> Would Aristotle, perhaps, have defended his position by so using 'Either' that a disjunction of indeterminate propositions is not itself automatically indeterminate, but automatically true? Hardly. It is plain, I think, that Aristotle would not have regarded a disjunction of indeterminate propositions as 'automatically' anything. . . . This amounts to saying that in the three-valued logic of Aristotle, so far as he has such a thing, disjunction was not a truth-function. Or alternatively we may say—and this, I think, is the simple truth—that at this point Aristotle was quite excusably muddled, and was trying to use 'proposition', 'true', etc., at once in senses in which the logic of these things is two-valued and in senses in which it is three- valued.[152]

[152] Arthur N. Prior, 'Three-Valued Logic and Future Contingents', *Philosophical Quarterly,* 3 (1953,) 317–26, at p. 326.

But in Section 5.3 we saw, in effect, that there is good reason for thinking that Aristotle was not muddled on this matter. The claim that there are contexts where disjunction can be employed, even though it is not truth-functional in those contexts, is by no means absurd. On the contrary, it can be supported by a very plausible argument.

That argument, in very brief outline, was as follows. First, a distinction can be drawn between logical truth and factual truth: a statement is logically true in virtue of its logical form, but factually true in virtue of the existence, in the world, of some state of affairs that is a relevant truth-maker.

Secondly, given that distinction, one can form the concept of what I have referred to as factual-truth values, and it can be shown that what are normally referred to as the truth-functional connectives are also functions that map ordered *n*-tuples of factual-truth-values into factual-truth-values. The question thus arises as to whether it is truth-functionality, or factual-truth- functionality, that is the more basic property of the familiar logical connectives.

Thirdly, in response to this question, I argued that it is factual- truth-functionality that should be taken to be the defining property of the familiar logical connectives. In the first place, the familiar logical connectives certainly appear to be perfectly intelligible within the context of the three-valued logic that must be employed if one holds that the world is a dynamic one where the past and the present are real, but the future is not. But the logical connectives would not be intelligible within that context if truth-functionality were the defining property of the logical connectives, since they are not truth-functional within that three-valued logic. On the other hand, the logical connectives are functions with regard to factual- truth status both in three-valued logic and in two-valued logic. If, therefore, one adopts the view that the basic or defining property of the logical connectives is factual-truth-functionality, rather than truth-functionality, it will then be possible to make sense of their use within a three-valued context.

The view that the fundamental property of the familiar logical connectives is factual-truth-functionality rather than truth-functionality can only be sustained, of course, if it turns out that, when the logical connectives are defined in this way, they are truth- functional within two-valued logic. The final stage of my argument, accordingly, involved showing that, if factual-truth-functionality is taken as the basic property of the logical connectives, it follows that those connectives, while not truth-functional within three-valued logic, are truth-functional within two-valued logic.

The thrust of my response, in short, is that the standard view of the logical connectives according to which it is a defining characteristic of them that they are truth-functional is mistaken: truth- functionality is a secondary characteristic of the familiar logical connectives, and one that they have only within two-valued logic. Their defining characteristic is instead that they are functions with respect to *factual*-truth status. This, however, is a characteristic that they have in three-valued logic as well as in two-valued logic. Accordingly, the objections that have been considered in this section, including the fundamental and underlying one which appeals to the idea that the familiar connectives of propositional logic are necessarily truth-functional in all contexts, can be answered, since there is an argument that renders very plausible the initially surprising conclusion that truth-functionality is not the defining property of the connectives in question.

10.1.6 Logical Truths

Another frequently advanced objection, very closely related to the truth-functionality argument, is this. If contingent propositions about the future are neither true nor false at the present moment, but indeterminate, then a number of propositions that one takes to be logical truths are not true at the present moment, but indeterminate, and, correspondingly, a number of propositions that one takes to be contradictions are not now false, but indeterminate. Tobias Chapman, for example, puts the point as follows:

> An objection to Łukasiewicz's three-valued logic as a solution to the apparent incompatibility between indeterminism and the fact (or apparent fact) that propositions about future contingents are true or false is that it involves a rejection of (one version of) the law of contradiction. If P and $-P$ are each indeterminate (in truth-value, not necessarily in modality) then according to Łukasiewicz '$P.-P$' also has the truth-value indeterminate. This is highly paradoxical: it entails that a contradictory proposition might be true (since that is what 'indeterminate' must mean in this context) providing each of the conjuncts composing it is a contingent statement.[153]

[153] Tobias Chapman, 'On a New Escape from Logical Determinism', *Mind,* 81 (1972,) 597–9, at p. 598. Cf. A. N. Prior's discussion, 'Three-Valued Logic and Future Contingents', 325–6.

Chapman then goes on to argue that the only way to avoid this sort of unacceptable consequence is by denying that the connectives in question are truth-functional.

Chapman is right on both counts; the consequence is unacceptable, and the only way of avoiding it is by a denial of truth- functionality. We have seen, however, that the view that the standard connectives of propositional logic are not truth- functional in *all* contexts, rather than being absurd, as Chapman takes for granted, is in fact very plausible.

10.2 Statements, Assertions, and Beliefs About the Future

The next two objections concern the questions of whether statements about the future can be meaningful, and whether beliefs about the future can be rational, if the future is not real.

10.2.1 The Meaningfulness of Statements About the Future

The thesis that the future is not real is sometimes held to be incompatible with the proposition that sentences about the future are meaningful. This contention is, I shall maintain, unsound. But, while it is unsound, it is true that *most* tensed approaches are exposed to a very serious objection concerning the meaningfulness of statements about the future.

Why might one think that tensed approaches to time face a problem in this regard? In the case of tensed approaches that deny the reality of the future, the main reason is provided by the general argument which claims that cognitive significance is necessarily connected with truth and falsity. Thus Williams, for example, in discussing Broad's views on the nature of time, remarks that 'a conclusion which implies that a statement can be significant—that is, genuinely a statement—and yet neither true nor false . . . is intolerable'.[154]

This line of thought can without unfairness, I believe, be set aside as question-begging. That a sentence must have a truth-value if it is to be cognitively significant can be accepted as true by definition. If

[154] Williams, 'The Sea Fight Tomorrow', 297.

there are only the two truth-values, it will then follow that a cognitively significant sentence must be either true or false. But this will not follow if the future is not real, and if one is dealing with truth at a time, for then there is a third truth-value.

In addition, even if it could be established that a cognitively significant sentence must be either true or false, that would not tell against the present approach, as I have defended the concept of truth *simpliciter,* along with the claim that it is necessarily two-valued.

Nevertheless, there is a serious problem confronting almost all tensed approaches to time concerning the meaningfulness of statements about the future. The problem, moreover, is not confined to those approaches that deny the reality of the future: it arises for any tensed view that incorporates certain claims about the unanalysability of tensed statements in general, or of statements about the future in particular.

This difficulty was discussed in Section 6.3, so I shall confine myself to a very brief summary. Consider, first, tensed approaches—such as Broad's in his *Scientific Thought*[155]—that involve an explicit rejection of the analysability of statements about the future. Can such approaches provide a satisfactory account of how we come to understand such statements? In support of the contention that they cannot, I appealed, among other things, to the claims, first, that we are not, as a matter of fact, directly acquainted with future events, and, secondly, that general terms that are unanalysable can be understood only if they function to pick out properties or relations with which we can be directly acquainted.

Next, what about tensed approaches that do not explicitly assert that statements about the future are unanalysable? In most cases, one can show that they are implicitly committed to that claim. This becomes clear once one asks what possibilities there are with respect to the analysis of statements about the future. To analyse them in terms of other tensed statements is surely impossible: statements about the future cannot be equivalent to statements about the past and the present. So, if statements about the future are to be analysed, it must either be in terms of tenseless statements, or in terms of both tensed and tenseless statements. But then the difficulty is that most tensed approaches maintain that

[155] C. D. Broad, *Scientific Thought* (London: Routledge & Kegan Paul, 1923,) 76–7.

tenseless statements are to be analysed in terms of tensed ones, and this leads immediately to the question whether statements about the future are needed for the proposed analysis of tenseless statements, or whether the analysis can be couched simply in terms of statements about the past and the present. In the former case, one's analysis of statements about the future will be implicitly circular. In the latter, one is once again back to the impossible idea of analysing statements about the future in terms of statements about the past and the present.

There is one way, and only one way, to avoid this difficulty. That is to deny that tenseless statements can be analysed in terms of tensed ones. But, as we have seen, and contrary to standard tensed views on this matter, there is nothing troubling about this conclusion. Moreover, as I have argued in Chapters 6 and 7, once one does reject the view that tenseless statements are to be analysed in terms of tensed ones, the way is clear for a satisfactory account of the meaning of tensed statements in general, and of statements about the future in particular.

10.2.2 Rational Beliefs and Assertions About the Future

People constantly make assertions about, and have beliefs about, the future, and they act on the basis of those beliefs. We think that some of those beliefs are rational, to a greater or lesser degree, and others irrational. In some cases we may say that someone has knowledge of the future. Can such claims be justified if the future is not real?

Let us begin by considering whether rational belief about the future is rendered impossible if the future is not real. One way of tackling this question is by appealing to an epistemological claim which, though not uncontroversial, is widely accepted—namely, the foundationalist claim that every rational belief is either non-inferentially justified, or else justified on the basis of other beliefs that are non-inferentially justified. Consider, then, noninferentially justified beliefs. Since, as a matter of fact, no one enjoys non-inferentially justified beliefs about the future, the unreality of the future can affect what beliefs are non-inferentially justified only if it affects what beliefs about the past or the present are non-inferentially justified. As there seems to be no reason to suppose that it has any effect on the latter, we can conclude that what we are non-inferentially justified in believing is unaffected by the question of whether the future is real.

What about what we are inferentially justified in believing? This also will be unaffected. Whether a given belief is inferentially justified is a matter simply of what we are non-inferentially justified in believing, and of the logical relations of the belief in question to the body of non-inferentially justified beliefs, and neither the logical relations among beliefs nor the non-inferentially justified beliefs will be altered by the unreality of the future. We can therefore conclude, not only that rational beliefs about the future are possible even if the future is not real, but that what beliefs are justified, and to what extent, is totally unaffected by whether the future is real.

But what about *knowledge* of the future? Can it not be argued that here the situation is different, on the grounds that, first, a proposition cannot be known unless it is true, and, secondly, the view that the future is unreal entails that statements about the future are not now true. So knowledge of the future is precluded.

This point does tell against tensed approaches that reject the idea of truth *simpliciter* in favour of the concept of truth at a time. On such a view, knowledge of the future *is* impossible. But, if one also accepts the concept of truth *simpliciter,* the above objection poses no problem: statements about the future, though not true at the present moment, may be true *simpliciter.*

10.3 Meta-Time Objections

Some philosophers have argued that acceptance of a dynamic view of time forces one to postulate a meta-time. In the present section I shall consider two objections of this sort, the first concerned with the speed with which time passes, and the second with the problem of how instantaneous events can undergo change.

10.3.1 The Speed of Time's Passing

In his *Examination of McTaggart's Philosophy,* Broad discusses the tensed view of time according to which past, present, and future events are all equally real, but there is a special property of presentness that events initially lack, acquire for an instant, and then lose forever. He contends that this view of time is exposed to at least two fatal objections. His formulation of the first begins as follows:

> If anything moves, it must move with some determinate velocity. It will always be sensible to ask 'How fast does it move?' even if we have no means of answering the question. Now this is equivalent to asking 'How great a distance will it have traversed in unit time-lapse?' But the series along which presentness is supposed to move is temporal and not spatial. In it 'distance' *is* time-lapse. So the question becomes 'How great a time- lapse will presentness have traversed in unit time-lapse?' And this question seems to be meaningless.[156]

Broad's argument then seems to proceed as follows. If the tensed view in question is to be tenable, the question of how fast the present moves must be an intelligible one, and a determinate answer must be possible. But how can that be? The only possibility, it would seem, is that there exists a meta-time. But then the problem is that, if one adopts the same sort of tensed account of the meta- time, one will be forced to postulate a meta-meta-time, and one is off on an infinite regress, which, even if not vicious, is certainly uneconomical.

As Broad formulates this objection, it is directed against a specific sort of tensed view. But, as Donald Williams and others have insisted, it applies equally to the tensed view advanced by Broad himself in *Scientific Thought:* 'He has not, therefore, got rid of the paradoxes of meta-time. Instead of a bull's-eye which moves along the existence-fence in meta-time, he gives us a fence which lengthens itself in meta-time.'[157]

Williams is surely right about this. Indeed, the speed-of-time objection is surely applicable to any tensed view. But is there anything at all in the objection? Does it show, in particular, that it is necessary to postulate a meta-time, and thus to start off on an infinite regress? I cannot see that it does. The crux of the argument seems to be the contention that a meta-time must be postulated if the question of how far in time the present moves in a unit time interval is not to be meaningless. Parallel questions can, however,

[156] C. D. Broad, *Examination of McTaggart's Philosophy* (Cambridge: Cambridge University Press, 1938,) 277.

[157] Williams, 'The Sea Fight Tomorrow', 277.

be raised about travel through space: ‘How far does something move in travelling a mile?’ Does one need, then, to postulate a meta-space if this question is not to be meaningless? The answer, surely, is no. Similarly, the refusal to postulate a meta-time does not render the corresponding question about the speed of travel of the present through time meaningless. It merely means that any correct answer to it—such as, ‘The present travels at sixty minutes an hour’—will be analytic, and hence not overly exciting.

10.3.2 Meta-Time and the Changing of Events

Broad's other objection to tensed views that accept the reality of the past, the present, and the future may be put as follows. If an instantaneous event has the intrinsic property of presentness at one moment, and then loses that property, acquiring the intrinsic property of pastness, then events themselves must undergo change. Accordingly, even an instantaneous event must, in some sense, exist at different times, since otherwise an event could not have the property of presentness at one time, and then lose that property. But how can an instantaneous event exist at different times? Broad's answer is that the only way that one can avoid an outright contradiction is by postulating a meta-time:

> If there is any sense in talking of presentness moving along a series of events, related by the relation of earlier-and-later, we must postulate a second time dimension in addition to that in which the series is spread out. An event which has zero duration, and therefore no history, in the first time-dimension, will yet have an indefinitely long duration and a history in the second time-dimension.[158]

Broad then goes on to argue that here, just as in the case of the previous objection, a meta-time does not provide a terminus, since, if one adopts the same tensed view in the case of the meta-time, then precisely parallel considerations show that one needs to postulate a meta-meta-time if one is not to be landed with a contradiction. So, once again, one is off on an infinite regress.

Is this objection sound? Some philosophers have argued that it is not. George Schlesinger, for example, commenting on the infinite regress portion of Broad's argument, remarks that

[158] Broad, *Examination of McTaggart's Philosophy*, 278.

> Broad moves far too quickly. Not only does he not bother to show that the regress is vicious, he fails also to show that there is indeed any regress at all. It is by no means clear that if we wanted to endow the new series with a moving now we would have to postulate yet another series. For just as the second series could be instrumental in helping to make sense of temporal becoming in the first series, in the same manner the first series could serve as the extra series through the use of which temporal becoming in the second series makes sense.[159]

Schlesinger is certainly right that Broad does not show that the regress is vicious, and he may also be right in thinking that Broad has not shown that one must have a regress, rather than a circle involving time and meta-time. But, even if both points are granted, it seems to me that what really lies at the heart of Broad's argument is left untouched. Consider, for example, the statement that, in the year 1873, the birth of Bertrand Russell was an event that lay in the past. One wants to know what the logical grammar of that statement is. In particular, one wants to know whether one can take the statement as asserting that there is an intrinsic property of pastness, and that the event that is the birth of Russell had that property in 1873. As I in effect argued earlier—in Section 8.4.1—the first part of Broad's argument establishes that the latter interpretation leads to a contradiction. The birth of Russell, for example, could have an intrinsic property in the year 1873 only if it had a temporal part that lay in that year, and this it does not have. And if one then goes on to suggest, as Broad does, that the contradiction can be avoided by the postulation of meta-time, what one is really saying is that, if the expression 'the year 1873' is taken as referring, not to a stretch of time, but to a stretch of meta-time, then the contradiction disappears. But then one is not really providing an account of the logical grammar of the original statement. One is, instead, treating the original statement as logically hopeless, and suggesting a different sort of statement which will, one believes, be free of contradiction.

If this is right, then Broad's objection is a serious one. But what exactly is the scope of the objection? In the formulation offered in this section, I have talked about intrinsic properties of presentness and pastness. Does the objection have force only against tensed views that treat presentness and pastness as intrinsic properties of

[159] George N. Schlesinger, *Aspects of Time* (Indianapolis: Hackett Publishing Company, 1980,) 32.

events, or is it also applicable to approaches that claim that presentness and pastness are relational properties of events?

Can an event have different relational properties at different times, even if the event does not itself exist at different times? Not if the past, the present, and the future are all equally real. But if, on the other hand, the future is not real, then an event can have different relational properties at different times even if the event exists only for an instant. Thus, in the year 2005, an instantaneous event that occurs in the year 2000 will have the relational property of there being events that happen at least four years later, whereas, if the future is not real, the event cannot have that relational property in the year 2002.

The upshot is this. Once the postulation of a meta-time is seen for what it is—namely, as an admission of an inability to provide a coherent account of tensed statements as they stand—it becomes clear that Broad's argument is a powerful objection to a wide range of tensed views. Any tensed account that maintains that pastness and presentness are intrinsic properties of events falls prey to Broad's objection. It also applies, with equal force, to tensed accounts that hold, instead, that presentness and pastness are relational properties of events, but which maintain, in addition, that the past, the present, and the future are all real. It is only by denying the reality of the future, and holding that pastness and presentness are relational properties of events, that a tensed account can avoid the present objection.

10.4McTaggart's Argument

Among the most famous arguments in the philosophy of time is one advanced by J. M. E. McTaggart,[160] in which he attempted to show that time is unreal. His argument involved two parts. In the first, he argued that it is essential to the nature of time that events be objectively classifiable into past, present, and future. Then, in the second part, he argued that the idea that there are objective features of reality corresponding to the concepts of past, present,

[160] J. M. E. McTaggart, *The Nature of Existence,* ii (Cambridge: Cambridge University Press, 1927.) An earlier, but in some ways less satisfactory version of his argument can be found in his article 'The Unreality of Time', *Mind,* 17 (1908,) 457–74.

and future gives rise to a contradiction. If both arguments are sound, we are therefore forced to conclude that time cannot be real.

The structure of the first part of McTaggart's argument is as follows. He starts out from the premiss that 'there could be no time if nothing changed'.[161] Next, he argues that a Russellian account of change will not do. Change cannot, contrary to Russell,[162] be analysed as a matter of an entity's having different properties at different times: the world involves genuine change only if *events* undergo change.[163] But how can events change? McTaggart contends that events cannot come into existence or drop out of existence,[164] and thus that the only way in which they can change is with respect to their properties—either intrinsic or relational. It is impossible, however, for events to change with respect to tenseless properties. Therefore, the only way in which they can change is with respect to tensed properties.[165] But, if this is right, we have the following conclusion: time cannot exist unless events have tensed characteristics.

If this first part of McTaggart's argument is sound, it refutes tenseless approaches to time. But is it sound? This is a difficult issue, and one which I shall not pursue. It does seem to me that McTaggart, in asking why a poker's being hot at one time, and cold at another, should count as change, whereas one part's being hot, and another part's being cold, does not,[166] raises a crucial issue for tenseless approaches: why is difference along a temporal axis change, whereas difference along a spatial axis is not? But, while this is certainly an important challenge, it is far from clear that no satisfactory response is possible.[167]

Let us turn, then, to the second part of McTaggart's argument, which runs as follows. First, 'past, present, and future are incompatible determinations'.[168] If, for example, an event, *M,* lies in the past, it cannot lie either in the present or in the future. But, secondly, is it not also supposed to be the case that every event is past, present,

[161] McTaggart, *The Nature of Existence,* ii. 11.

[162] Bertrand Russell, *The Principles of Mathematics* (London: George Allen & Unwin, 1903,) 469–71.

[163] McTaggart, *The Nature of Existence,* ii. 15.

[164] Ibid. 12.

[165] Ibid. 13.

[166] Ibid. 15.

[167] For one answer to this challenge, see D. H. Mellor, *Real Time* (Cambridge: Cambridge University Press, 1981,) 9.

[168] McTaggart, *The Nature of Existence,* ii. 20.

and future, so that every event possesses all three of these incompatible characteristics? So it would seem that we are faced with a contradiction.

At first glance, however, it might seem that there is not really any problem here:

> It is never true, the answer will run, that *M is* present, past, and future. It *is* present, *will be* past, and *has been* future. Or it *is* past, and *has been* future and present, or again *is* future, and *will be* present and past. The characteristics are only incompatible when they are simultaneous, and there is no contradiction to this in the fact that each term has all of them successively.[169]

But this is not, McTaggart holds, the end of the matter; he argues that the suggested specification of the different times at which a given event possesses the incompatible tensed properties gives rise to precisely the same problem:

> Thus our first statement about *M*—that it is present, will be past, and has been future—means that *M* is present at a moment of present time, past at some moment of future time, and future at some moment of past time. But every moment, like every event, is both past, present, and future. And so a similar difficulty arises. If *M* is present, there is no moment of past time at which it is past. But the moments of future time, in which it is past, are equally moments of past time, in which it cannot be past. . . . And thus again we get a contradiction, since the moments at which *M* has any one of the three determinations of the *A* series are also moments at which it cannot have that determination.[170]

One can, of course, argue that what has just been said about events must also be said about moments—namely, that they do not have incompatible characteristics at a given time, but only successively. But the specification of the different moments at which a given moment has incompatible tensed characteristics gives rise, McTaggart argues, to a new, but precisely parallel contradiction. This sequence of move and countermove can then be repeated indefinitely, giving rise to an infinite regress. But this regress is, McTaggart holds, vicious, since one is left with a contradiction at every stage.

There has been considerable disagreement among philosophers, not only about the soundness of this second argument, but also

[169] Ibid. 21.

[170] Ibid.

about exactly what the argument is.[171] In particular, there are two interpretations that seem to me especially important—one offered by Mellor, and the other by Dummett—and it is these that I shall consider.

On Mellor's reading, McTaggart's argument turns upon the question of whether one can specify 'in *tensed* terms'[172] when events have the various tensed attributes, and the thrust of the argument is that such a tensed specification cannot be satisfactory, essentially because different tokens of the same tensed sentence, uttered at different times, will express different propositions.

So interpreted, there would seem to be a perfectly satisfactory response to McTaggart's argument—namely, that there is no way of justifying the demand that the time at which something has a given tensed attribute be specified in *tensed* terms. Why should it matter whether the time is specified in a tensed fashion, or a tenseless one? But, if it does not matter, then the restriction to a tensed specification is unjustified, and, once that restriction is dropped, the argument collapses—for there is no difficulty in specifying in *tenseless* terms the times at which an event has various tensed attributes.

This response is unavailable, of course, if one holds—as most advocates of a dynamic view of the nature of time do—that the relation of temporal priority must be analysed in terms of tensed properties, for then any specification, by means of dates, of when an entity has a tensed characteristic will ultimately be a tensed description. But not all tensed approaches to time hold that the relation of temporal priority is to be analysed in tensed terms. There are, for example, tensed approaches that hold that reality involves, on the one hand, a series of events, ordered by the unanalysable relation of temporal priority, and, on the other, a special property of presentness, which is constantly moving along

171 For some discussions of McTaggart's argument, see e.g. Donald C. Williams, 'The Myth of Passage', *Journal of Philosophy,* 48 (1951,) 457–72; Michael Dummett, 'A Defence of McTaggart's Proof of the Unreality of Time', *Philosophical Review;* 69 (1960,) 497–504, repr. in Dummett, *Truth and Other Enigmas* (Cambridge, Mass.: Harvard University Press, 1978,) 351–7; J. J. C. Smart, 'The River of Time', *Mind,* 58 (1949,) 483–94, repr. in A. G. N. Flew (ed.), *Essays in Conceptual Analysis* (London: Macmillan, 1963,) 213–27; J. N. Findlay, 'Time: A Treatment of Some Puzzles', in A. G. N. Flew (ed.), *Logic and Language,* first ser. (Oxford: Blackwell, 1951,) 37–54; and Broad, *Examination of McTaggart's Philosophy,* ii, pt. I.

172 D. H. Mellor, *Real Time* (Cambridge: Cambridge University Press, 1981,) 93. The emphasis is added.

that series of events. Given this sort of view, there is no problem about specifying, in tenseless terms, when an event has a tensed property. Nor is there any problem if one adopts the tensed approach that I am defending here.

The other, and very different interpretation of McTaggart's argument which I want to consider is that advanced by Michael Dummett.[173] His interpretation turns upon the idea that what really underlies McTaggart's argument is the view that 'there must be a complete description of reality; more properly, that of anything which is real, there must be a complete—that is, observer- independent—description'.[174] Given that assumption, Dummett argues that McTaggart's argument goes through. His reasoning is that a purely tenseless description of events leaves something out, since it fails to tell one what event is happening *now*.[175] If one is to capture the latter fact, one needs to employ tensed expressions. Dummett holds, however, that tensed expressions are token- reflexive, and so he concludes that 'what is in time cannot be fully described without token-reflexive expressions'.[176] As a consequence, 'if time were real, then, since what is temporal cannot be completely described without the use of token-reflexive expressions, there would be no such thing as the complete description of reality'.[177] Therefore, if a complete description of reality is possible, it follows that time is not real.

If this argument were sound, it would be a decisive objection to the present approach to the nature of time, given that the latter entails that there is a state of affairs that is the totality of what is actual. Dummett's argument, however, is unsound. To see why, consider any description of reality that would be complete *if* a tenseless view of time were correct, and let us ask whether anything can be added to such a description by means of tensed sentences that involve indexicals. The answer will depend upon how such sentences are interpreted. If they are interpreted in any of the ways adopted by advocates of a tenseless view of time, the answer is that nothing will be added to a description of reality that is complete in tenseless terms. The tenseless description will logically determine, for any token of an indexical tensed sentence, be it actual or possible, whether that token is, or would be, true or false. So any information that could be conveyed by indexical sentences, thus

173 Dummett, 'A Defence of McTaggart's Proof of the Unreality of Time'.

174 Ibid. 356.

175 Ibid. 354.

176 Ibid. 356.

177 Ibid.

interpreted, is implicitly contained in any tenseless description of reality that is complete from a tenseless point of view. Or, to put it in a slightly different way, if what Dummett calls an observer- dependent point of view is expressible through the use of indexical tensed sentences, where these are interpreted in a way compatible with a tenseless view of time, then any complete, observer- independent description of reality necessarily contains full information concerning every observer-dependent description of reality, both actual and possible.

Suppose, on the other hand, that indexical tensed sentences are interpreted in a way that is not compatible with a tenseless view of time—perhaps along the lines set out earlier. Then it will be true that a description of reality that would be complete given a tenseless view of time does *not* fix the truth-values of tokens of tensed sentences containing indexicals. From this, one might be tempted to conclude that, if a tensed view of time is correct, then, first, there are facts that can be described only by means of tensed sentences involving indexicals,[178] and therefore, secondly, a complete, observer-independent description of reality is not possible. But the view of time being defended here shows that neither conclusion is justified. If the future is not real, the sort of tenseless description of reality that would be complete if a static view of time were correct will certainly leave something out—namely, the central fact that the totality of tenseless states of affairs increases with the passage of time. To capture that fact, however, one need not employ tensed sentences involving indexicals: non-indexical ones will do just as well. Moreover, when any description of the world that would be complete, given a tenseless view of time, is supplemented by the addition of all true, *nonindexical* tensed sentences, the result will be a complete, observer- independent description of reality. Such a description, moreover, will logically fix the truth-values of all tokens, both actual and possible, of all tensed sentences that involve indexicals. So, even if a dynamic account of the nature of time is correct, there is no reason why there cannot be a complete, observer-independent description of reality that contains within itself complete information about every observer-dependent description, both actual and possible.

[178] Cf. Richard Swinburne, 'Tensed Facts', *American Philosophical Quarterly,* 27 (1990,) 117–30. See esp. pp. 125–7.

To sum up. McTaggart's argument can be interpreted in quite different ways. Two of the most important are Mellor's interpretation, according to which the problem is to specify, in tensed terms, when events have tensed characteristics, and Dummett's, the thrust of which is that the reality of time is incompatible with the existence of a complete, observer-independent description of reality. We have seen that neither argument succeeds against the type of tensed view that is being defended here.

10.5 Mellor's Arguments

In his book *Real Time* Hugh Mellor attempts to show that McTaggart's argument, properly understood, is not refuted by the objections that friends of tense have urged against it, and that, while not a proof of the unreality of time, it is indeed a proof of the unreality of tense. But Mellor also goes on to offer two further arguments in support of the unreality of tensed facts—arguments which I shall consider in the present section. In addition, Mellor has also discussed, in his article 'McTaggart, Fixity, and Coming True', Richard Jeffrey's espousal of the view that 'the world grows by accretion of facts',[179] and he has tried to show that this idea is untenable. I shall argue that Mellor's criticisms cannot be sustained, for a reason that is very closely related to the central problem with his other two arguments.

10.5.1 McTaggart's Argument and Token-Reflexive Truth Conditions

Mellor's first argument may be put as follows. If tense is real, so that there are tensed facts, then such facts will function as truth- makers for tensed statements. It is then crucial to ask, however, whether the resulting tensed truth conditions for tensed sentences are token-reflexive or not. Mellor argues that, either way, the consequences are unacceptable.

Suppose, first of all, that tensed facts supply non-token-reflexive truth conditions for tensed statements. Given that the truth conditions

[179] Richard Jeffrey, 'Coming True', in C. Diamond and J. Teichman (eds.), *Intention and Intentionality* (Ithaca, NY: Cornell University Press, 1979,) 251–60. See p. 253.

for a given token of a tensed sentence will not then involve any reference to the token in question, it follows that all tokens of the tensed sentence in question must have the same truth-value. But this, Mellor argues, is simply not the case. A 1942 utterance of 'World War II is over' is false, while a 1947 utterance of it is true. Different tokens of a single tensed sentence often have different truth-values, and, consequently, such sentences cannot have non- token-reflexive truth conditions, be they tensed or tenseless.

Suppose, on the other hand, that the tensed truth conditions for tensed sentences are token-reflexive. Mellor then argues that they in effect reduce to tenseless truth conditions. Consider, for example, the sentence 'The birth of David Hume lies in the past'. What would be the tensed truth conditions of tokens of that sentence? The natural tensed, token-reflexive answer is that a token is true if and only if the birth of David Hume lies in the past when the token lies in the present. But then, Mellor contends, the two tensed terms—'past' and 'present'—in what is being offered as a tensed, token-reflexive truth condition for the sentence in question do no work. What matters is not the supposedly tensed fact that the birth of David Hume lies in the past when a certain token lies in the present, but only the tenseless consequence of it—to wit, that the birth of David Hume is earlier than the token in question. So, if one tries to formulate token-reflexive tensed truth conditions, it turns out that the tensed conditions reduce to tenseless ones.[180]

Some advocates of a tensed view of time would challenge the first part of Mellor's argument, and maintain that the truth-value of a token of a tensed sentence does not depend upon the time of its occurrence. We saw in Section 8.3, however, that this contention cannot be sustained. Ordinary tensed sentences do involve indexicals.

Another objection to the first part of Mellor's argument, however, appears to be sound. It is that, even though tensed statements of the sort that are most frequently employed in ordinary discourse do involve indexicals, there is, as we have seen, another, more basic class of tensed statements that do not—statements such as 'Event *E* lies in the present at time *t*'.

Mellor's response at this point would presumably be, first, that such statements are not really tensed statements, since they are

[180] Mellor, *Real Time,* 98–101.

analytically equivalent to tenseless ones: to say, for example, that event *E* lies in the present at time *t* is just to say that it is simultaneous with *t*; and, secondly, that, even if one does classify such statements as tensed statements, the equivalence just noted means that they have tenseless truth conditions.

But this response is only satisfactory if the claim that such statements are analytically equivalent to tenseless statements can be sustained, and this, in turn, can only be done if there is no coherent, tensed account of the meaning of such statements, according to which the claimed equivalences do not obtain. I have argued, however, that to say that event *E* lies in the present at time *t* is to say more than that *E* is simultaneous with *t*, for it is also to say that no state of affairs that is later than *E* is actual as of time *t*. If, as I have argued, that analysis is coherent, the above response collapses, and with it, the first part of Mellor's argument.

The second part of Mellor's argument is exposed to essentially the same objection, since Mellor argues there that, if one attempts to offer token-reflexive truth conditions for a statement such as 'Event *E* is past' by saying that it is true just in case *E* is past when the token in question is present, the supposedly tensed truth condition in question reduces to the tenseless requirement that *E* is earlier than the relevant token. But, if tensed statements can be analysed in the manner proposed earlier, then it follows, as was argued in Section 7.4, that there is something that is immediately entailed by the tensed conditions, but not by the tenseless ones—namely, that the world is a dynamic one in which what is actual as of later times is not necessarily actual as of earlier times.

10.5.2 Mellor's Second Argument

Mellor concludes his case for the unreality of tense by offering the following, simpler argument:

> The sole function of tensed facts is to make tensed sentences and judgments true or false. But that job is already done by the tenseless facts that fix the truth-values of all tensed sentence and judgment tokens. Provided a token of '*e* is past' is later than *e*, it is true. Nothing else about *e* and it matters a jot: in particular, no tensed fact about them matters. It is immaterial, for a start, where *e* and the token are in the A series; and if that is not material, no more *recherché* tensed fact can be. Similarly for tokens of all other tensed types. Their tenseless truth conditions leave tensed facts no

> scope for determining their truth-values. But these facts by definition determine their truth-values. So in reality there are no such facts.[181]

This argument rests on the same assumption, and thus can be answered in the same way, as the previous argument. *If* there were no coherent alternative to a tenseless account of the truth conditions of tokens of tensed sentences, then it would be true that the only thing that matters with respect to the determination of the truth-value of a token of '*e* is past' is whether that token is later than *e*. But there is, I have argued, a coherent alternative, and it is one that entails that something else does matter—namely, whether a certain tenseless statement has the truth-value, indeterminacy, at the time in question. That in turn depends upon whether tenseless facts are, or are not, time-dependent.

One might put the matter this way. Let us suppose that there could be a tenseless temporal world—that is, a world where events stand in the relations of temporal priority and simultaneity, but where there are neither special tensed properties, nor any ontological gulf with respect to past, present, or future. In such a world, a token of '*e* is past' that is later than *e* would be true on a tenseless account of its truth conditions, but false on the account that I have offered—for in such a world it is not indeterminate at any time *t* that there is anything later than *t*.

If the argument developed in Chapter 4 is correct, a tenseless world must be one without causally related events. But then, if, as Mellor holds, and as I have argued in Chapter 9, temporal priority is to be analysed in terms of causal priority, it follows that tenseless temporal worlds are logically impossible. In the present context, however, it does not matter whether or not this is the case. If tenseless temporal worlds are impossible, then all tenseless accounts of the nature of time are ruled out, while, if tenseless temporal worlds are possible, then such worlds illustrate, in a vivid way, precisely what it is that tenseless accounts of the truth conditions of tensed statements fail to capture.

10.5.3Mellor and the Concept of Coming True

It is in his book *Real Time* that Mellor both develops his own approach in a detailed way, and sets out, in a careful and extended fashion, his central arguments against a tensed account of the nature

[181] Mellor, *Real Time,* 102.

of time. In an article published in the same year, however, Mellor, in addition to covering some of the same ground in briefer fashion, also goes on to criticize two recent writers who have embraced tensed views—John Mackie, who appealed to the idea of events' becoming fixed, and Richard Jeffrey, who set out a formal semantics dealing with statements about propositions' coming true.

Let us take a brief look, then, at Mellor's criticism of Jeffrey. Mellor focuses upon Jeffrey's contentions that events happen, and that propositions come to pass, and he asks what sense can be made of these notions. In response, he argues, first, that one can certainly offer simple relational accounts of what it is for an event to have occurred, and for a proposition to have come to pass. Thus, let E be any event, and let p be the proposition that E happened at time t. Then it is true that E happened at time t just in case E is simultaneous with t; similarly, the proposition that p comes to pass at time t is true just in case E is simultaneous with t. Jeffrey, however, cannot accept these reductive analyses, since to do so would mean that his theory was in no way incompatible with a tenseless view of time. The question, therefore, is whether alternative accounts of events' happening, and of propositions' coming to pass, can be given. Mellor's answer is that they cannot: such accounts would be possible only if there were 'real non-relational properties' that events acquire at the time of their occurrence, and, Mellor argues, the idea that there are such non-relational properties is untenable.[182]

Mellor's argument against the existence of such non-relational properties of events is not spelled out quite as fully as it might be, but it appears to be this. Given that the required properties must be *non-relational,* any sentences attributing them to events will refer to the events in question, but not to any times. So we need to consider, not sentences such as 'E happened at time t', but sentences such as 'E has happened'. But the latter sentences are obviously indexical, and the truth-values of any tokens are necessarily fixed by the relation between E's date and the date of the token. There is no room, therefore, for the truth of such judgements to be fixed by the possession, by events, of non-relational properties.[183]

[182] D. H. Mellor, 'McTaggart, Fixity, and Coming True', in R. Healey (ed.), *Reduction, Time and Reality* (Cambridge: Cambridge University Press, 1981,) 79–97. See pp. 91–5.

[183] Ibid. 95.

What I take to be the right response to this argument will be clear, given the preceding discussion of Mellor's other arguments. The basic point is that, if one wishes to hold, for example, that the sentence '*E* happened at time *t*' is not to be analysed in terms of '*E* is simultaneous with *t*', one is not forced, contrary to Mellor's contention, to postulate the existence of non-relational properties of events. If one is willing—as Jeffrey is—to hold that 'the world grows by accretion of facts',[184] then it is not only possible, but very natural, to explain the truth conditions of '*E* happened at time *t*' in terms of a *relational* property that an event lacks at the time of its occurrence, but then immediately acquires—the property, namely, of there being something later than it. Tensed sentences such as '*E* happened at time *t*' can be analysed, in short, using the ideas set out in Chapter 7, and when that is done, no non-relational properties of events need to be postulated.

[184] Jeffrey, 'Coming True', 253.

11 The Special Theory of Relativity and the Unreality of the Future

The previous chapter focused upon purely philosophical objections to the approach to time being defended here. In this chapter I shall turn to the objection that such a view of time, even if it manages to avoid all conceptual problems, is still unacceptable, since it conflicts with a very well-established scientific theory—namely, Einstein's Special Theory of Relativity.

11.1 The Special Theory of Relativity, and the Unreality of the Future: The Challenge

At least two quite different types of argument can be set out, based upon the Special Theory of Relativity, against the view that, while the past and the present are real, the future is not. One involves trying to show that the Special Theory of Relativity, when combined with one or more, additional, supposedly plausible assumptions, entails the conclusion that the ontological status of the future does not differ from that of the present or the past: all events—past, present, and future—are real. This type of argument is set out by Robert Weingard in his article ‘Relativity and the Reality of Past and Future Events’,[185] by C. W. Rietdijk in ‘A Rigorous Proof of Determinism Derived from the Special Theory of Relativity’,[186] and by Hilary Putnam in his article ‘Time and Physical Geometry’.[187]

[185] Robert Weingard, ‘Relativity and the Reality of Past and Future Events’, *British Journal for the Philosophy of Science,* 23 (1972,) 119–21.

[186] C. W. Rietdijk, ‘A Rigorous Proof of Determinism Derived from the Special Theory of Relativity’, *Philosophy of Science,* 33 (1966,) 341–4.

[187] Hilary Putnam, ‘Time and Physical Geometry’, *Journal of Philosophy,* 64/8 (1967,) 240–7.

Slightly different auxiliary assumptions can be employed, but in the case of Putnam and Rietdijk the additional premiss is roughly that, if two events are simultaneous relative to some frame of reference, then, if the one event is real, so is the other: reality is, so to speak, transmitted via the relation of simultaneity relative to a frame of reference.[188] The essential idea is then that, if E and F are any two events, then either there is some frame of reference relative to which E is simultaneous with F, or, alternatively, F, say, is in the future light cone of E, in which case there will be an event S that is simultaneous with E relative to one frame of reference, and simultaneous with F relative to another frame of reference. In either case, it follows that E is real if and only if F is also real.

The second type of argument is also found in Putnam, and may be put as follows. Suppose that there were an ontological gulf between the past and the present, on the one hand, and the future on the other, and where, moreover, this is a universe-wide division between what is already real, and what is not yet real, rather than one that is different for any two distinct spatiotemporal locations. The relation of absolute simultaneity would then be definable: two events are simultaneous if and only if there is some spatiotemporal location at which it is true that both events lie in the present. The Special Theory of Relativity, however, does not involve the postulation of a relation of absolute simultaneity. Quite the contrary, the only simultaneity relations definable within standard formulations of the Special Theory are those of simultaneity relative to a frame of reference.[189] The Special Theory of Relativity, however, is a very well-confirmed scientific theory. Moreover, there is no reason at all for thinking that a more adequate theory could be generated by postulating, in addition, a relation of absolute simultaneity. So the situation is this. The view that the future is not real, while the present is, commits one to postulating a relation for whose existence there is no empirical evidence. Other things being equal, however, simpler theories are to be preferred. The idea that there is an ontological gulf between the past and present, on the one

[188] Hilary Putnam, 200–1, and Rietdijk, 'A Rigorous Proof', 341, 343. Putnam also offers a second, somewhat more general version of this type of argument, but the issues raised are really the same. See Putnam, 'Time and Physical Geometry', 198–9.

[189] David Malament, 'Causal Theories of Time and the Conventionality of Simultaneity', *Noûs,* 11 (1977,) 293–300. Malament's discussion will be considered in Sect. 11.5.2.

hand, and the future, on the other, should therefore be rejected in favour of the view that the Special Theory of Relativity provides us with a complete account of all of the spatiotemporal relations that there are in the world.

11.2 Possible Responses

How should one respond to the above objections? One possibility is set out by Howard Stein in his discussion of the arguments advanced by Putnam and Rietdijk. Stein points out that a person who wants to deny that future events are real, but who believes that the Special Theory of Relativity forces one to abandon the idea of absolute simultaneity, can always adopt the view, first, that what events are real is relative to *spatiotemporal locations,* rather than to *times,* and, secondly, that what is real as of a given time and place consists of the events at that time and place, together with the events in the past light cone.[190]

Stein's proposal is an interesting metaphysical alternative, and it does show that there is no hope of *proving,* on the basis of the Special Theory of Relativity, that all events—past, present, and future—are real. So the first of the above arguments cannot possibly succeed. In addition, if one shifts from the view being defended here, to Stein's alternative metaphysics, one escapes the second argument as well, while still holding that the world is a dynamic one in which the future is not real.

Stein's response is not, however, the one that I wish to adopt—principally for two reasons. First, it is unclear what status should be assigned to events that lie outside the past and future light cones of a given spatiotemporal location. Stein adopts the view that such events are not real as of the time and place in question. But why not hold instead that such events are real, and that it is only events lying inside the future light cone that are not real? It is hard to see how this issue can be resolved, and, if so, that seems unsatisfactory.[191]

Secondly, on the view that I am defending, the present is distinguished ontologically by being the time at which things come into

[190] Howard Stein, 'On Einstein–Minkowski Space-Time', *Journal of Philosophy,* 65 (1968,) 5–23. See p. 14.

[191] For some interesting discussion of this and related issues, see Paul Fitzgerald, 'The Truth about Tomorrow's Sea Fight', *Journal of Philosophy,* 66 (1969,) 307–29, esp. pp. 321ff.

existence. On Stein's proposal, however, this is not so, since, as one moves forward along any given world-line, more and more events are included within the relevant past light cones. The vast majority of events that become real for one at any given time and place, therefore, are not present events, but past events—some of them extremely remote. So statements about the past can be true at a given point on a particular world-line even though no corresponding present-tense statements have ever been true at any point on that world-line. This consequence is, I suggest, one to be avoided, if possible.

But what alternative is there to Stein's response? One obvious possibility is to challenge the Special Theory of Relativity itself—or, at least, standard formulations of it. That would involve arguing either that the Special Theory of Relativity is false, or, alternatively, that a superior theory can be constructed whose predictive and explanatory power will be at least as great as the Special Theory of Relativity, but which will diverge in entailing that events in our world do stand in relations of absolute simultaneity. But both of these are drastic measures, so it might well seem that one should surely seek some other, less heroic way of countering the above arguments.

In the case of the first argument, a less dramatic response is certainly possible, since one can challenge—successfully, I believe—the auxiliary assumption. When it comes to the second argument, however, there is no alternative to a direct challenge to the Special Theory of Relativity. The tensed view in question is committed to the existence of absolute simultaneity—a relation that does not enter into the Special Theory of Relativity, and for which, on the face of it, there is no empirical evidence. So, if one is to hold that the future is not real, while the past and present are, one must be prepared to argue that the Special Theory of Relativity does not provide a complete account of the spatiotemporal relations that obtain between events.

11.3 A Defence of Absolute Simultaneity: The Basic Strategy

The goal, accordingly, is to defend the claim that events in our world do stand in relations of absolute simultaneity. Let me begin by sketching, then, my basic line of argument. First, I shall argue that the concept of absolute simultaneity is definable within the Special Theory of Relativity. Or rather, it is definable within any version that meets two conditions. The first is that space-time is not viewed as reducible to spatiotemporal relations between events. The second is that the theory incorporates the idea of causal relations.

Definability of a concept is, of course, one thing, and the existence of anything corresponding to that concept quite another. So the fact that absolute simultaneity is definable within the Special Theory of Relativity does not mean that the latter entails that some events are absolutely simultaneous. Indeed, the Special Theory of Relativity entails nothing of the sort. But what about a modified theory? Can one construct a theory which is closely related to the Special Theory of Relativity, and which does entail that events stand in relations of absolute simultaneity? If that is possible, can one offer reasons for preferring the modified theory?

The former question brings me to the second main claim that I wish to defend—namely, that it is possible to modify standard formulations of the Special Theory of Relativity to produce theories with the desired entailment. I shall support this claim by showing, in a detailed way, how this can be done for the type of formulation offered by Einstein in 1905. But other formulations of the Special Theory of Relativity can equally well be modified to produce equivalent theories.

In the case of Einstein's 1905 formulation, the modified theory can be arrived at in three steps. First, one shifts to a more modest formulation of the Special Theory of Relativity, of what is known as an ∈-Lorentz sort, in which the assumption that the one-way speed of light is the same in all inertial frames is jettisoned in favour of the weaker assumption that the average round-trip speed of light is the same in all inertial systems. Secondly, one adds additional postulates that entail, among other things, that the relation of being in the same location at different times, and the relation of absolute simultaneity, do exist in our world, and that light has a fixed velocity relative to absolute space. Thirdly, given these additional postulates, one no longer needs the postulate that the measured, average round-trip speed of light is the same in all directions within all inertial systems, as this is entailed by the rest of the theory.

If such a modified theory based upon the Special Theory of Relativity is possible, the second question arises. Are there any reasons for thinking that the modified theory is preferable to the Special Theory of Relativity, and thus for thinking that our world really is one where events do stand in the relation of absolute simultaneity? My third thesis is that there are. More specifically, I shall argue that the modified theory is superior in at least three ways. First, if an absolute, or realist view of space-time is adopted, then there are states of affairs for which the Special Theory of Relativity specifies no causes, but the modified theory does. The predictive and explanatory power of the modified theory is, accordingly, greater than that of the Special Theory of Relativity. Secondly, the modified theory avoids an assumption that is made by standard formulations of the Special Theory of Relativity, but which has no experimental support, and which may even be untestable in principle—the assumption, namely, that the measured one-way speed of light is a constant in all directions in all inertial frames. Thirdly, the experimental results connected with Bell's Theorem in quantum mechanics, and, more generally, an issue posed by the idea of the collapse of wave packets, provide grounds for holding that the Special Theory of Relativity is incomplete, and that, specifically, the world must involve a relation of absolute simultaneity.

11.4 Absolute Simultaneity and the Special Theory of Relativity

Can the programme just sketched be carried out? In this section, I shall attempt to show that it can be.

11.4.1 The Definability of Absolute Simultaneity

Let us begin, then, with the question of definability. It is often thought, I believe, that the concept of absolute simultaneity is not even *definable* within the Special Theory of Relativity.[192] I shall show, however, that this is not so, and that, given any formulation of the Special Theory of Relativity that involves both an ontology

[192] Cf. Malament, 'Causal Theories of Time and the Conventionality of Simultaneity'.

of space-time points and the relation of causation, the concept of absolute simultaneity can be defined, in the following way. First, one needs the relativistic notion of two events' being simultaneous relative to a given frame of reference. This notion can be defined in a number of slightly different, but equivalent ways. One common method involves the idea of synchronizing clocks in other locations with a clock at rest at the origin of the frame of reference in question.[193] This synchronization, in turn, might be done either by the method of 'infinitely slow' transport of a clock from one location to the other, or, alternatively, by means of light signals.

The latter method, the one most commonly employed in expositions of the Special Theory of Relativity, is as follows. Let C and D be clocks, in different locations, that are at rest relative to some frame of reference, F. Suppose, further, that a light signal, travelling through a vacuum, is sent out from clock C, arrives at clock D, and is immediately reflected back to clock C. If t_1 and t_2 are, respectively, the times at which the signal left clock C, and then arrived back, as measured by clock C, while t^* is the time, as measured by clock D, when the signal arrived there, then the standard method of signal synchrony involves synchronizing clocks C and D by equating time t^* on clock D with the moment that is exactly halfway between times t_1 and t_2 on clock C.

Given this method of synchronizing clocks, one can then say that two events E_1 and E_2 are simultaneous relative to frame of reference F if and only if it is the case that, if there were clocks, D_1 and D_2, in the vicinity of E_1 and E_2 respectively, both of which were at rest within frame F, and both of which had been synchronized with an appropriate clock in that frame, then the time of occurrence of E_1, as measured by D_1, would be the same as that of E_2, as measured by D_2.

193 An alternative approach to the definition of simultaneity relative to a frame which has less of an operationalist flavour, and which may well seem preferable, makes use of optical parallelograms, and was set out by Alfred A. Robb in *A Theory of Time and Space* (Cambridge: Cambridge University Press, 1914). A more accessible account is found in his later work, *The Absolute Relations of Time and Space* (Cambridge: Cambridge University Press, 1921;) for a very clear introduction to Robb's approach, see John A. Winnie, 'The Causal Theory of Space-Time', in John Earman, Clark Glymour, and John Stachel (eds.), *Foundations of Space-Time Theories* (Minnesota Studies in the Philosophy of Science, 8; Minneapolis: University of Minnesota Press, 1977), 134–205.

An important issue arises, however, at this point. When two clocks are synchronized by means of a light signal, why should the time at which the light signal arrives at clock *D,* and is reflected back, be equated with the moment that is precisely *halfway* between the time at which the signal leaves *C,* and the time at which it arrives back there, rather than with some other instant between the latter two times? This procedure is justified, it would seem, if and only if light travels with the same speed in both directions, relative to frame of reference *F,* for then and only then will it take the same time for the signal to travel from *C* to *D* as it does to return. But what justification, if any, is there for thinking that the speed of light is the same in all directions, in all inertial frames? If there is none, then surely there is something unsatisfactory about standard formulations of the Special Theory of Relativity, since they assume that the one-way speed of light is a constant in all inertial frames.

I shall consider this issue later. For the moment, let us return to the question of the definability of absolute simultaneity within the Special Theory of Relativity. The basic idea is that, given some standard definition of simultaneity relative to a frame of reference, one can define absolute simultaneity as simultaneity relative to certain privileged frames of references—namely, those that are at rest relative to absolute space. But how is the latter notion to be defined? What does it mean to say that something is at rest relative to absolute space?

One can arrive at a very natural answer to this question as follows. First, space-time points are contingent entities, rather than necessarily existent ones, since the existence of a given space-time point entails *empirical* possibilities with regard to the location of physical objects and events. Secondly, given that space-time points are contingent entities, one would very much like to be able to explain their existence. Otherwise the fact that there is an actual space-time point at every one of the non-denumerably many logically possible locations in the future light cone of a given space- time point is a brute fact that represents an extraordinarily improbable state of affairs. Thirdly, it is hard to see what alternative there is to the hypothesis that the existence of a given space- time point is to be explained by its having been caused by the existence of an earlier space-time point. But, if this is so, the question arises as to the structure of the causal relations involved. In particular, are the causal chains connecting space-time points branching chains, or non-branching ones?

The possibility that the causal chains in question are non- branching ones suggests that one can define the concept of sameness of location at different times, and then the concept of absolute simultaneity, along the following lines:

> Distinct space-time points *S* and *T* are in the same location

means the same as

> Either the existence of *S* causes the existence of *T,* or the existence of *T* causes the existence of *S,* and the following principle is true:

> The Principle of the Parallel, Non-Branching
> Conservation of Space
>
> (1) Every space-time point is such that its existence is a cause of the existence of at least one other space-time point.
> (2) Every space-time point is such that its existence is caused by the existence of at least one other space-time point.
> (3) If *P* and *Q* are any two causally connected space-time points and *S* is any other space-time point on the line determined by *P* and *Q,* then the existence of *S* is causally connected both with the existence of *P* and with the existence of *Q.*
> (4) If *P, Q, R,* and *S* are any four space-time points such that the existence of *P* causes the existence of *Q,* and the existence of *R* causes the existence of *S,* then the line defined by *P* and *Q* is parallel to the line defined by *R* and *S.*

Clauses (1) and (2) capture the general idea that space is an enduring entity, while clause (3) imposes the requirement that all space-time points on any line containing two causally connected space-time points must also be causally connected, so that there is no causal gappiness. Finally, clause (4) ensures that appropriate betweenness and congruence relations are preserved, and that the causal relations involved in the continuing existence of space are non-branching ones, with the result that what one has is a strict *conservation* of space. The idea of absolute simultaneity can then be defined as follows:

> Two events, *E* and *F,* are *absolutely simultaneous*

means the same as

E and F are simultaneous relative to some frame of reference that is at rest with respect to absolute space—that is, which is such that no part of it is ever in different spatial locations at different times.

11.4.2 A Modified Theory Based Upon the Special Theory of Relativity

Absolute simultaneity is definable, then, within any formulation of the Special Theory of Relativity which involves the concept of causation, and which does not reduce space-time points to spatiotemporal relations between events. The fact that the concept is thus definable provides no reason, of course, for thinking that the world contains anything corresponding to that concept. Moreover, standard formulations of the Special Theory of Relativity certainly do not entail that events stand in relations of absolute simultaneity. The crucial questions, accordingly, are whether it is possible to modify the Special Theory of Relativity to produce a theory that does entail that events stand in relations of absolute simultaneity, and, if so, whether such a modification can be justified.

My second thesis is that such a modification is possible, and the basic idea will probably be readily apparent at this point. Given the above definition of absolute simultaneity, the crucial ingredient is the proposition that space-time points are causally related in the way specified by the Principle of the Parallel, Non-Branching Conservation of Space, and so the root idea is that, by combining the Special Theory of Relativity with the latter principle, one will have a theory that entails that absolute simultaneity is a relation that is present in the world.

Such is the essential idea. There is, however, a problem, which arises as follows. Absolute simultaneity has been defined as simultaneity relative to certain privileged inertial frames—namely, those at rest in absolute space. Relative simultaneity, in turn, is defined in some familiar way, such as in terms of standard signal synchrony. But then, if the account of absolute simultaneity is to capture the intended concept, it must be the case, if standard signal synchrony is used to define relative simultaneity, that the speed of light is the same in all directions relative to any frame at rest in absolute space. Is there any reason for holding that that is so?

I believe that there is. I think that it is plausible to postulate that, when light travels through a vacuum, it is space itself that is the medium of transmission. Historically, of course, the dominant view was that the medium of transmission was a rather ethereal substance. But the postulation of the ether seems to me both to be unnecessary, and to reflect a mistaken conception of space—for one idea that seems to have been lurking when it was thought necessary to postulate the ether is that space itself consists of nothing other than empirical possibilities with respect to the existence of physical objects and events. The issue that confronts such a conception of space, however, is whether there can be empirical possibilities that have no categorical bases. If, as I believe, this is not possible, then the question arises as to what the relevant categorical basis is. If space is something whose existence does not presuppose the existence of physical objects and/or events, the only plausible answer would seem to be that the relevant categorical states of affairs must consist of the possession of non-dispositional properties by *space-time points themselves*. But, then, given a conception of space according to which it involves categorical properties itself, it is no longer necessary to postulate the existence of an ether. Space itself can perfectly well serve as the medium through which light is transmitted, and it then seems plausible to hold that the speed of light is a constant relative to absolute space.

In itself, this conclusion is welcome. If there are grounds for holding that the speed of light is a constant in all directions, relative to absolute space, then there is reason for thinking that the above account of absolute simultaneity is sound. But the above argument also shows that one needs to add *two* things to standard formulations of the Special Theory of Relativity in order to get an account that has the desired entailment—namely, the Principle of the Parallel, Non-Branching Conservation of Space, *and* the claim that the speed of light is a constant relative to absolute space. The second addition, however, generates a problem—namely, what guarantee is there that the resulting theory is *consistent*? Indeed, is there not a reason for thinking that the theory is not consistent? If the speed of light, in all directions, is a constant relative to absolute space, then surely it cannot be a constant, in all directions, relative to *all* inertial frames, since, in any inertial frame that is not at rest with respect to absolute space, the speed of light relative to that frame will have to be greater for light that is moving through absolute space in the opposite direction to that of the frame than for light that is moving in the same direction as the frame. It is, however, a fundamental postulate of the Special Theory of Relativity that the speed of light is the same in all directions, in *all* inertial frames. So one has a contradiction.

The argument, in short, is this. In order to have a theory that entails that the relation of absolute simultaneity does hold between events, one must add, to the Special Theory of Relativity, not only the Principle of the Parallel, Non-Branching Conservation of Space, but also the Principle of the Constancy of the Speed of Light Relative to Absolute Space. The resulting theory, however, is logically inconsistent.

This argument is sound as far as it goes. That is to say, it will not do simply to add the two principles in question to standard formulations of the Special Theory of Relativity: the result is an inconsistent theory. But it would be a mistake to conclude from this that the idea of constructing a modified theory which will entail that absolute simultaneity is a relation that obtains between events in the world does not work. The conclusion is merely that, if one is to formulate such a modified theory, one must also *eliminate* some- thing from any standard formulation of the Special Theory of Relativity, so that the resulting theory does not entail that the one-way speed of light is a constant in all directions in all inertial frames. The questions, accordingly, are whether such a cutting-back is possible, and, if so, whether it is justified. I shall argue that there are excellent reasons for answering both of these questions in the affirmative.

The natural place to begin is with Einstein, and his original, 1905 formulation of the Special Theory. There, Einstein explicitly assumed that the one-way speed of light is a constant in all inertial frames. He did not, however, view that postulate as one for which there was experimental evidence. His position was rather that, while there is evidence for the assumption that the *round-trip* speed of light in a vacuum is a universal constant, the further postulate that the time taken for light to travel between two locations is the same in both directions is instead something which one establishes as true '*by definition*'.[194] On Einstein's own approach, therefore, it is

[194] Albert Einstein, 'On the Electrodynamics of Moving Bodies', in H. A. Lorentz, A. Einstein, H. Minkowski, and H. Weyl, *The Principle of Relativity* (London: Methuen, 1923,) 37–65, at p. 40. The emphasis is in the original.

simply a matter of convention that the *one-way* speed of light in a vacuum is a constant.[195]

This idea that one can view it as true by definition that the oneway speed of light is a constant is a rather jarring one, and has given rise to a controversy that is still not yet fully resolved. Thus, on the one hand, a number of philosophers, starting with Hans Reichenbach, have strongly defended the view that the non- conventional content of the Special Theory of Relativity precludes any experiment that could be used to determine whether the oneway speed of light is in fact a constant.[196] But, on the other hand, a number of proposals have been advanced, and continue to be advanced, by physicists and others, concerning experiments that could be carried out to determine the one-way speed of light. The experiments proposed so far, however, all seem to be flawed, for, upon close scrutiny, all of the experiments appear to involve some principle or other that is true only if the one-way speed of light is a constant, and, if this is right, then none of the experiments proposed so far can possibly result in a value for the one-way speed of light which differs from that of the average round-trip speed.[197]

[195] The same is true in the case of the very different formulation of the Special Theory of Relativity offered by A. A. Robb, for the definitions of congruence that Robb offers, first, for segments of spacelike lines and, secondly, for segments of timelike lines, entail that the one-way speed of light is a constant. See e.g. *The Absolute Relations of Time and Space,* 56–61.

[196] Among the more important philosophical discussions of this issue are the following: Hans Reichenbach, *Axiomatization of the Theory of Relativity* (Berkeley and Los Angeles: University of California Press, 1969)a translation of *Axiomatik der relativistischen Raum-Zeit-Lehre* (Brunswick: F. Vieweg & Sohn, 1924)—and *The Philosophy of Space and Time* (New York: Dover Books, 1957) —a translation of *Philosophie der Raum-Zeit-Lehre* (Berlin: W. de Gruyter & Co., 1928); Adolf Grünbaum, 'Logical and Philosophical Foundations of the Special Theory of Relativity', in Arthur Danto and Sydney Morgenbesser (eds.), *Philosophy of Science* (New York: Meridian Books, 1960,) 399–434, and *Philosophical Problems of Space and Time* (2nd edn., Dordrect: D. Reidel, 1973;) John A. Winnie, 'Special Relativity without One-Way Velocity Assumptions', *Philosophy of Science,* 37 (1970,) 81–99, 223–38; Wesley C. Salmon, 'The Conventionality of Simultaneity', *Philosophy of Science,* 36 (1969), 44–63, and 'The Philosophical Significance of the One-Way Speed of Light', *Noûs,* 11 (1977,) 253–92.

[197] A description of a number of proposals, together with criticisms of them, can be found in Salmon's article, 'The Philosophical Significance of the One-Way Speed of Light'. For more recent proposals, see e.g. Charles Nissim-Sabat, 'A Gedankenexperiment to Measure the One-Way Velocity of Light', *British Journal for the Philosophy of Science,* 35 (1984,) 62–4, and George Stolakis, 'Against Conventionalism in Physics', *British Journal for the Philosophy of Science,* 37 (1986,) 229–32. Nissim-Sadat's proposal is criticized by John Norton, 'The Quest for the One Way Velocity of Light', *British Journal for the Philosophy of Science,* 37 (1986,) 118–20, and by Peter Øhrstrøm in 'Nissim-Sabat on the One-Way Velocity of Light', *British Journal for the Philosophy of Science,* 37 (1986,) 120–2. For criticisms of Stolakis's proposal, see Vesselin Petkov, 'Simultaneity, Conventionality and Existence', *British Journal for the Philosophy of Science,* 40 (1989,) 69–76, and W. T. Morris, 'Conventionalism in Physics', *British Journal for the Philosophy of Science,* 40 (1989,) 135–6.

The situation is a rather curious one. What is the explanation of this apparently unbroken series of sometimes quite ingenious, but unsuccessful attempts to design an experiment to determine the one-way speed of light? One possibility that naturally suggests itself is that the Special Theory of Relativity somehow entails that such an experiment is impossible. This conclusion is strongly reinforced, moreover, by an argument advanced by John Winnie, which, though not completely general, appears very close to a proof that versions of the Special Theory of Relativity that incorporate different assumptions about the one-way speed of light must be '*kinematically equivalent*', so that any kinematical experiment that disconfirmed one version of the theory would disconfirm every version.[198]

It would be nice, for my present purposes, if one could state unequivocally that an impossibility proof was at hand. But that is not crucial. What is crucial is simply that there is no experimental evidence for the assumption that the one-way speed of light is a constant in all inertial claims. Given that that is so, there is no barrier to jettisoning that assumption, and advancing a modified theory that has no such implication.

How will such a modified theory differ from the Special Theory of Relativity? One of the most conspicuous differences will be with respect to the standard Lorentz transformations—the equations for translating an event's spatiotemporal coordinates relative to one inertial frame into coordinates relative to another inertial frame—for derivations of the Lorentz transformations depend upon the assumption that the one-way speed of light is a constant in all inertial frames. Thus, intimately associated though they are with the Special Theory of Relativity, the standard Lorentz transformations are not valid in a theory where the latter assumption is dropped.

[198] Winnie, 'Special Relativity without One-Way Velocity Assumptions', 236–7.

What one will have, instead, are what have been referred to as '∈-Lorentz transformations'. These latter transformations are more general than the standard Lorentz transformations, for they contain a variable term—'∈'—that can be assigned different values, between zero and one, corresponding to different assumptions concerning the relevant one-way speed of light.[199] More precisely, if '$c+$' is the one-way speed of light in the positive direction along the relevant axis, and c' is the round-trip speed of light, then the value of ∈ is equal to the ratio $c/2c+$. So, if the relevant one-way speed of light is equal to the average round-trip speed, ∈ will be equal to one-half, and the substitution of this value for ∈ in the general ∈-Lorentz transformations will give rise to the standard Lorentz transformations.

The task of formulating a modified version of the Special Theory of Relativity that will entail the generalized ∈-Lorentz transformations, rather than the standard Lorentz transformations, was addressed several years ago by John Winnie, in his article 'Special Relativity Without One-Way Velocity Assumptions'. Winnie's approach was to consider principles that have been used to formulate standard versions of the Special Theory of Relativity, and then to ask how those principles could be modified to eliminate the assumption that the one-way speed of light is a constant in all inertial frames. More specifically, Winnie focused upon approaches that appeal to the principles that he refers to as the *One-Way Light Principle* and the *Special Relativity Principle*. The first of these is straightforward: it simply asserts that the one-way speed of light is a constant in all directions in all inertial frames. The situation is a little more complicated, however, with regard to the second of these principles. Initially, the second principle seems reasonably clear. For, as formulated by Einstein, it is simply this:

> If, relative to *K*, *K*' is a uniformly moving co-ordinate system devoid of rotation, then natural phenomena run their course with respect to *K*' according to exactly the same general laws as with respect to *K*.[200]

[199] The useful '∈' notation was introduced by Hans Reichenbach. See e.g. *The Philosophy of Space and Time,* 127.

[200] Albert Einstein, *Relativity: The Special and General Theory* (New York: Crown, 1961,) 13. Cited by Winnie, 'Special Relativity without One-Way Velocity Assumptions', 229.

But the problem is that this principle is frequently appealed to in support of other claims that do not appear to follow from it. Thus, as Winnie points out, both of the following principles have been advanced on the basis of the Special Relativity Principle:

The Principle of the Reciprocity of Relative Velocities

> If inertial frame *K*' has a relative velocity *v* with respect to inertial frame *K,* then frame *K* has a relative velocity − *v* with respect to frame *K*'.

The Principle of the Reciprocity of Relative Lengths

> Given two inertial frames *K* and *K*' in relative motion and standard orientation, then the length in *K* of a rod *s* units long in *K*' is equal to the length in *K*' of a rod *s* units long in *K*—provided that both rods have the same orientation in their respective rest-frames.[201]

It is, moreover, principles such as the latter two that play a crucial role in standard formulations of the Special Theory of Relativity. Einstein, for example, appeals to the Principle of the Reciprocity of Relative Lengths in one of the derivations that he offers of the Lorentz transformations.[202] In formulating a modified version of the Special Theory of Relativity, it may be a sound strategy, therefore, to look for alternatives to the latter principles.

Winnie's own proposals are as follows. First, the One-Way Light Principle has to be abandoned, and the most natural idea is simply to replace it by a corresponding principle dealing with the round- trip speed of light as measured within a given frame of reference—a principle for which there is experimental support:

1. The Round-Trip Light Principle

> The average round-trip speed of any light-signal propagated (*in vacuo*) in a closed path is equal to a constant *c* in all inertial frames of reference.[203]

Secondly, as Winnie shows, both the Principle of the Reciprocity of Relative Velocities and the Principle of the Reciprocity of Relative Lengths must be dropped, since they hold only if the one-way

201 Winnie, 'Special Relativity without One-Way Velocity Assumptions', 229–30.

202 Einstein, *Relativity: The Special and General Theory,* 117–18.

203 Winnie, 'Special Relativity without One-Way Velocity Assumptions', 229. If this principle is to be one for which there is experimental support, 'speed' must be interpreted as meaning speed *as measured within the inertial frame.*

speed of light is a constant. In place of them, Winnie suggests the following principle:

2. The Principle of Equal Passage-Times

> Let K and K' be two inertial frames in relative motion, and let A and A' be arbitrary points on the x-axis of K and K' respectively. Let Δt be the time- interval in K of the passage of a rod at rest in K' of rest length s past the point A in K, and let $\Delta t'$ be the time-interval in K' of the passage of a rod at rest in K of rest length s past the point A' in K'. Then $\Delta t = \Delta t'$.[204]

One final principle is required. In the body of his paper, Winnie suggests what he refers to as the Linearity Principle:

> For any two inertial frames K and K', *regardless of the choices of* $\in$ *in* K *and* K' *,* any point P in constant straight line motion with respect to K is also in constant straight-line motion with respect to K', and conversely.[205]

In a footnote, however, he mentions, as an alternative, a principle that, when combined with the first two principles, entails the Linearity Principle, but which, in addition, has the advantage of not involving the concept of the one-way speed of light:

3. The Principle of Proportional Time-Passage

> The passage-time in K (or K') of a rod of rest-length L_0 is directly proportional to the rest-length L_0.[206]

Finally, Winnie shows that, given the first two principles, together with the Linearity Principle, one can derive the $\in$-Lorentz transformations.[207] The same is true, accordingly, with respect to principles 1–3.

It would seem, therefore, that there is no problem about formulating a version of the Special Theory of Relativity that does not entail the One-Way Light Principle. The modified theory that I wish to advance can now be arrived at by dropping, from Winnie's formulation of the Special Theory of Relativity, the Round-Trip Light Principle, and then adding the two principles that I advanced earlier—namely, the Principle of the Conservation of Space, and the Principle of the Constancy of the Speed of Light Relative to Absolute Space.

Is the resulting theory consistent? I think it is clear that it can be inconsistent only if the Special Theory of Relativity is also inconsistent.

[204] Ibid. 230.

[205] Ibid. 231.

[206] Ibid. 231.

[207] Ibid. 231–5.

First of all, adding the Principle of the Conservation of Space to Winnie's formulation of the Special Theory of Relativity will surely not give rise to any inconsistency, since the latter theory entails nothing at all about what causal relations there are between space-time points. Secondly, the addition of the Principle of the Constancy of the Speed of Light Relative to Absolute Space will generate an inconsistency only if it leads to the conclusion that Winnie's Round-Trip Light Principle is false, and this, as we shall see shortly, is not the case. It would seem, then, that the modified theory cannot be inconsistent unless Winnie's formulation of the Special Theory of Relativity is inconsistent. If the latter is inconsistent, however, then the same must be true of standard formulations. So the modified theory can be inconsistent only if the Special Theory of Relativity is itself inconsistent.

But is the modified theory as powerful as the Special Theory of Relativity? That it is at least as powerful can be seen as follows. First, given the principle that the speed of light is the same in all directions relative to absolute space, it follows that the round-trip speed of light must be a constant relative to absolute space. Secondly, given this analogue of Winnie's Round-Trip Light Principle, one can then derive the ∈-Lorentz transformations for the special case of the motion of inertial frames relative to absolute space. But, since one is also assuming that the one-way speed of light is a constant relative to absolute space, one can set ∈ equal to one half, thus giving one the Lorentz transformations, restricted to the case of inertial motion relative to absolute space. Thirdly, that, in turn, will enable one to derive the formulas for length contraction and time dilatation—once again for the special case of inertial motion relative to absolute space. So one now has:

The Principle of Absolute Fitzgerald-Lorentz Contraction

The length L^* of a rod that is moving uniformly with respect to absolute space with velocity v in a direction along the length of the rod is equal to $\sqrt{1-\frac{v^2}{c^2}} \times L$, where L is the length of the rod when it is at rest relative to absolute space.

The Principle of Absolute Time Dilatation

The temporal duration, T^*, of a given type of process when it involves objects that are moving uniformly with velocity v relative to absolute space is equal to $\frac{T}{\sqrt{1-\frac{v^2}{c^2}}}$, where T is the temporal duration of precisely the same type of process when it involves objects that are at rest relative to absolute space.

Finally, it can be shown that the conjunction of these two principles, together with the principle that the speed of light is a constant in all directions relative to absolute space, entails the Round-Trip Light Principle—where this is the principle, not that the round-trip speed of light is a constant *relative to* all inertial frames, but rather that the round-trip speed of light is a constant as *measured within* all inertial frames.[208] So one can derive Winnie's Round-Trip Light Principle, which shows that the modified theory must entail everything that is entailed by Winnie's formulation of the Special Theory of Relativity

It seems clear, then, that it is possible to modify the Special Theory of Relativity to produce a consistent theory which entails all of the experimentally confirmed, empirical consequences of standard formulations of the Special Theory of Relativity, and which also entails that events do stand in relations of absolute simultaneity. One way of formulating such a modified theory, as we have seen, is by combining two of the principles advanced by Winnie in his formulation of a synchrony-free version of Special Relativity with two other principles: the Principle of the Constancy of the Speed of Light Relative to Absolute Space, and the Principle of the Parallel, Non-Branching Conservation of Space. This is, admittedly, not the most fundamental way of formulating the modified theory, for a fundamental formulation of a scientific theory should, I think, satisfy the following two constraints. First, and as Field has maintained,[209] it should characterize the relevant causal processes in a purely *intrinsic* way, and so it should avoid reference to entities—such as numbers—that do not enter into those processes. Secondly, the general principles involved in the theory should express *basic* laws, and preferably basic *causal* laws. The above version of the modified theory does not satisfy

[208] If the one-way speed of light is a constant relative to all frames that are at rest relative to absolute space, the round-trip speed of light *cannot* be a constant *relative to* inertial frames that are moving relative to absolute space.

[209] Hartry Field, *Science Without Numbers* (Princeton: Princeton University Press, 1980,) 43–4.

those constraints. The construction of a version satisfying those two constraints should, however, be a relatively straightforward matter.

Given a consistent theory which entails all of the experimentally confirmed consequences of standard versions of the Special Theory of Relativity, and which also entails that events do stand in the relation of absolute simultaneity, the question is simply this. Which theory should be adopted? The Special Theory of Relativity, or the modified theory? In the next section, I shall argue that the modified theory is clearly preferable.

11.4.3 The Superiority of the Modified Theory

The modified theory is superior to the Special Theory of Relativity in at least three ways. First, it has greater predictive and explanatory power. Secondly, it avoids a low-level empirical assumption for which there is neither theoretical motivation nor experimental support, and which may even be in principle untestable—the assumption, namely, that the one-way speed of light is a constant in all directions, in all inertial frames. Thirdly, quantum mechanics seems to require the notion of absolute simultaneity, both because of the general idea of the collapse of a wave packet, and because of experimental results, connected with Bell's Theorem, that provide strong grounds for concluding that there is sometimes no temporal gap between spatially separated events that are nomologically connected. The Special Theory of Relativity is therefore at the very least incomplete in a way that the modified theory is not.

First of all, then, there is the greater predictive and explanatory power of the modified theory. Because the modified theory incorporates a law of conservation of space, there are contingent states of affairs that are predicted and explained by that theory, but not by the Special Theory of Relativity, since, given any temporally bounded spatiotemporal region, the modified theory entails that the existence of that region was caused by, and so is explained by, the existence of some earlier spatiotemporal region. As with other explanations based upon conservation laws, this is not quite the most complex and exciting explanation that one can imagine. But it is, nevertheless, a perfectly legitimate causal explanation, and it is an advantage of the modified theory that it generates such explanations, and a shortcoming of the Special Theory of Relativity that it does not.

Similarly, the modified theory entails, given the existence of any temporally bounded spatiotemporal region, the prediction that there will be later spatiotemporal regions. Just as with the corresponding explanations, such predictions are not especially exciting, given the familiarity of what is being predicted. But they are predictions none the less, they have been repeatedly confirmed, and never falsified, and we are surely justified in believing that such predictions would stand the test of any experiment. There is, in short, excellent reason for accepting some principle of the conservation of space—such as is contained in the modified theory, but not in the Special Theory of Relativity.

Secondly, standard versions of the Special Theory of Relativity either contain the explicit postulate that the one-way speed of light is a constant in all directions, in every inertial frame, or else they involve other postulates having that as a consequence. The modified theory, by contrast, has no such implication. It is crucial to ask, therefore, whether there is any justification for this assumption concerning the one-way speed of light.

Einstein, as I noted earlier, was happy to treat that proposition as true by definition. But the principle of the constancy of the one-way speed of light is not a very plausible candidate for an analytic truth, and it is not surprising that many later physicists and philosophers have sought for ways to put that principle to the test of experiment. As noted earlier, however, no one as yet appears to have described an experiment which could be used to determine the one-way speed of light, and which is such that different results would be compatible with the part of the Special Theory of Relativity that is independent of the one-way velocity principle. So one can say, at the very least, that standard formulations of the Special Theory of Relativity involve an assumption for which, more than ninety years after Einstein's formulation of the theory, there is absolutely no experimental support. The fact that the modified theory does not entail the One-Way Light Principle would seem to be a reason, therefore, for preferring it to standard formulations of the Special Theory of Relativity—though not, of course, to formulations of the $\in$-Lorentz variety.

In addition, as I also noted earlier, the situation is probably worse than this. The fact that many highly ingenious proposals have been advanced concerning experiments that could be used to determine the one-way speed of light, all of which, upon closer scrutiny, appear to be unsatisfactory, strongly suggests that the part of the Special Theory of Relativity that is independent of the One- Way Light Principle entails the impossibility of any experimental determination of the one-way speed of light. If so, then standard formulations of the Special Theory of Relativity involve an assumption that is not even in principle testable if the rest of the theory is true: the status of the One-Way Light Principle will be that of a gratuitous metaphysical assumption.

The final way in which the modified theory is superior to the Special Theory of Relativity, regardless of whether the latter is formulated in standard, or synchrony-free ways, is connected with the fact that a central idea in quantum mechanics—namely, that of the collapse of a wave packet—seems very clearly to involve the notion of absolute simultaneity. Put in such a general way, however, the force of this point may seem open to question, since one might well respond that, if quantum mechanics is inconsistent with the Special Theory of Relativity, perhaps it is the former, rather than the latter, that needs to be modified. I think that it will be helpful, therefore, if we focus upon certain crucial experiments—experiments that show that the above response is not really satisfactory.

The story begins with a famous argument advanced by Albert Einstein, Boris Podolsky, and Nathan Rosen.[210] Their argument involves a thought experiment designed to show that quantum mechanics does not provide a complete description of the world. In outline, the structure of the argument is this. On the one hand, quantum physics does not attribute any properties to an object until a relevant measurement has been made. So an electron, for example, does not have any definite position until a measurement of its position is made, nor any definite momentum until a measurement of its momentum is made, and so on. But, on the other hand, an experimental situation can be described in which there will be a correlation that can be satisfactorily explained *only* on the assumption that objects do have properties before any relevant measurement on them has been carried out. So the description

[210] Albert Einstein, Boris Podolsky, and Nathan Rosen, 'Can Quantum- Mechanical Description of Physical Reality be Considered Complete?', *Physical Review;* 47 (1935,) 770–80.

of the physical world provided by quantum physics must be incomplete.

What experimental situation did Einstein, Podolsky, and Rosen have in mind, as posing a problem for quantum mechanics? It was one based upon the fact that it is possible to create a pair of particles that are *correlated* in the sense that there is some determinable property such that, if the value of that property is fixed for one of the particles, it must also be fixed for the other. So, for example, a pair of electrons can be created in such a way that the total spin of the two electrons along a given axis must have a certain value, and, if this is the case, then, once the spin of either of the electrons, along the given axis, is measured, and so has a determinate value, the spin of the other electron, along the same axis, must also have a determinate value. Suppose, then, that such a pair of electrons is created, that they are then separated, and that at time *t* a measurement is made of the spin, along a given axis, of one of the electrons. Then, *at least* from that time onward, the spin of that electron, along the given axis, has a determinate value. But what about the other electron? When does it have a determinate spin, along the axis in question?

Only two views seem possible. The one is that neither electron *acquires* a determinate spin as the result of measurement, since both electrons have a determinate spin, along the axis in question, from the time that they are created. Measurement merely enables us to know what those determinate values are; it does not bring those determinate values into existence.

This is the view favoured by Einstein, Podolsky, and Rosen. It implies, of course, that the description of the electrons given by quantum mechanics is incomplete, since quantum mechanics does not attribute determinate spins to the electrons prior to a measurement's being made.

The other view is that the two electrons acquire a determinate spin, along any given axis, only when a measurement is made on at least one of the electrons. But if this is right, a crucial question arises—namely, what is the relation between the time of the acquisition of a determinate spin by the electron on which the measurement is carried out, and the time at which the other electron has a determinate spin?

Since the second electron surely does not acquire a determinate spin at an earlier time, either it comes to have a determinate spin only later, or else it acquires a determinate spin at the same time. If it has a determinate spin only later, there are two possibilities. One is that there is a temporal gap between the time at which the first electron acquires a determinate spin, and every moment at which the second electron has a determinate spin. But surely this cannot be possible, since it would imply that, if a measurement were made on the second electron during the temporal gap in question, then it would be possible for the measurement to yield a value for the spin along the axis in question that, in conjunction with the value of the spin of the first electron, would imply a violation of the principle of conservation of spin. So there cannot be any temporal gap.

Alternatively, it may be that, while the second electron does not acquire a determinate spin when the first electron does, it has a determinate spin at every time throughout some immediately following, open temporal interval. This possibility is best addressed, however, after we have considered the third possibility—namely, that the second electron acquires a determinate spin at precisely the same time as the first electron. The question that immediately arises, of course, is what is meant by 'at the same time' in this context. In particular, can it be interpreted as simultaneity relative to some inertial frame, *F*? It would seem that it cannot, since, if it were true merely that the acquisition of a determinate spin by the second electron was simultaneous with the acquisition of a determinate spin by the first electron relative to some inertial frame, *F,* then there would be another inertial frame, *F*,* such that, relative to that frame, the second electron acquires a determinate spin *after* the first electron does, and with an intervening gap, so that we would be confronted, once again, with the possibility of a measurement being made on the second electron during the gap between the moment when the first electron acquires a determinate spin and the moment when the second electron would otherwise acquire a determinate spin, in virtue of the measurement made on the first electron. Thus, if simultaneity is merely relative simultaneity, there will be inertial frames where there is a temporal gap, and so, from the perspective of those inertial frames, there will be the possibility of pairs of measurements generating values that violate conservation principles. Only if simultaneity is absolute simultaneity will such a possibility be excluded.

Finally, what about the possibility that, while the second electron does not have a determinate spin at the time when the first electron acquires one, it has a determinate spin at every time throughout some immediately following, open temporal interval? The answer is that precisely the same problem arises as in the case when the two electrons acquire a determinate spin at the same time, for, in characterizing the relevant open interval, one has to make use of the idea that the instant that immediately precedes that interval is simultaneous with the instant at which the first electron acquires a determinate spin, and, once again, it will not do to interpret the simultaneity as simultaneity relative to a frame of reference: only absolute simultaneity will do.

What the Einstein–Podolsky–Rosen thought experiment shows, in short, is this. Either particles have determinate states prior to measurement, in which case quantum mechanics does not provide a complete description of physical reality, or else correlated particles must acquire corresponding determinate properties simultaneously, in the absolute sense—or at least without there being an intervening temporal gap—in which case the Special Theory of Relativity does not provide a complete description of the spatiotemporal relations between events.

Given the argument to this point, I think it is fair to say that it would be plausible to back the Special Theory of Relativity, and so to conclude that quantum mechanics fails to provide a complete description of reality. But there is more to the story. In 1964 a physicist, John S. Bell, published a paper in which he showed that the quantitative predictions generated by quantum mechanics logically *preclude* there being properties that make it the case, for example, that an electron possesses determinate spins along various possible axes before any measurements are made.[211] So the thrust of the Einstein–Podolsky–Rosen thought experiment is no longer merely that either the Special Theory of Relativity, or else quantum mechanics, is incomplete. It is rather that either the Special Theory of Relativity is incomplete, or quantum mechanics is *false*.

When it was a matter merely of the incompleteness of quantum

[211] John S. Bell, 'On the Einstein–Podolsky–Rosen Paradox', *Physics,* 1 (1964), 195–200. For clear formulations of Bell's theorem which do not presuppose any specialist background, see B. d'Espagnat, 'The Quantum Theory and Reality', *Scientific American,* 241/5 (Nov. 1979), 158–81, and N. David Mermin, 'Is the Moon there When No One Looks? Reality and the Quantum Theory', *Physics Today,* Apr. (1985), 38–47, and 'Quantum Mysteries for Anyone', *Journal of Philosophy,* 78 (1981,) 397–408.

physics, that option was not too difficult to accept. But with Bell's theorem on board, it became rather more difficult to hold that the Special Theory of Relativity provides a complete description of the spatiotemporal relations between events, since one could do so only by holding that quantum mechanics, which is very well confirmed indeed, is false.

The crucial point, however, is that, with the proof of Bell's theorem, it becomes possible to put the question to an experimental test. It is no longer a matter for speculation which view should be adopted. What happens, then, when the relevant experiments are performed? The answer is that the predictions of quantum mechanics in this area are correct.[212] But this means, as we have seen, that it will not do to say, for example, that the electron on which the measurement is not made has a determinate spin from the time that the two electrons are created. It must be the case, rather, either that there is a time at which it *acquires* a determinate spin, and which, for the reason indicated earlier, must be absolutely simultaneous with the time at which the other electron acquires a determinate spin, or else it has a determinate spin at every moment after a time that is absolutely simultaneous with the time at which the first electron acquires a determinate spin. Both possibilities presuppose absolute simultaneity. The conclusion, accordingly, is that there are experimental grounds for holding that absolute simultaneity is a relation that obtains between events in our world.

11.5 Objections

I have argued that it is possible to formulate an alternative theory, closely related to the Special Theory of Relativity, which reinstates absolute simultaneity, and which is superior in at least three ways. Those three considerations constitute, I believe, a very powerful prima-facie case for the modified theory, so, unless it is exposed to objections at least as serious as those that tell against the

[212] A. Aspect, P. Grangier, and G. Roger, 'Experimental Tests of Realistic Local Theories via Bell's Theorem', *Physical Review Letters,* 47 (1981,) 460–7, and 'Experimental Realization of Einstein–Podolsky–Rosen–Bohm *Gedankenexperiment* : A New Violation of Bell's Inequalities', *Physical Review Letters,* 48 (1982,) 91–4.

Special Theory of Relativity, the modified theory should surely be accepted. In the present section, accordingly, I shall attempt to complete the case for the modified theory by arguing that none of the objections that might naturally be raised against it can be sustained.

11.5.1 Absolute Rest and Absolute Simultaneity as Physically Meaningless

The most common objection to any suggestion that one's theory of the world should incorporate concepts such as absolute rest or absolute simultaneity is that such concepts are in some sense objectively or physically meaningless, given what we know about the world. Consider, for example, the following remarks by Hartry Field, when he is discussing the problem of comparing spatial distances within a Newtonian world:

> We can now see that in Newtonian mechanics there is not even an 'objective' way to compare the spatial distance between space-time points x and y with the spatial distance between z and w, except in the case where x is simultaneous with y and z is simultaneous with w. To assume a more general comparison of spatial distance is to assume a notion of sameness of place across time, i.e., a notion of absolute rest; and this notion makes no objective sense in Newtonian mechanics.[213]

Field's appeal here appears to be to some form of the verifiability principle of factual meaning, for he remarks, in an earlier passage, that 'the notion of absolute rest is one that the positivists have quite rightly objected to . . . '.[214] If so, then his argument is exposed to familiar objections that can be urged against a verifiability account of factual content.

Sometimes, however, when it is said that notions such as absolute rest, or absolute simultaneity, have 'no objective sense', or are 'physically meaningless', what the person is appealing to is not a principle of meaning, but a principle of demarcation. The idea is then that, although statements about a particle's being in a state of absolute rest, or about two events' being simultaneous, may be factually meaningful, they should not be part of a *scientific* theory of the world, since they do not generate any testable consequences.

[213] Field, *Science Without Numbers,* 49.

[214] Ibid. 35–6.

Clearly, however, this objection cannot succeed against the modified theory, since, given that the Principle of the Parallel, Non- Branching Conservation of Space has testable consequences, and that there is no logically weaker nomological statement that generates the same testable consequences, any acceptable version of a demarcation principle must surely classify the principle in question as scientifically admissible. That principle, however, together with the assumption that there is at least one space-time point, entails that there are at least two space-time points that occupy the same location at different times. So, while the latter statement may not itself generate any testable consequences—depending upon the rest of the relevant theory—it must nevertheless be admissible on any acceptable criterion of demarcation, given its logical relationship to statements that are admissible.

11.5.2 The Definability of Equivalence Relations Within the Special Theory of Relativity

A second objection to attempts to incorporate reference to the relation of absolute simultaneity into one's theory of the world centres upon claims concerning what equivalence relations are definable within the Special Theory of Relativity, and the thrust of this objection is that one can demonstrate that absolute simultaneity is not among them.

The clearest presentation of this objection is found in David Malament's article 'Causal Theories of Time and the Conventionality of Simultaneity'[215]—even though Malament's main concern in this paper is not with the question of absolute simultaneity, but, rather, with the question of whether 'the relation of simultaneity relative to an inertial observer is conventional rather than factual in character'.[216] At the end of his paper, however, Malament does offer an argument that focuses specifically on the issue of absolute simultaneity.

What Malament shows is, first, that the standard relation of simultaneity relative to a reference frame is explicitly, first-order definable on the basis of the relation of causal connectibility, together with the relation of being a point on the reference frame in

[215] Malament, 'Causal Theories of Time and the Conventionality of Simultaneity', 293–300.

[216] Ibid. 293.

question, and, secondly, that that is the only non-trivial, non-universal equivalence relation that is even implicitly definable on that basis. Absolute simultaneity, consequently, is not even implicitly definable within the space-time theory in question.

Does Malament's result constitute an objection to the modified theory? The answer is that it does not. In the first place, the theory of space-time employed by Malament is itself metaphysically unsound: causal *connectibility* is a counterfactual notion, and the theory in question does not contain the resources needed to supply categorical truth-makers for the relevant counterfactuals.[217] In the second place, once the theory of space-time is supplemented by the addition of actual causal relations between space-time points—causal relations of the sort specified by the Principle of the Parallel, Non-Branching Conservation of Space—Malament's proof of the undefinability of absolute simultaneity is completely undercut, since, as we saw above, with the addition of causal relations connecting space-time points, the notion of the world-line of a spatial *location* is explicitly definable, and with it, the relation of absolute simultaneity.

11.5.3 The Conspiracy-Of-Silence Objection

In 'Three Steps towards Absolutism',[218] John Mackie began by distinguishing a number of different issues that fall under the general label of 'absolutism versus relativism about space and time', and he then went on to defend three forms of absolutism. These involved, first, the existence of absolute acceleration; secondly, the existence of absolute duration; and, thirdly, the existence of absolute rest and motion. Of these three, the third is by far the most controversial. As Mackie observed, his arguments for absolute acceleration and absolute duration 'were directed only against loose thinking in some philosophical views about scientific matters', whereas the argument in support of the existence of absolute rest and motion challenged 'what has been an orthodox view for about seventy years within science itself'.[219]

[217] I have discussed this problem in *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987,) 310–11.

[218] John L. Mackie, 'Three Steps towards Absolutism', in Richard Swinburne (ed.), *Space, Time and Causality* (Dordrecht: D. Reidel, 1983,) 3–22.

[219] Ibid. 16.

Mackie's argument for the existence of absolute rest and motion involved a consideration of light rays travelling in opposite directions, but emitted, at a single instant, by the same source. Mackie thought that one could appeal to 'the concrete reality of the similar causal processes',[220] involved along the paths of the two rays, in support of the conclusion that there must be, for any point on the path of the one ray, a *corresponding* point on the path of the other ray. As Jon Dorling has pointed out, however, Mackie's argument does not succeed.[221] The reason is this. Suppose that a light source *S* emits a burst of radiation at the space-time point *O,* and that rays travel from there to the space-time points *D* and *E*. Then for any point *A* on *OD* there will indeed be a corresponding point *B* on *OE*. One can imagine, for example, counting wave crests along the two paths, to determine the corresponding points. So far, so good. But the problem is that there could be another light source, *S*,* which is in motion relative to *S,* and which also emits a burst of radiation at point *O*. Light rays from it will also travel along *OD* and *OE*. Suppose, then, that one determines, in the same way, the point on *OE* that, for those two rays of light, corresponds to point *A*. For Mackie's defence of absolute rest to work, that point will also have to be *B*. But, in fact, the point that corresponds to point *A* for radiation emitted by source *S** will have to be some other point *C*—essentially because of the Doppler shift phenomenon.

What is of interest here, however, is not Mackie's argument itself, but a certain objection to its conclusion—an objection that Mackie himself sets out: 'Why, and how, does it come about that although there really is such a thing as absolute rest, we cannot identify it? There must be something odd about the laws of nature that enables them to constitute such a conspiracy of silence.'[222]

This objection is developed in greater detail, and very forcefully, by Elie Zahar in a paper commenting on Mackie's argument for the existence of absolute rest and motion. Zahar begins by observing that

> Mackie faces the same puzzling problem which confronted Lorentz. If one postulates, or philosophically defines, an absolute frame of reference, then

[220] John L. Mackie, 20.

[221] Jon Dorling, 'Reply to Mackie', in Swinburne (ed.), *Space, Time and Causality,* 23–35. See p. 27.

[222] Mackie, 'Three Steps towards Absolutism', 20.

> one has simultaneously to accept, in Mackie's own words, a huge 'conspiracy of silence'. Nature conspires systematically to conceal from us the asymmetry which marks off one privileged frame from all other inertial systems. This explains why, until 1909, Lorentz hoped that Maxwell's equations would turn out not to be fully covariant; once he realized that they were, and that the set of Lorentz transformations formed a group, he conceded defeat.[223]

Zahar then offers the following formulation of the basic argument:

> One could argue as follows: it is unlikely that Nature contains both deep asymmetries and compensatory factors which exactly nullify these asymmetries. Such a state of affairs is not logically impossible and to envisage it is not meaningless; but it is unlikely, or improbable, in the same intuitive sense in which a series of coincidences and accidents having a single global effect are improbable.[224]

This is, I believe, the most forceful objection that can be mounted against any theory that entails the existence of absolute rest. But there is a perfectly satisfactory answer, the gist of which is that, if it is true that the modified theory entails that there is, in nature, a conspiracy of silence with respect to the existence of absolute rest, this is so only because, and precisely because, the Special Theory of Relativity itself entails that there is, in nature, a conspiracy of silence with respect to a certain matter—namely, the one-way speed of light.

Earlier, in Section 11.4.2, I discussed the problem of the one-way speed of light. There I mentioned, first, that Einstein had treated the proposition that the speed of light is the same in all directions, in any inertial frame, as something that is true 'by definition'; secondly, that that treatment has always met with considerable dissatisfaction; and, thirdly, that, as a result, many proposals have been advanced, and continue to be advanced, concerning experiments that could be used to determine the one-way speed of light—though as yet, no satisfactory experiment seems to have been devised.

This long history of unsuccessful attempts strongly suggests that there may be something about the synchrony-free part of the Special Theory of Relativity which entails the impossibility of any

[223] Elie Zahar, 'Absoluteness and Conspiracy', in Swinburne (ed.), *Space, Time and Causality,* 37–41, at p. 39.

[224] Ibid.

experimental determination of the one-way speed of light. But, if that is so, then it means that nature is so constructed that, even if there are inertial frames where the one-way speed of light is not the same in all directions, there are compensatory factors that prevent us from ever determining that that is the case. The Special Theory of Relativity would therefore entail that nature involves a *total* conspiracy of silence with respect to whether the one-way speed of light is the same in all directions, in all inertial frames.

Perhaps, however, the synchrony-free part of the Special Theory of Relativity does not preclude the possibility of experiments that would determine the one-way speed of light. If that were so, one could still argue that the Special Theory of Relativity entails, at least, a very far-reaching conspiracy of silence in nature with respect to the one-way speed of light, as is testified by the failure of so many ingenious proposals.

The extensiveness of the conspiracy, however, is not really the important point. The crux of my response to Zahar concerns, instead, the *relation* between the two conspiracies. First, however, we need to be clear about the consequences of the modified theory with respect to measurements of the speed of light. According to the modified theory, absolute space is an enduring entity, temporal parts of which are connected via non-branching causal relations, and light has a uniform speed relative to absolute space. As a consequence, the one-way speed of light in any given direction relative to any inertial frame depends upon the velocity of that inertial frame relative to absolute space, and upon the relation between the direction in which the frame is moving and the direction of the light whose velocity one is considering. In particular, if an inertial frame has velocity v relative to absolute space, then the velocity of light in that direction, relative to the inertial frame, will not be c, but $(c - v)$, while the velocity of light in the opposite direction, relative to the moving frame, will be $(c + v)$. These will not, however, be the estimates of the velocities that one would arrive at if one were able to measure the speed of light within the moving frame. Given both Lorentz contraction of lengths, together with time dilatation, the velocities as measured within the frame would be $\frac{c^2}{c+v}$ and $\frac{c^2}{c-v}$ respectively. The crucial point here, however, is simply that these velocities are different. So, while the modified theory does entail that the *round-trip* speed of light, as measured within a moving frame, and without correction for Lorentz contraction and time dilatation, will be equal to *c,* it also entails that the measured *one-way* velocities will *not* be equal to *c*.

Let us now consider the relation between the two conspiracies. Suppose that an experiment is possible that would enable one to measure the one-way speed of light. If the outcome of that experiment were that the one-way speed of light was the same in all directions in all inertial frames, then the modified theory would be conclusively refuted, since, as we have just seen, it entails that this will not be the case. If, on the other hand, it turned out that the oneway speed of light not only was not the same, but varied in accordance with the above relation, then it would be possible to determine the velocity of any inertial frame relative to absolute space. So, unless there is a conspiracy in nature that prevents any measurement of the one-way speed of light, the choice between the modified theory and standard formulations of the Special Theory of Relativity is experimentally decidable.

Suppose, however, that there is no experimental way of measuring the one-way speed of light. Then there will be no way of determining the velocity of any inertial frame relative to absolute space, and there will be the conspiracy of silence that Zahar contends is an objection to theories that postulate absolute space. But we have just seen that a conspiracy of silence with respect to absolute rest and motion can obtain only if, and precisely because, there is a conspiracy within nature with respect to the measurement of the one-way speed of light. So any conspiracy of silence within nature that one must countenance, on the modified theory, is either identical with, or derives from, a conspiracy of silence that one must countenance according to any version of the Special Theory of Relativity—both standard formulations, and $\in$-Lorentz formulations—given the supposition that there is no experimental way of determining the one-way speed of light.

The conclusion, in short, is that either the choice between the modified theory and standard formulations of the Special Theory of Relativity can be settled experimentally, or else both the modified theory and all versions of the Special Theory of Relativity involve the acceptance of what is essentially the same conspiracy of silence within nature. One cannot, therefore, hold that the conspiracy-of-silence objection provides good grounds for rejecting the modified theory unless one is also prepared to reject the Special Theory of Relativity itself, on precisely the same grounds. So Zahar's objection fails.

11.5.4 Other Modified Theories

I have argued that a certain alternative theory is superior to the Special Theory of Relativity in at least three respects, and I have also tried to show that the alternative theory does not succumb to objections often directed against theories involving concepts such as absolute rest and absolute simultaneity. If those points are correct, then the modified theory is surely to be preferred to the Special Theory of Relativity.

There are, however, two other alternatives which I have not yet mentioned, and which need to be considered before the case for the theory that I am advocating is complete. These other alternatives consist of a synchrony-free formulation of the Special Theory of Relativity, together with either of two expansive 'conservation' principles for space. The latter principles can be formulated in terms of what I shall refer to as a linear causal process—where this is a causal process in which all of the relevant events lie along a geodesic. Given that idea, the two principles in question are as follows:

Expansive Conservation of Space: Principle IEvery space-time point is such that its existence is a cause, via a linear causal process, of the existence of any space-time point on the surface of its future light cone.

Expansive Conservation of Space: Principle IIEvery space-time point is such that its existence is a cause, via a linear causal process, of the existence of any space-time point in its future light cone.[225]

What reasons might be offered for viewing these alternatives as serious competitors? First, by incorporating either of the expansive conservation principles, rather than the non-expansive one involved in the modified theory that I have advanced, the alternative

[225] The reference to linear causal processes is needed to ensure that the second principle is stronger than the first.

theories avoid entailing that events stand in relations of absolute simultaneity. So they are closer to the Special Theory of Relativity. Secondly, the combination of either of the expansive conservation principles together with the synchrony-free part of the Special Theory of Relativity results in a theory that is superior to Special Relativity itself in at least two ways. Such alternative theories will share the modified theory's greater explanatory and predictive power: the existence of any spatiotemporal region causes later regions, and was caused by earlier ones. They will also avoid the low-level, and theoretically unmotivated assumption that the one-way speed of light is the same in all directions, in all inertial frames.

In short, there are alternative theories which are closer to the Special Theory of Relativity, but which avoid most of its disadvantages. Should one not, then, adopt one of those theories, rather than the modified theory, with its commitment to absolute rest and absolute simultaneity?

The answer is that there are at least five reasons why the modified theory is preferable to the alternatives just described. First, although the latter avoid two of the objections to standard formulations of the Special Theory of Relativity, they do not escape the third—namely, the argument for absolute simultaneity based upon the idea of the collapse of a wave packet, and upon the experimental results connected with Bell's Theorem in quantum mechanics.

Secondly, the modified theory is *simpler* with respect to the number of states of affairs that it postulates. Whereas the Principle of the Parallel, Non-Branching Conservation of Space does not entail anything beyond the existence of *non-branching* causal chains connecting some space-time points, both of the expansive conservation principles entail that every space-time point is causally connected, via *uncountably many* causal chains, with *every* space-time point on the inside of the relevant forward and backward light cones. In addition, each of those causal chains branches *infinitely often at every point,* whereas, according to the modified theory, the causal chains connecting space-time points never branch. The modified theory is therefore vastly simpler with respect to the actual causal connections that it postulates.

Thirdly, and as an immediate consequence of the preceding point, the alternative theories involve massive causal overdetermination, since, for every space-time point, there are nondenumerably many, causally unconnected space-time points such that the existence of any one of those points is a sufficient cause of the existence of the space-time point in question. By contrast, no such overdetermination exists in the case of the modified theory.

Fourthly, the conservation of space principle involved in the modified theory is, in virtue of its non-branching quality, analogous to other conservation principles in physics, such as the conservation of mass/energy, of momentum, of charge, and of spin, whereas the expansive conservation principles postulated by the alternative theories appear to be without parallel in other physical principles. This fact provides, I suggest, another reason for preferring the modified theory.

A final consideration concerns the status of a proposition that all three theories involve—namely, the principle that the round-trip speed of light is a constant in all inertial frames—and the relevant question is whether that principle can plausibly be regarded as basic, or whether, on the contrary, it should be derived from other principles.

The following line of thought seems to support the view that it should not have the status of a basic principle. Consider the behaviour of a light ray that has travelled along a certain line, has been reflected, and is now returning. Its average round-trip speed will depend upon the speed with which it is now travelling. That speed, however, cannot be causally dependent upon what happened earlier: the cause of its having the speed it now has cannot be its having had a certain speed as it was moving in the other direction. All rays of light travelling in the direction in which it is now moving presumably do so at the same speed, regardless of whether they had previously travelled in the opposite direction. The round-trip speed of a light ray is, in short, logically determined by two states of affairs that are not causally dependent upon one another—namely, the speed of the light ray in one direction, and its speed in the opposite direction. So it would seem that the round-trip principle cannot be a basic law. Rather, it must be derivable from causal principles that determine the one-way speed of light in each direction.

But this is a difficulty for the two alternative theories. Since they contain no principles dealing with the one-way speed of light, they are forced to treat it as a basic law that the round-trip speed is a constant in all inertial frames. The modified theory, on the other hand, can provide a derivation: the combination of the principles of Lorentz contraction and time dilatation, together with the principle that the one-way speed of light is a constant relative to absolute space, entails that the measured round-trip speed of light is a constant in all inertial frames.

11.6 Summing Up

The Special Theory of Relativity constitutes a serious challenge to any tensed view that maintains that the future is not real. One common response to that challenge—advocated by Howard Stein and others—involves modifying the tensed view in question. I believe, however, that the original tensed position has nothing to fear from the Special Theory of Relativity, and I have tried to demonstrate that this is so by arguing, first, that the Special Theory is exposed to very strong objections, and, secondly, that it is possible to set out a modified theory which avoids those objections, which possesses greater explanatory and predictive power than the Special Theory of Relativity, and which does so precisely because it entails that events stand in relations of absolute simultaneity.

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Part VI A Summing-Up

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12 Summary and Conclusions

12.1 Central Features of the Present Approach to the Nature of Time

The present account of the nature of time is, in some ways, intermediate between tenseless approaches to the nature of time, and traditional tensed accounts, for, while it shares with the latter the view that the world is dynamic, it also differs from such accounts in a number of crucial respects. Most of these differences are connected with the fact that traditional tensed accounts of the nature of time disagree with tenseless approaches with regard to two fundamental issues: first, on whether the world is dynamic, rather than static; and, secondly, on whether tenseless facts are logically supervenient upon tensed facts, or vice versa. The approach that I am defending, however, agrees with traditional tensed accounts only on the first of these matters: the world is dynamic, but tenseless facts are not logically supervenient upon tensed facts.

In more detail, the account of the nature of time that I have set out differs from traditional tensed approaches in the following ways. First, one of the two most central features of the present account of the nature of time is the view that the world is a dynamic world, and one, moreover, where the past and the present are real, but the future is not. Given that the world is dynamic in this way, even what *tenseless* facts are now actual depends upon what time it is. It is therefore natural to ask whether this time-dependence of tenseless facts is all that there is to the world's being dynamic, or whether, on the contrary, and as traditional tensed approaches claim, the world's being dynamic depends upon the existence of irreducible tensed facts. The answer for which I have argued is that the latter is not the case: the world is dynamic because, and only because, what tenseless states of affairs are now actual changes with the passage of time.

Secondly, the other fundamental feature of the present approach is the relevance of causation. In traditional tensed approaches, causation plays no part; on the present approach, by contrast, causation lies at the very heart of time itself. Not only is the direction of time to be defined in terms of the direction of causation, but, more importantly, the fundamental argument for the central thesis that the world is a dynamic one in which the past and the present are real, but the future is not, rests upon a claim concerning the nature of causation—namely, that causation is a theoretical relation between events, and one whose basic postulates can only be satisfied in a dynamic world of the type in question.

Thirdly, there is the issue of how tensed facts and concepts are related to tenseless ones. According to traditional tensed accounts, tenseless concepts can be analysed in terms of tensed ones, and thus tenseless facts are logically supervenient upon tensed states of affairs. I have argued, however, that this view has things exactly the wrong way around. In the first place, and as I argued in Chapter 6, not only can tenseless concepts not be analysed in terms of tensed ones, but at least some central tensed concepts themselves—and in particular, the concepts of the past and the future—stand in need of analysis, and cannot be taken as analytically basic. The analysis of the latter concepts, however, requires the concept of temporal priority, and because of this, that concept cannot be analysed in tensed terms, on pain of circularity. But then secondly, and as I argued in Chapter 7, given the concept of temporal priority, together with either the ontological notion of states of affairs that are actual as of a time, or the corresponding semantical concept of truth at a time, one can analyse all tensed concepts, including the concept of the present. It then follows from those analyses that tensed facts are logically supervenient upon what tenseless states of affairs are actual as of different times.

Fourthly, another important feature of the present approach, and a consequence of the analysis offered for tensed concepts, is that, while tenseless approaches to the nature of time are correct in holding that the most familiar tensed sentences involve indexicals, they are wrong in holding that this is true of absolutely all tensed sentences. Indexicality is not essential to tensed language—indeed, the most fundamental tensed sentences contain no indexicals.

Fifthly, the combination of the thesis that the world grows by the addition of tenseless states of affairs, with the rejection of irreducible tensed facts, entails that there is such a thing as the totality of all states of affairs. This in turn means that one can speak not merely of what is actual as of a given time, but of what is actual *simpliciter*. Because of this, the present approach entails that both the concept of truth at a time and the concept of truth *simpliciter* are legitimate concepts. By contrast, both tenseless accounts and traditional tensed approaches claim that either the former concept, or the latter, must be rejected.

Sixthly, unlike many tensed accounts, the present approach does not presuppose the idea of an indeterministic world. If the world is one where the past and the present are real, but the future is not, that fact alone ensures that the world is dynamic, since, regardless of whether the future is determined, or whether there are, instead, many possibilities for the future course of events, the present is, in either case, the point at which what was hitherto non-actual becomes actual.

Seventhly, and by contrast with traditional tensed approaches that analyse temporal priority in terms of tensed concepts, the present approach involves what is basically a causal analysis of temporal priority. Many tenseless approaches, of course, accept such an account. But the present account differs from standard causal theories of time by embracing a realist view of space and time—and one, moreover, where space-time points themselves stand in causal relations.

Finally, in grounding the dynamic nature of the world upon causation, the present approach entails that time, understood as involving the coming into existence of events, is a totally objective feature of the world that is not dependent in any way upon the experiences of humans, or other conscious (or self-conscious) beings. In this respect, it contrasts sharply with those tensed accounts that assign a central and crucial role to the phenomenology of the experience of time.

12.2 Some Advantages of This Approach

What considerations can be offered in support of this account of the nature of time? In the first place, by grounding the fact that the world is a dynamic one where the past and the present are real, but the future is not, upon causation itself, one ensures that the dynamic nature of the world is not dependent either upon the existence of any relatively accidental features—such as certain experiences—or upon any special, tensed properties. Any world whatsoever that contains causally related events must be a dynamic world, and one, moreover, where the past and the present are real, while the future is not.

Secondly, by holding that tensed concepts can be analysed in terms of tenseless ones, together with the concept of what is actual as of a time, one escapes some very serious difficulties associated with alternative ontologies that involve intrinsic, irreducible, tensed properties—especially the problem of how an instantaneous event can have different intrinsic properties at different times. If pastness and presentness are relational properties of events, rather than intrinsic ones, and if, in particular, whether an object lies in the past or in the present at a given time is a matter of whether there are, or are not, later states of affairs that are actual as of the time in question, then there is no difficulty about explaining how an instantaneous event can be present at one time, and past at another.

Thirdly, when the traditional tensed thesis that tenseless concepts are to be analysed in terms of tensed ones is rejected, a decisive answer to McTaggart's argument is available, since the times at which an event has various tensed properties can then be specified in a tenseless fashion, using dates, and, when this is done, McTaggart's regress does not even get started.

Fourthly, the view that some tensed sentences involve indexicals, and others do not, allows one both to avoid the implausible claim that any ordinary tensed sentence expresses the same proposition, regardless of when it is uttered, and to do so without falling prey to important anti-tense arguments advanced by Mellor.

Fifthly, the present approach involves a rejection of the view that temporal priority can be analysed in terms of tensed concepts, and this rejection makes it possible to employ the concept of temporal priority in offering analyses of the concepts of the past and the future: the past is simply what is earlier than the present, and the future is what is later. Traditional tensed approaches, by contrast, cannot offer such analyses, since they hold that temporal priority is to be analysed in tensed terms. This in turn means that they cannot avoid the very implausible claim—and one that is incompatible with traditional empiricism—that the concepts of the past and the future are analytically basic.

Sixthly, a tensed view according to which the dynamic quality of the world is a matter of the reality of the past and the present, and the unreality of the future, is one where it is irrelevant whether the world is deterministic or indeterministic. By contrast, tensed views that are predicated upon the assumption of indeterminism are hostages to fortune, for whether the world will turn out to be dynamic or static depends, on such accounts, upon whether the present indeterminism of quantum theory is or is not overthrown, at some point, by a deterministic theory.

Seventhly, the present approach provides a comprehensive account of the relation between time and causation. First of all, given an analysis of the concept of causation that does not involve any temporal notions, together with grounds for holding that backward causation is impossible—and is so even in the case of worlds where causal loops cannot arise—the way is clear for a plausible definition of the direction of time in terms of the direction of causation. Secondly, because the underlying theory of causation is a realist one, the familiar objections that can be raised to reductionist theories—which make the direction of time dependent upon patterns to be found in the world—do not arise. In particular, no problem is posed either by the possibility of very simple worlds—in which time has a direction even though there are no asymmetries with respect to the patterns that events exhibit—or by the possibility of 'inverted' worlds—where the direction of time is opposite to the direction defined by such things as increase in entropy, the expansion of the universe, the propagation of order in irreversible processes, and the apparent control of one process by another.

Finally, the causal theory of temporal order and direction that has been defended here has two unusual features that set it apart from traditional causal theories of time—namely, it involves an absolute, rather than a relational theory, of space and time, and the absolute space in question consists of space-time points that stand in causal relations to one another. These features, in turn, are important for at least three reasons. First, they make it possible for an event that is not causally related to any other events to have, nevertheless, spatiotemporal location. Secondly, the idea that space-time points are causally connected makes it reasonable to conclude that our world contains events that stand in the relation of absolute simultaneity, thereby answering a crucial objection based upon the Special Theory of Relativity, and one that tells against most tensed approaches to the nature of time. Thirdly, if the direction of time is given by the direction of causation, and space- time points themselves stand in causal relations, then time is, as one naturally thinks of it as being, an all-pervasive feature of the world.

12.3 A Third Way?

> Once Einstein said that the problem of the Now worried him seriously. He explained that the experience of the Now means something special for man, something essentially different from the past and the future, but that this important difference does not and cannot occur within physics. That this experience cannot be grasped by science seemed to him a matter of painful but inevitable resignation. I remarked that all that occurs objectively can be described in science; on the one hand the temporal sequence of events can be described in physics; and, on the other hand, the peculiarities of man's experiences with respect to time, including his different attitudes towards past, present, and future, can be described and (in principle) explained in psychology. But Einstein thought that these scientific descriptions cannot satisfy our human needs; that there is something essential about the Now which is just outside the realm of science. We both agreed that this was not a question of a defect for which science could be blamed, as Bergson thought. I did not wish to press the point, because I wanted primarily to understand his personal attitude to the problem rather than to clarify the theoretical situation. But I definitely had the impression that Einstein's thinking on this point involved a lack of distinction between experience and knowledge. Since science in principle can say all that can be said, there is no unanswerable question left. But though there is no theoretical question left, there is still the common human emotional experience, which is sometimes disturbing for special psychological reasons.[226]

The conversation with Einstein that Rudolf Carnap describes in the above passage from his autobiography concerns one of the great gulfs in metaphysics—that between tensed and tenseless approaches

[226] Rudolf Carnap, 'Intellectual Autobiography', in Paul Arthur Schilpp (ed.), *The Philosophy of Rudolf Carnap* (La Salle, Ill.: Open Court, 1963,) 37–8.

to the nature of time. It is a long-standing divide—going back at least to the pre-Socratics—and philosophers have formulated a number of arguments in an attempt to settle the issue of whether the world is dynamic or static. But the difficulty posed by this problem has proven formidable indeed, and it is not at all clear that any of the crucial arguments that have hitherto been advanced can be sustained.

In the present discussion, accordingly, I have attempted to develop a fundamentally different line of attack—one that is based upon the idea that the best way of approaching the question of the nature of time is by focusing upon the relation between time and causation. In addition, I have also suggested, in effect, a possible diagnosis of the intractability of this problem: perhaps the truth about time lies somewhere between traditional tensed and tenseless approaches—in an account that combines the central tenseless rejection of the idea of irreducible, tensed facts, with the traditional tensed insistence upon the idea of a dynamic world.

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