THE PHILOSOPHY OF TIME TRAVEL

by

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Abstract

In this essay, I defend the logical possibility of time travel against philosophical criticism. I examine the science fiction version of time travel and conclude that in some limited respects it remains logically possible, although it is not likely to be physically possible.

In Chapter I, I develop a working definition of time travel. I examine the relevant work of David Lewis and Paul Horwich and proceed to offer a more precise definition of time travel. I argue that in order for someone to be considered a time traveller, she must leave the time of the present and, while continuing to age, arrive at some point in time that does not coincide with her personal time (i.e., her aging process).

In Chapter II, I examine various logical objections to time travel. I argue against these objections, offering a refutation of each.

In Chapter III, I examine a more difficult objection to time travel: its implication of reverse causation . I argue that reverse causation, which occurs when a past event is caused by a present or future event, is not logically impossible. I conclude that it has not been shown to be impossible and that one can tell a coherent story of reverse causation.

In Chapter IV, I consider one last objection, which is that time travel implies fatalism. The objection is that if a past event is caused by a present or future event then once that past event happens the future event is 'fated' to happen. I argue that this is not the case on the basis of what it means to be in a causal relationship. If A causes B, and only A can cause B (i.e., B can come about by no other means), then once B happens we know that A either has already happened or, according to reverse causation, will happen.

I conclude in this thesis that time travel remains a logical possibility because reverse causation remains a logical possibility. I also conclude that time travel for humans is unlikely ever to occur because of the degree of coincidence that would be required.

Acknowledgments

I would like to express my sincere appreciation to my supervisor Stephen Maitzen. Stephen captured my interest by introducing me to this topic and by helping me to understand the complexities involved. Working with Stephen has been a very enjoyable and rewarding experience. Thanks Steve.

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Introduction

The philosophical discussion of time travel stems from science fiction and physics. The two key figures at the origins of discussion about time travel are the novelist H.G. Wells and the physicist Kurt Gödel. Wells simply uses this fascinating concept to enhance his literature, whereas Gödel claims to have discovered some mathematical indication that time travel may, in fact, be possible.

It seems, however, that our familiarity with time travel is due to the popular media's influence on us. Thanks to the science fiction writers of books and screenplays, it is difficult to avoid the notion of time travel. The fascinating plots and puzzling situations that time travel offers to science fiction go unquestioned by the average movie viewer. In fact, it seems fair to say that many science fiction fans hope, and indeed believe, that the time travel of the movies is possible. The only obstacle that many see with time travel is that it will simply take time to figure out how to do it.

Philosophers, however, take a less naive approach to time travel. They are concerned with the logical possibility of time travel and with the logical implications of time travel. The puzzles of science fiction contribute to the philosophical fascination with time travel and also offer some of the initial objections to its logical possibility. This inundation with time travel and the logical puzzles it poses have led to an increase in contemporary philosophical investigation into time travel. It is this investigation that I wish to pursue further in this work.

My Project

In this work, I will discuss many of the common objections to time travel (especially backward time travel) and defend the notion of time travel against these objections. I will defend time travel against the claim that it is logically impossible and will show that with some minor revisions time travel remains a logical possibility that is void of any unusual or even unwelcome consequences. I will conclude that the type of time travel that remains after clarification and consideration of objections is not exactly what might be wished for by science fiction fans, although even the science fiction version of time travel may remain logically possible despite its practical unlikelihood.

I will begin in Chapter I by discussing the concept of time travel. I will develop a working definition of time travel. I will consider briefly how we ought to understand time itself, and then I will move on to define time travel. In defining time travel I will consider many of the notions from science fiction, as well as the physical possibility of time travel as discussed by Gödel. I will then discuss a more philosophical understanding of time travel. After setting a stage for my working definition, I will consider some conceptual difficulties with the notion and attempt to clarify and sharpen our understanding of time travel. In so doing, it will be necessary to distinguish *personal time* from *external time*, as David Lewis and others do. Finally, I will discuss briefly how we might be able to understand the science fiction account of time travel in a way that is compatible with Gödel's discovery and the philosophical conception of time travel.

In Chapter II, I will move on to discuss many of the common objections to time travel. I will discuss briefly the physical constraints on time travel that Gödel believed

would at least make it impractical if not impossible. I will also acknowledge that some physicists object to Gödel's equations, but I will not discuss their objections in any detail. My focus will be to discuss the more philosophically significant objections that are based on its being logically impossible or absurd. I will discuss objections that deal with the following issues: changing the past and *autofanticide*, Leibniz's Law and personal identity, the time discrepancy paradox and conceptual absurdity, causal loops and time loops, and the rocket probe puzzle. I will show that each of these puzzles and problems can be dealt with adequately and that they pose no problems for time travel's logical possibility.

In Chapter III, I will address the issue of reverse causation. I will consider whether or not reverse causation is necessarily implied by time travel. I will conclude that it is in fact entailed by time travel and will then proceed to consider its logical possibility. I will consider many of the arguments for and against the possibility of reverse causation, and I will conclude that reverse causation remains a logical possibility. Furthermore, I will conclude that the logical possibility of time travel depends on the logical possibility of reverse causation. Therefore, my conclusion that reverse causation is logically possible reinforces my further conclusion that time travel is logically possible.

In Chapter IV, I will consider an apparent implication of reverse causation and hence of time travel, namely, fatalism. Time travel remains counter-intuitive even after refuting all of the logical objections raised against it. I suggest that one of the things that are counter-intuitive is its entailment of reverse causation and that it seems to further entail fatalism. I will examine how and why opponents to time travel think that it and its

implication of reverse causation entail fatalism. I will show that such objections are mistaken. I will show that the argument from time travel to fatalism fails in just the same way that the traditional argument for fatalism fails and also that it fails in a similar way to the failure of the argument against reverse causation.

In my final chapter I will conclude that time travel (and reverse causation) remains a logical possibility. I will discuss the type of time travel that remains possible after having dealt with the many objections that are raised. I will show that this new revised version of time travel is not exactly what a science fiction fan might wish for, although it does not rule out the possibility of some of what science fictions fans appreciate about time travel. I will show that time travel may be impractical and thus next-to-impossible and that it is unlikely, perhaps even impossible, for a human being ever to accomplish time travelling. Despite these conclusions, time travel is not reduced to logical absurdity even though it seems to be entirely counter-intuitive. It remains counter-intuitive because people recognize the practical difficulties associated with time travel. However, my project is only to ascertain whether or not backward time travel is logically possible, and I intend to show that it is indeed logically possible.

What My Project Isn't

Before I get into detail about the type of time travel I will be discussing, I want to mention briefly some of the things that I will not be discussing. First of all, the type of time travel I will be dealing with is physical time travel and not spiritual or mental time travel. This means that I am concerned with the possibility of physical objects (e.g.,

persons) travelling backwards through time. If we were to suppose the existence of disembodied souls and spirits or disembodied Cartesian minds then time travel may be quite easy or even trivial for such *immaterial* beings.[1] I will not be discussing the possibility of immaterial beings. Also, I will not be discussing the possibility of any *atemporal* beings (including God). For the purposes of this project I will assume that these do not exist despite the fact that it seems logically possible that they exist. Again, time travel for atemporal or immaterial beings would be quite trivial and not of philosophical interest.

I will not be discussing the possibility of time travel involving other possible worlds. The notion here is that time travel is really just a journey to another possible world that somehow exists parallel to ours (in another dimension) and is very similar to ours. If this is all that time travel were, then it would not be 'time' travel at all, rather it would be travel between possible worlds. Although this type of travel would be philosophically interesting, it has little to do with the conception of time travel that I intend to discuss.

Finally, I will not be discussing any unusual theories of time. Jack Meiland offers a theory of a two-dimensional model of time. This theory may very well work and may very well be true. It is not my purpose to consider such possibilities. As I will point out in Chapter I, I will be using only a traditional theory of time.

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[1] Note the work of Antony Flew (1988). Here Flew argues that a time traveller could not be "...a flesh and blood human person but a disembodied soul" (268).

Now that I have made clear what I will not be discussing let us move on to what I will be discussing.

Chapter I

What is time travel?

In this chapter, I begin our discussion of time travel. I develop a working definition of time travel which will undergo further improvement and revision in later chapters. Since much of the discussion on time travel stems from science fiction, I will work towards a definition that, as near as possible, resembles the science-fiction-based notion.

In working towards a definition of time travel it will be necessary to consider some of the ideas in science fiction, some of the theories in physics, some of the logical requirements on the possibility of time travel, and some concepts to help clarify the notion. It will also be necessary to point out some conceptual problems that arise in formulating a simple definition of time travel and to address these problems. Ultimately, I am working towards a *philosophical* definition of time travel and a discussion of the merits of such a definition.

Time

Before we begin formulating a definition of time travel, it should prove helpful to comment briefly on the understanding of time presupposed in this work. An exact definition of time is very difficult to formulate. According to George Schlesinger, time is a fundamental feature of the physical universe. He says that time is like a container and that "Everything that is exists *in* time... [E]very event occurs *at* some point in time..." (Schlesinger: 3). Richard Swinburne describes time in essentially the same way: he says,

"Spatial things exist, their states persist or change during periods of time; and anything during which a spatial thing could... exist is a period of time" (Swinburne: 157). These are very general descriptions of time, but they help us to begin to understand the notion of time presupposed in this work.

Time, like space, contains all events. For the purpose of this work time ought to be understood just as any layperson might understand time prior to any philosophic investigation. It will suffice to understand time as the experiential phenomenon of passing time. It is what we experience as moving towards the future from the past through the present. For the purpose of this work I will ignore any assumptions about the direction of time or the dimensionality of time. I will leave the understanding of time simply as it is intuitively understood. Further investigation of the phenomenon of time itself might distract from my present purpose of investigating time travel.

Defining Time Travel

To put it simply, time travel is the abnormal passing of time. It is an aberration of time. This means that in order for time travel to be possible it must be possible for one to travel from the perceived present to another time in the past or in the future. This other time (i.e., the time traveller's destination) must require travel through time that is either accelerated or reversed. What this means is that for forward time travel a time traveller must traverse further in time than the duration of his journey. For backward time travel it means that a time traveller must continue to age (i.e., time continues to pass in a forward

direction for the time traveller) and must traverse backwards in time (i.e., arrive at a point in time prior to his departure).

Forward Time Travel

Physics has determined that time travel into the future is, in fact, possible. It seems that accelerated forward time travel can be achieved simply by accelerating to and travelling at very high velocities. According to the Special Theory of Relativity, the faster an object travels the slower time passes for that object. Time slows down as velocity increases. This type of time travel is considered to be a "well-known consequence of the Special Theory of Relativity, and [is] of comparatively little philosophical interest" (Horwich, 1975: 111). The twin paradox exemplifies this consequence (i.e., forward time travel) of the Special Theory of Relativity. In the twin paradox, we have a set of 20-year-old twins. The story is that A enters a rocket-ship and twin B stays on Earth. A travels for quite some time, say 10 years, at very high velocities before returning to Earth. When he returns he finds that his twin brother is an octogenarian. What has happened? Twin A has not aged as rapidly as twin B, because he was travelling as such high speeds, and therefore he is now younger than his twin (thus the paradox).

It seems, however, that this type of time travel is little more than an accelerated variety of our present experience of passing time. Since it is largely undisputed, I will not discuss further this type of time travel (i.e., forward time travel). I will be concerned

solely with the possibility of and consequences of backward time travel. When I subsequently use the term 'time travel,' I will be referring solely to backward time travel.

Science Fiction

The science fiction accounts of time travel can be fun and interesting, but often they are logically impossible or absurd. However, some of these stories appear to be consistent and thus warrant some philosophical investigation into a science fiction-type of time travel.

Many of us are familiar with the science fiction accounts of starships that travel through time several hundred years to the past and then are able to get back to the time that they left. Time travellers such as these are represented as leaving the present and arriving at another time. These time travellers continue to age inside their vessel at the normal rate of one hour per hour. In some stories, the time travellers make a conscientious effort to avoid changing the past or to ensure that the past occurs as it did according to their records. In other stories, the time traveller is on a mission to change the past in order to prevent some terrible disaster.

The story-lines of science fiction accounts may seem so radically fictitious as to be unhelpful in a serious philosophical investigation. This may not necessarily be the case. Although many of the details are unimportant, the main idea behind the science fiction accounts of time travel is the same as the philosophical notion of time travel that I am concerned with here. One of the more important things that can be lifted from the science fiction accounts is that the time travellers continue to age and experience things

as if they were not time travellers. This requirement avoids the objection that time travel is simply the reversing of time. Reversing time would mean that clocks literally run backwards, people (including the time traveller) become younger instead of older, and everything happens in reverse as if it were in rewind. This would not count as time travel. It may be that the rest of the world is in reverse time, but the time traveller must not also be in reverse time and still be called a time traveller.

Gödelian Time Travel

Perhaps the whole reason that time travel is at the centre of much philosophical debate is the fact that it is now deemed to be a physical and mathematical possibility. Kurt Gödel has claimed that backward time travel may be physically possible. His "...discovery of certain solutions of the field equations of General Relativity that permit the existence of closed causal chains..." (Horwich, 1975: 432) leads him to make the following claim:

> ...by making a round trip on a rocket ship in a sufficiently wide curve, it is possible in these worlds to travel into any region of the past, present, and future, and back again, exactly as it is possible in [our world] to travel to distant parts of space (Gödel, 1949a: 560).

"A journey back in time would be nothing more than the 'backwards' part of [a closed causal] chain" (Horwich, 1975: 432).

Despite the fact that physics supports claims in favour of time travel, I will not be discussing the physics of time travel in this work. I dare not attempt to go into any more detail in the physics of the matter than I already have in describing Gödel's claims. I will

be using the above description and some other elementary points of physics, but the equations themselves and the technical details I will leave to those who are able.[2]

Lewisian Time Travel

It seems that despite all of this talk about time travel, I still have not provided an adequate definition. To sharpen our understanding of time travel it might be helpful to consider some of the criteria necessary for qualifying as a time traveller. First of all, it is necessary that any time traveller travel through time at a rate other than one hour per hour into the future. Otherwise everyone would be considered a time traveller, for we all are moving towards the future at the pace of one hour per hour. Therefore a time traveller must travel through time at a rate faster *or* slower than one hour per hour into the future. But, to be a *traditional* time traveller, one must travel through time, in either direction, at a significantly faster rate (e.g., one year per hour towards the past, or several days per hour towards the future).

Another necessary requirement, which is really just part of the latter requirement, is that our time traveller must remain the same age (for instantaneous time travel) or must continue to age. This means that a time traveller will be older, not younger, when he arrives at his destination. How much older will depend upon how quickly he is able to get there.

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[2] I refer those who are more interested in the physics of time travel to a mere sampling of the relevant works, by George Berger, John Earman, Kurt Gödel, and Robert Weingard as listed in my bibliography. Those who have a layperson's interest in physics might want to look more closely at the work of Paul Horwich and Hilary Putnam.

One philosophical description of time travel, found in the contemporary literature, is very much like the one just offered. David Lewis says that time travel is a "discrepancy between time and time" (Lewis: 145). This means roughly that when a time traveller begins a journey through time, he travels for a certain elapsed time (e.g., two hours), but his journey actually takes him further in time (e.g., 15, 50, or 500 years); hence the discrepancy.

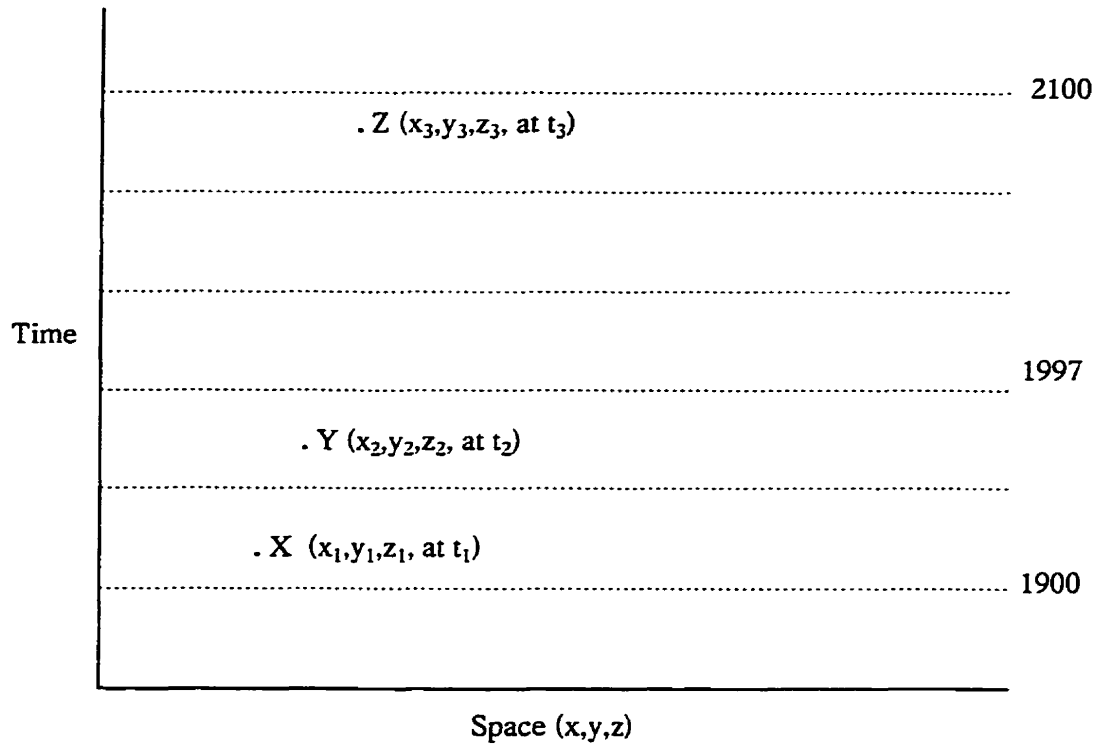

Figure 1

Like Lewis, we regard space-time as a "four-dimensional manifold of events" (Lewis: 145). If we collapse the three dimensions of space into a single dimension (hence the x, y, and z on the base line) and let time be the other dimension, we can diagram space-time as per figure 1. Any point on this space-time map is a spatial point and a

temporal point (i.e., it has an spatial coordinate and a temporal coordinate). Any object or person or what Lewis calls an "enduring thing" (i.e., anything that exists through time) can be represented on this space-time map by a line or what Lewis calls a "timelike streak." Non-time-travelling objects and persons would be depicted on this map as lines having positive slopes. Time-travelling objects and persons, however, would be depicted by a line whose slope either reaches zero and becomes negative or else stops at a point and continues at a different point earlier in time (refer to B in figure 2).

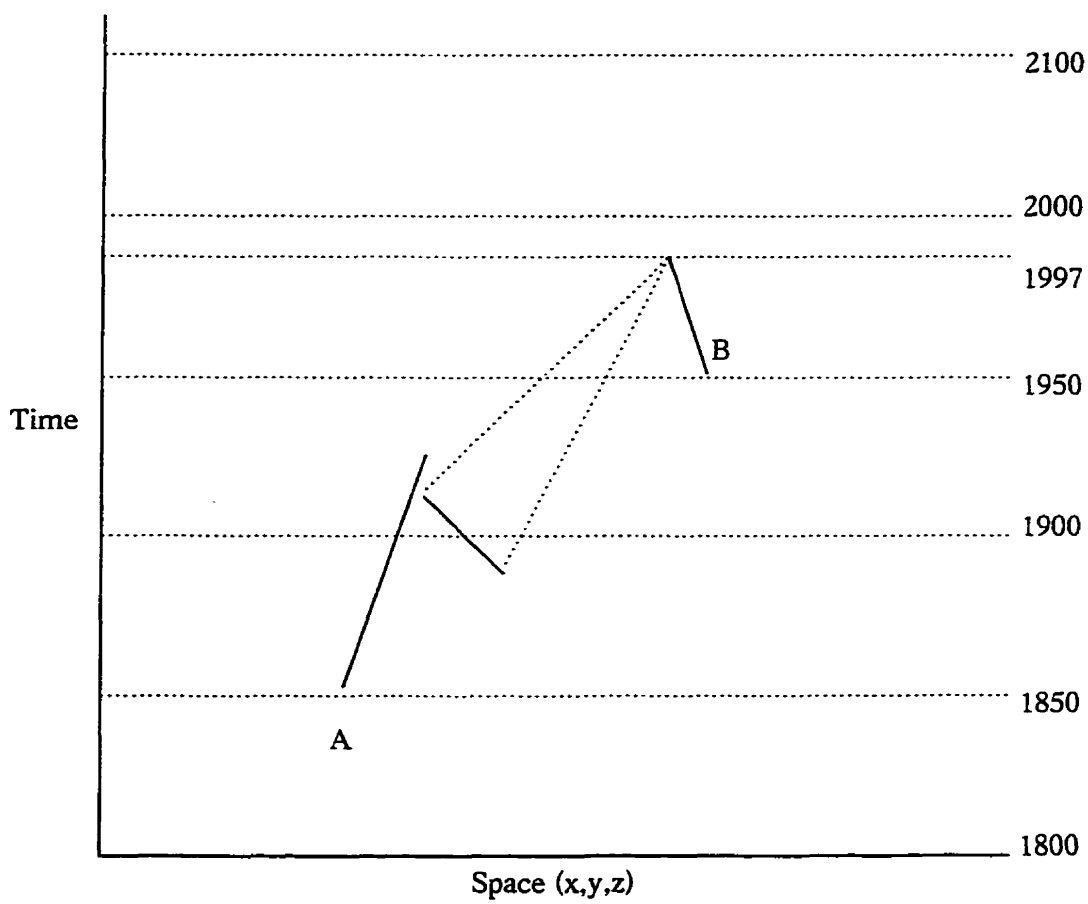

Figure 2

Lewis describes a time traveller's streak as a "zig-zag streak" for backwards time travel, a "stretched out streak" for forward time travel, and a "broken streak" for instantaneous time travel (Lewis: 146).

Conceptual Difficulties

The conception of time travel that Lewis describes seems to be of some help in developing a working definition of time travel. However, there remain some conceptual problems in his definition that might cause some confusion and ought to be addressed.

If we examine the Lewisian model, we see that the lines on the graph that move towards the past suggest that time is actually in reverse. If there is a reversal of time, it means that people walk backwards and become younger and that events happen in some sort of rewind mode. This would not properly be called time travel. In fact, it is doubtful that anyone even would be aware of such a reversal, for presumably one's mental faculties would also be reversed. The only way that this could properly be called time travel is if one were to remain the same age or continue to age (one hour per hour) even though the time line of events is moving in reverse. If one's personal time were to reverse at the same rate as the rest of the world in this time reversal, then it would not be time travel.[3] This suggests that there needs to be some clarification as to how we are to understand a graphical interpretation of time travel.

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[3] I should point out that it seems also to be time travel when one regresses in age at a rate that is less regressive than the rest of the world in time reversal. This however, would be forward time travel and is not of the sort that is philosophically interesting. As I have mentioned, I will only be discussing backwards time travel.

There are other potential problems with a Lewisian model that also should be addressed. Normally when we think of time travel we think of its taking a very short amount of time to travel a very long amount of time (i.e., the journey is understood to be *much* shorter than the time traversed). However, if we are to understand time travel as simply a "discrepancy between time and time" then problems will arise. Consider the following scenarios involving time travel: First, suppose that I have devised a time machine that works but that is very slow. I need to get to a time six months prior to now, but because of my machine's poor design it will take me 12 months to get there. Or even worse, what if it took 10 years to simply go back in time 10 weeks? Are these still cases of time travel?

Consider the following case: I have devised another machine that is designed to give me more time than everyone else. For example, suppose that I have a deadline in one week, but I am certain that I need more time to meet that deadline. My device will enable me to stay inside for two weeks and when I get out only one week will have passed for everyone else. Is this still time travel?[4]

It seems fairly clear that if these situations were to occur then they would both be considered cases of time travel. Both situations display an obvious discrepancy in times. The question remains, however, what kind of time travel it is. Is it backward time travel,

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[4] I realize that neither of these situations seems to fit the type of time travel that Gödel had envisioned (i.e., the closed causal loops) and my interpretation of Gödel's equations. For my present purpose, however, I am simply using these situations to exemplify some of the conceptual problems. In later chapters I will consider the physical impossibility of these situations when I further clarify the type of time travel that might, in fact, be possible.

forward time travel, or instantaneous time travel? We need more precision in our definition so that these conceptual difficulties do not arise.

Personal Time and External Time

In response to these problematic situations, perhaps it is best to appeal to a common distinction in discussions of time travel, the distinction between *personal time* and *external* or *world time*. Personal time is the time that the time traveller measures (e.g., by his wristwatch) and *experiences*. It is the time frame in which he ages. Personal time passes at the rate of one hour per hour for the time traveller.

External time is time relative to historical events. External time is the timeline of events that have taken place in history and that *will* take place. External time also passes at the rate of one hour per hour, and normally it coincides with a person's personal time. However, what defenders of time travel argue is that personal time and external time need not always coincide. They believe that external time can vary. Indeed, we have seen that external time does seem to vary when objects travel at high velocities.

To help clarify this distinction, consider the following example: Suppose that I enter my time machine and travel back to 25 March 1827, the day before Beethoven's death. Also suppose that it took me only two hours and fifty minutes of actual travelling time to get back to 1827 (i.e., I was travelling through time at the rate of one year per minute). Those 170 minutes would constitute my personal time, while the 170 years would constitute external time. With respect to my personal time, it would even make

sense to say that within 24 hours Beethoven will die, even though in external time his death is already 170 years in the past.

The distinction between personal time and external time enables us to make sense of the talk about the time traveller's time and the rest of the world. It enables us to sharpen our definition and say that a time traveller is a person whose personal time remains at a rate (and on some occasions a direction) different than the rate (and sometimes direction) of external time. As Lewis says, "...a stage of [a backward time traveller] is slightly later in his personal time, but ... earlier in external time" (Lewis: 146). Travelling forward in time, which is to travel faster than time, means that a stage of a time traveller is later in personal time but even later in external time.

So, what about the cases mentioned above? It seems that they are also cases of backward time travel. Considering the case where one takes two weeks to travel into the future one week, we can say that the time traveller's personal time is later (by one week over the external time) and that the external time is earlier than it would have been otherwise (i.e., if one were not a time traveller). So to be as precise as possible regarding backward time travel, we need to say more than just that it is a discrepancy between time and time. We need to say something like this: to travel backwards in time is to travel through time such that one's personal time is later and external time is earlier. In other words personal and external time fail to coincide for a time traveller. It must also be stipulated that a time traveller's personal time passes at a different rate than the external time of the rest of the world. To be even more precise we need to make sure that it is stipulated that one's personal time is moving forward (i.e., one is aging), whereas

external time may move either forward or backward relative to the time traveller. Therefore we ought to say that backward time travel means that one's personal time moves forward and that external time is moving backward at some rate, it matters not what. (We want to say, moreover, that external time is moving backwards at a very rapid rate so that our time traveller can make a significant trip into the past, although this is not a necessary criterion of something's counting as time travel.)

Finally, we need to clarify the graphical interpretation of time travel. The problem arises with a timelike streak on a graph or a map of space-time that when the slopes become negative it seems that time must be in reverse, yet I have said that this is not time travel. However, to salvage the graphical interpretation, we can suppose that the space-time map corresponds to external time and the timelike streak corresponds to personal time. This allows us to say that the timelike streak representing a time traveller may be moving towards the space-axis, but that it is still getting longer, and that provided it is getting longer the time traveller's personal time is moving forward regardless of where it moves on the space-time map. Therefore, the only way to interpret the space-time map to be representing the reversal of time would be if each timelike streak on the map were to move backwards and be erased as it doubled back towards the space-axis.

Summary

Now that we have seen what counts as time travel, we must compile what we have seen into a more succinct definition of time travel. It seems that we can say that time travel is indeed a discrepancy between time and time, but we need a bit more

clarification. Therefore, I propose that time travel is an occurrence in which a time traveller leaves the present and, continuing to age, *arrives at some point in time that does not coincide with his personal time*. This means that for backward time travel, one must continue to age and must arrive at some point in the past relative to his personal time.

To prepare for further discussion of the possibility of time travel and of the implications of, and objections to, time travel I shall now briefly comment on how we should understand Gödelian time travel and also the contemporary science fiction accounts of time travel. The type of time travel that commonly occurs in the television series *Star Trek* may not be so different from the Gödelian model as one might expect. If we consider the possibility that these closed causal chains or loops exist at various points in space-time, then all that is required is that one be able to detect one of these loops and attempt to get into it. This, of course, is to assume that there are numerous causal loops throughout space-time, and also that these causal loops are of various sizes (e.g., some may loop through a billion years, perhaps others loop for only a thousand or perhaps for only a few years). The onus is simply to find one of these loops and get on it. In this sense, the type of time travel on *Star Trek* may not be so far-fetched as we might initially believe.

In light of this, it seems that we ought to understand time travel in this manner so as to be as sympathetic as possible to the science fiction interpretation of time travel. Note, however, that this initial understanding of time travel does not mention anything about changing the past or getting back to the future. These are some of the logical problems that will be discussed in the next chapter.

Chapter II
Logical Considerations

We have seen that backward time travel can be understood as a discrepancy between time and time, such that a time traveller leaves the present and, while continuing to age at the rate of one hour per hour, arrives at some point in time prior to his personal time (i.e., in the near or distant past). In regard to its physical possibility, we have seen that backward time travel ought to be understood in a Gödelian sense. There is some physical evidence for backward time travel because there are equations derivable from the theory of General Relativity that suggest the existence of closed time loops (viz., causal chains or causal loops). I have suggested that the best way to conceptualize these loops would be to understand them as existing throughout space-time, and that to travel back in time would be simply to get caught up in one of these loops. This explanation seems to allow for some of the science fiction notions about time travel, even the possibility of detecting and catching these causal loops. It does not, however, tell us whether or not there are problems associated with time travel, problems having to do with some of the logical consequences of an actual occurrence of time travel.

In this chapter, I want to discuss many of the logical objections to time travel and to show that they do not pose any persisting problems for the conception of time travel proposed in Chapter I. I will begin by considering briefly some of the physical concerns that Gödel claims would hinder time travel, and also the objection of some physicists to the accuracy of Gödel's equations (i.e., the physics of time travel). I will then move on

the primary purpose of this chapter, which is to consider the logical objections to time travel. I will discuss objections that deal with the time-discrepancy paradox and conceptual absurdity, Leibniz's Law and personal identity, changing the past and *autofanticide*, causal loops and time loops, the rocket probe paradox, and others. I will also, in this chapter, show how these objections fail to prove that time travel is logically impossible. In the chapter that follows this, I will consider one further logical objection dealing with reverse causation and some consequences that time travel might entail (viz., fatalism).

I should warn the science fiction fan that what follows will be very disappointing. Despite the fact that I am defending the logical possibility of time travel, the type of time travel that results is very strange indeed. This resulting form of time travel will reduce the science fiction accounts to impossibilities and will remove the excitement from the traditional stories.

Mathematical Absurdity

Gödel discovered that there is mathematical evidence (viz., solutions derived from equations in General Relativity) to suggest that backward time might in fact be physically possible. The question now, however, is to evaluate whether such evidence is acceptable or if it ought to be rejected on the basis of logical absurdity (just as we reject the solution to a physics equation that calls for the square root of -2). Horwich points out (1975: 432-3) that some physicists and theorists reject Gödel's equations on similar logical grounds. Many, he tells us, "...rule out Gödel's solutions in the way that we often reject

unacceptable mathematical solutions to physical problems." The example that Horwich gives us of such unacceptable solutions is when we solve quadratic equations and we derive one root as being the square root of -2. This root is immediately rejected, and similarly some theorists want to reject Gödel's solutions. If it is true that Gödel's solutions are like the root of -2 then Gödel's evidence would, of course, not be time travel after all, and it would seem that opponents would have gained a small victory towards concluding that time travel is logically impossible. What I intend to show is that time travel is not logically impossible and that none of the problems and criticisms commonly raised against time travel entail its logical impossibility or absurdity.

Physics

Before I turn this project over completely to a logical consideration of time travel, I want to discuss briefly some physical constraints on time travel. Gödel has shown that there are equations suggesting the possibility of time travel, but he also considers what would be required to perform time travel, and he concludes that it is unlikely that it will ever be successful. This is due primarily to physical obstacles that would prevent successful time travel. Gödel writes that "the velocities which would be necessary in order to complete the voyage [through time] in a reasonable length of time are far beyond everything that can be expected ever to become a practical possibility" (Gödel, 1949a: 561). He provides a rough calculation which suggests that if one wished to make the trip

through time[5] in one year of personal time the velocities required would result in the weight of the ship increasing by a factor of 10^{22} (i.e., 10,000,000,000,000,000,000,000 times the weight of the ship), and the velocity required would be well over 7/10 the speed of light. Although he does not believe that time travel can be rejected *a priori*, he does believe that these physical constraints would make it a *practical* impossibility. (I should note that the type of trip that Gödel seems to have in mind depends on time itself being circular and that this type of time travel is such that one continually moves forward through time, but that eventually one loops back around. Thus the high speeds required to make this extended journey in only one year of personal time.)

Another physical obstacle that might prevent the type of time travel portrayed in *Star Trek* might be the detection of these time loops. What kind of device could be designed to detect these loops? Even if such a device could be developed, it would seem that one would have no control over the time the trip took and that one would be unlikely to live long enough to get to the past (because of the length of time required, not to mention what accelerating to a velocity of 7/10 the speed of light might do to a living organism).

Another thing to consider in physics would be the location of the time traveller during the trip. Presumably since his trip depends on some naturally occurring temporal anomaly, the problem of running into himself would not arise. The problem of running into oneself arises when one conceives of a stationary time-machine. As one travels back

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[5] What Gödel seems to have in mind by such a trip is that one must traverse the entirety of time and can then stop at whatever point in time one desires. Gödel believes that the physics is *logically* possible, but that it would be physically impossible.

in time in such a machine, one would be unable to avoid running into oneself and one's time-machine because they would be at the same spatial location in two (or more) different times. For time travel to be successful, one must traverse through space as well as through time. Just as one cannot travel through a wall in space, one also cannot travel through obstacles in time. This is the downfall of many of the science fiction accounts of time travelling and of time machines.

It seems to me that the objectionable cases of time travel considered below are all impossible on physical grounds. Consider the type of time travel that is believed by Gödel to be possible. It requires travelling at very high speeds for quite some time and somehow getting caught in a time loop and looping around to the past. This suggests to me that after your journey you would be a very great spatial distance from where you left. It seems that it would be impossible to coordinate a trip through time in such a way that you would end up in the near past on Earth, or even that you would end up in this same part of the universe. For example, consider any point in space and suppose that it is fixed. That point does not move but all of the stars and planets move relative to that point. We have no idea how fast our galaxy might be moving through the universe or how fast everything is moving relative to that point. Presuming that some of this is possible, it seems to suggest that it would be very difficult to find the point in space-time that corresponds to the point in space-time that Earth was at, say, in 1900.

I shall now devote the rest of this chapter to a discussion of the logical possibility of time travel.

Logical Objections to Backward Time Travel

Conceptual Absurdity

A common objection against time travel is that it is conceptually absurd and impossible on that ground.[6] Its conceptual absurdity is believed to reside in the fact that time travel requires that one "...traverse some temporal interval in a time that differs from the duration of that interval" (Horwich, 1975: 114). Such a discrepancy between time and time is deemed to be a contradiction. How can anything traverse a greater time than it takes to traverse it?

There seem to be several responses to this objection. The first and perhaps the easiest to understand is the multiplication of frames of reference for time. This is based on the distinction between *personal time* and *external time* that I discussed in Chapter I. In applying this distinction to this objection one need only point out that the time traveller measures his personal time via his aging and the clocks in his time-ship. We already know from Special Relativity that time is relative to velocity. The faster that one travels the slower that time passes for that person, for his aging and for the clocks in his moving rocket-ship. In this case external time speeds up and everything outside of the rocket-ship ages much more quickly. Here there is an obvious distinction between personal and external time, and it seems to be quite acceptable. So, in giving up the notion of absolute time in this respect, we now can also give up the notion of absolute time with respect to the time travelling situation.

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[6] See Williams, especially p. 463.

Appealing again to the Gödelian conception of time travel, we can cite the theory that one must accelerate and travel at more than 7/10 the speed of light to achieve any time travel at all. Here we will have an obvious discrepancy between personal and external time, but the idea now is to apply this to time travel. We can do this by considering that Gödelian time travel requires that one travel forward through a time loop, through the backwards part of the loop, and reduce speed and come to rest at some point much earlier on this loop. In this sense, and because of the causal time loop, there will be an obvious discrepancy between personal and external time, a discrepancy that seems to be acceptable and unproblematic.

Yet Dennis Holt objects to this line of reasoning. Holt believes that the time discrepancy paradox cannot be so neatly dismissed and that the distinction between personal time and external time is mistaken. He argues for this on the ground that it changes the conception of time travel, making it such that, in his opinion, it is not really time travel at all. He believes that for something to engage in time travel it must leave the present and arrive at another time, but that it also would make sense for the observers who are left behind to make comments such as, "Well, our time traveller should be in the past by now; I wonder how he's doing." But the distinction between personal time and external time is incompatible with such statements. For such statements to hold true there would have to be a multiplication of time and not just a multiplication of frames of reference for time. What this would mean is that somehow the past time (i.e., the destination time) and the present time (i.e., the departure time) would have to coincide. Thus a multiplication of times. This, however, is absurd. There can only be one time at a

time (in any single possible world). Yet Holt seems to believe that time travel requires such a multiplication in order for sense to be made of it. Since he believes this to be impossible, he also concludes that time travel is impossible.

I would argue that the type of time travel that Holt envisions would be impossible regardless of our distinction between personal time and external time. Holt does not notice that the type of time travel he has in mind fails not because it does not allow for a multiplication of frames of reference for time. Rather, it fails because it would require a multiplication of times, which is impossible. It is a blatant mistake to say about our time traveller that he must be in the past *now*. He is not in the past *now*; rather he *was* in the past *then*. (What is strange about this is that he *was* in the past even before the discovery of time travel, but I will deal with this below when I discuss changing the past.) This means that statements such as "I wonder how our time traveller is doing in the past" are misguided and wrong. We cannot talk about a time traveller as being in the present; rather he was in the past. The point is that Holt's objection to our distinction is based on a mistaken notion. If Holt were simply trying to show that his conception of time travel is mistaken, then he may have succeeded. However it is unclear why he attacks the distinction between personal time and external time.

Holt does, on the other hand, raise some interesting objections to our distinction. He seems to suggest that there is an absolute standard of time regardless of the fact that being in motion seems to slow down time (or at least to slow down personal time like aging). He believes that despite the fact that someone in a very fast-moving rocket ages more slowly than the people he leaves behind, there is still an absolute standard of how

much time passes. Holt is saying that regardless of whether it takes 20 years for me to age only 6 months, 20 years has still passed. I reject Holt's claim on the basis of how we understand and define time. It seems to me that it is more accurate to measure time by the same standard in every space-time location. This would mean that despite the passing of 20 years on Earth, only 6 months passes in the rocket and that both of these time measurements are fair and accurate. Indeed this seems to be what is suggested by Special Relativity (that as velocity increases, time genuinely slows down). (I will not, however, discuss the nature of time or measuring time in any more detail in the present work.)

A Violation of Leibniz's Law

There is another objection which has to do with Leibniz's Law. The principle of indiscernibility in Leibniz's Law states that identical objects are indiscernible. This means that an object A *is* object B only if they are qualitatively identical in every way (i.e., indiscernible, without differences). The objection, as it relates to time travel, is as follows: Suppose that Charles, who was clean-shaven in 1960, has a beard in 1970. Suppose also that in 1970 Charles travels back to 1960. Our understanding of personal identity tells us that they are the same person, but they would have different qualities at the same time, a scenario which violates Leibniz's Law. It seems that this introduces a contradiction into a time travel situation, and opponents then suggest that time travel must be impossible because it is incoherent.

Horwich replies to this objection by appealing to the different frames of reference for time (i.e., personal and external time). He argues that Charles's personal time is the

frame of reference for personal identity. When we use this criterion we find that Charles both has and does not have a beard in the Earth time or external time of 1960, but that in his personal time he has a beard but does not also lack one.

I agree with Horwich, but I also believe that this objection in general is somewhat misguided. Personal identity cannot be based on the principle of the indiscernibility of identicals. What if I get a hair cut today? Or worse, what if I am seriously injured and have my leg amputated? Do I cease being the same person because I am now discernible from who I was yesterday? Of course not. Personal identity is not based solely on physical identity (although it does seem that there is necessarily some physical continuity).

Lewis has a better explanation of personal identity in regard to time travel. He believes that the mental continuity and connectedness that unite any person also unite the time traveller. The difference is that for the time traveller these connections are continuous only with respect to personal time, whereas for the person who does not travel in time, these connections are also continuous with respect to external time.

It should further be pointed out that the multiplication of persons in this example with Charles seems to presuppose changing the past. It must be made clear that both the bearded and clean-shaven Charles were present in 1960 (the one and only 1960). It is not that in 1970 Charles leaves and goes to a time where his 10-year-older self lives in 1960 with his younger self for the first time. The 10-year-older Charles was in 1960 along with his younger self the one and only time that 1960 occurred (regardless of whether or not they crossed paths).

The same would go for the time machine or rocket. It might seem that once the time machine begins to move into the past there would be a duplication of the time machine and that the principle of the indiscernibility of identicals would be violated. But this would not be the case. The origin of one of the time machines occurs when it is built, say, in 1970. The origin of the second time machine is unexplained in 1960. (At least it seems unexplained, I will show below that it would actually be caused by reverse causation.) Indeed, the time travelling time machine exists before it is built and leaves 1970. The point is that there is no duplication of time machines, for there were two all along. (There are further objections associated with this point that will be considered below with causal loops.) In light of these responses, it seems that the objection that time travel violates Leibniz's Law is unfounded.

Personal Identity Problems

I shall now discuss the topic of personal identity in more detail. There are interesting problems that seem to arise for personal identity (like the one already mentioned), but the most important involve cases where a time traveller travels to the near past and visits his earlier self. In such a case we have $Charles_1$ who lives (clean-shaven) in 1960, and we have $Charles_2$ (bearded) who leaves 1970 to travel through time and arrives in 1960. Therefore we have both $Charles_1$ and $Charles_2$ living in 1960. The question is whether or not this is a duplication of persons (i.e., are there two Charleses in 1960?). Are these two Charleses one person or two persons?

There seems to be a simple response to this objection, as pointed out by Douglas Ehring. He believes that there would be absurd consequences if there were only one person. He offers instead the explanation that there is an earlier stage of Charles ($Charles_1$) living at the same time as a later stage of Charles ($Charles_2$). Ehring suggests that "distinct stages of [Charles can] exist concurrently, and such stages may have different and incompatible characteristics" (Ehring: 429). This seems to be quite in line with the distinction between personal time and external time and to be acceptable and consistent.

Changing the Past

It seems appropriate that one of the first people to object to time travel is the very one who claimed that it was physically possible. Gödel himself poses the objection that time travel would result in a change in the past and therefore must be considered logically impossible or absurd. Gödel believes that the type of time travel that his equations permit would

> ...imply an absurdity. For it enables one e.g., to travel into the near past of those places where he has himself lived. There he would find a person who would be himself at some earlier period of his life. Now he could do something to this person which, by his memory, he knows has not happened to him. (Gödel, 1949a: 560-1)

In other words, Gödel is concerned that time travel would permit, or even require, one to change the past.

The belief that time travel might entail changing the past raises numerous objections to time travel. Indeed, the impression that time travel entails changing the past

was the basis for my initial rejection of time travel. I once thought that time travel would entail changing the past and that such a consequence was a fatal blow to any defense of time travel. I am no longer convinced, however.

Is it possible for a time traveller to change the past? Lewis replies, "It seems not: the events of a past moment could no more change than numbers could. Yet it seems that he [the time traveller] would be as able as anyone to do things that would change the past if he did them. If a time traveller visiting the past both could and couldn't do something that would change it, then there cannot possibly be such a time traveller" (Lewis: 149).

There is a logical contradiction in saying that a time traveller both can and cannot change the past. To illustrate the issue at hand consider the following scenario proposed by Lewis: Tim detests his grandfather and would like to kill him, but Grandfather has already died; Tim builds a time machine and goes back before Grandfather's death; he buys a rifle and takes shooting practice and is fully equipped and capable of killing Grandfather. So can Tim kill Grandfather? Lewis's answer is that Tim cannot kill Grandfather. He says that since Grandfather lived, killing him would be to change the past. Lewis argues that "the events of a past moment are not subdivisible into temporal parts and therefore cannot change" (Lewis: 150). He believes that it is logically impossible to change the past, so "Tim cannot kill Grandfather" (Lewis: 150).

We must ask, however, "What prevented Tim from killing Grandfather?" *Why* will he be unsuccessful? Lewis argues that Tim will inevitably fail, because otherwise it would change the past. He may fail because of some trivial reason such as a distraction, a mistake, a feeling of mercy or a lack of nerve. He defends this position by pointing out

that "we often try and fail to do what we are able to do. Success at some tasks requires not only ability but also luck, and a lack of luck is not a temporary lack of ability" (Lewis: 150).

Lewis's response seems to be inadequate. His response does not account for one's never being able to perform an act in the past that would result in a change. He insists that every attempt would inevitably fail, but Lewis offers no reason other than that it simply *must* fail. There appears to remain a contradiction when Lewis says that Tim both *can* and *cannot* kill Grandfather. He can because he is physically capable, and he cannot because it is logically impossible to change the past (i.e., something, a malfunction or otherwise, will prevent the assassination attempt). But Lewis maintains that there is no contradiction. He compares it to one's ability to speak a foreign language even though one cannot speak that language. One has the physical ability (i.e., the necessary physiology) to speak the language but does not know the language and therefore cannot speak it. He says that one set of facts makes it true that one is able to speak a foreign language, but another larger set of facts makes it false. In a sense Lewis is right. The two uses of "can" are of different sorts. One is physical capability and the other is logical. The problem that remains, however, is why it is logically impossible for a time traveller to act in such a way as to cause something to happen that would not otherwise have happened. In other words, a time traveller cannot change the past, but he can *influence* the past. This, I will show, is not logically impossible at all.

Horwich agrees with Lewis's argument that Tim is free and capable of changing the past but that he will be unable to actually cause any change. Horwich argues that Tim

cannot change the past, but that he can *influence* the past. He agrees that it is logically impossible to change the past, but that it is not logically impossible to influence the past. He says that it is the same as our influence on the future. Of course we cannot bring about an event that will not happen, but we can contribute to the occurrence of future events. He does not make it clear what exactly this would mean, but I infer that it means that Tim can influence the past only in so far as he can play a role in making the past occur exactly as it *did* occur.

Horwich refers to a change in the past effected by a time traveller as "bilking." Bilking "is bringing about some past event that did not occur, such as killing one's infant self [autofanticide] or doing something one remembers was not done" (Horwich, 1975: 120). Horwich and other defenders of time travel want to say that bilking is impossible. Horwich rejects the possibility of bilking by saying that it simply cannot happen and thus will not happen. In this scenario, either I don't do something to my earlier self that I don't remember, or else I do it, and my memory is simply mistaken. He also points out that you cannot go back in time and kill your earlier self because "only those who fail will ever be in a position even to make the attempt" (Horwich, 1975: 117). These objections to time travel take the following valid form:

1. If time travel is possible, then bilking is possible.
2. But bilking is impossible.
3. Therefore time travel is impossible. (Horwich, 1975: 119)[7]

[7] I should note that Horwich uses the subjunctive in the first premise, and I have used the indicative. I make this change simply to avoid unnecessary complications, and I do not believe that it affects the point that Horwich is making.

Both Horwich and Lewis avoid this argument by denying the first premise. They believe that it is an assumption that opponents to time travel have no reason to posit. They argue that it does not follow from the possibility of time travel that bilking must also be a possibility. The first assumption is no more than question-begging against the possibility of time travel.

Lewis's and Horwich's defenses of time travel against the claim that it would entail changing the past do not seem entirely adequate, however. For they fail to explain *why* no occurrence of time travel would result in bilking. Consider the following scenario: Suppose that A, age 40, leaves 1997 and travels back in time and encounters B around 1900. It would seem that A's very arrival at the turn of the century would be a change in the past. If A even exists in 1900, then that fact would constitute a change in 1900. Lewis's and Horwich's defenses do not explain why it is not the case that A's arrival would necessarily constitute a change in 1900. The way in which they construe the problem allows for the impression that A would have to try to cause a drastic change, such as killing someone or stopping a war or injuring his earlier self. They do not, however, make it clear why it is not the case that if A even arrives in 1900 then a change must occur. A's existing in 1900 seems to entail that something happens differently in the time traveller's 1900 (i.e., the second 1900) than actually happened in the original 1900 (i.e., the 1900 of the 1997 record books). In the original 1900, it is objected, there was no such person as A.

This argument simply affirms the premise that Horwich and Lewis reject and goes as follows:

1. If time travel is possible, then bilking is possible.
2. But bilking is impossible.
3. Therefore time travel is impossible.

Again, what is required to reject this argument is to show that one of the premises is false. Horwich and Lewis have not adequately demonstrated the falsity of premise one, thereby leaving us with the above scenario. What is required now is to make it much more clear why premise one is false.

Why is it that premise one is false (i.e., why doesn't time travel entail bilking)? We need to know how, contrary to our initial intuition, it can be that time travel avoids the possibility of bilking. One of the initial problems with the above scenario is the duplication of times (i.e., the talk about a first and a second 1900). What is required is a view that allows A to be present in 1900 the first and only time that it happened (i.e., *the* 1900), even though A was not born until 1950. (This view will require discussion of reverse causation, discussion of being alive and even dying before you are born, etc. I will reserve discussion of these issues for later and consider them in turn.)

Larry Dwyer also takes issue with any assumption, explicit or implied, that involves the duplication of times. He rejects any talk of there being an original 1900 that happened as per our history books, and there also being a second 1900 which is the destination of a would-be time traveller. In other words, he rejects the notion that there is a multiplication of times. Dwyer's position is the same as Lewis's and Horwich's in that he insists that changing the past is impossible. He insists that "Whatever else time travel may entail, it does not involve changing the past" (Dwyer, 1975: 341). Dwyer, however, makes his position a bit more clear and more persuasive, as I will argue. Dwyer's position

on time travel is best summed up in his following statement: "Having hypothesized that an individual travels back in time, the time traveller cannot travel to any time in the past that he has not already lived in" (Dwyer, 1975: 344). What this means is that a time traveller travels to the original 1900 (or whatever time is his destination) and lives there for an interval of time as things happened the first and only time.

The misconception that Dwyer wants to dismiss is the notion that a "year occurs twice, once as recorded in accurate history books and the second time in order to serve as the destination for the time traveller..." (Dwyer, 1975: 345). To explain his position he offers a scenario in which person *T* travels back to talk to his younger self. At t_1, *T* enters his time machine and begins his journey to the past; at t_2, *T* talks to his younger self. What Dwyer points out is that the misconception is that t_1 is temporally prior to t_2. In other words, that first *T* enters his machine (at t_1) and *then* talks to his younger self (at t_2). In other words, the misconception is that t_1 both precedes t_2. When in fact, t_2 must precede t_1. This means that *T* has talked to his earlier self before he enters his time machine. What Dwyer is saying is that *T* was present the first and only time that t_2 occurred; that there is no duplication of times or any other temporal anomaly in backward time travel. This view may be similar to what Horwich has in mind when he insists that a time traveller could only *influence* the past. It also corresponds to the inference that I made regarding this point: a time traveller can influence the past only in so far as he can play a role in making it occur exactly as it *did* occur.

This way of thinking about time travel avoids some of the confusion in Lewis's and Horwich's views. It helps to illustrate that Lewis and Horwich have made the

mistake of thinking that the time traveller *will* visit the past and interact with past persons. What Lewis and Horwich should have said is that the time traveller *has visited* the past. Perhaps they could have avoided this confusion if they continued their use of personal time and external time and made it clear which they were talking about and when. However, despite this confusion in their work, it seems that it is easily cleared up and that Lewis and Horwich were correct.

Although Dwyer seems to deal with this issue in a more satisfactory manner than do Lewis and Horwich he still has not made it entirely clear why we ought to believe that our time traveller was present in the original 1900 or how he might have gotten there. I will attempt to explain this further and to make it clear how we are to understand this case.

The best way to understand how this is supposed to work is to once again look closely at the physical conception of time travel proposed by Gödel. Gödel provides us with a model of circular time. It is a model of time such that time contains causal loops, loops in which time moves in a circle repeating itself. What is happening in these loops seems to entail some sort of reverse causation or even fatalism (the possibilities of which I will grant here but will not explore further until Chapter III). Person A is born in 1950, which is the beginning of his existence. But somehow A was present in 1900. How? It seems to me that the best way to make sense of how A existed and lived in 1900 even though he was not born until 1950 is to say that he was born into a causal loop. This would permit us to say that he arrived in 1900, died in 1930, was born in 1950, and

mysteriously vanished in 1997 (i.e., if we are to consistently refer to external time), all of this being possible only because of the time loop.

When we look at it this way, it seems that the objection that A cannot even arrive in 1900 without changing the past becomes more obviously confused. A can do whatever he wants. He can breathe, he can run, he can influence politics, etc., etc. The only thing that A cannot do is something that is logically impossible (just like everybody else, whether a time traveller or not). And something that is logically impossible is to change the past or to change the future. Notice however, that both of these phrases mean only that one cannot have done something that didn't happen, and one cannot do something that won't happen.

At first glance, it seems that if A had travelled to the near past and encountered his earlier self, then he could indeed kill himself, for the causal loop would seem to permit it. However, because of the effects of reverse causation (which I will deal with in Chapter III) there are some things that cannot be avoided or undone. In this case it is logically impossible for A to kill his earlier self, because A survived to enter this causal loop.

Others might want to argue that A could in fact have killed his earlier self because of the fact it would have happened within a causal loop. What this would mean is that A could have killed the younger A because in a causal loop we could allow for the unexplained origin of A. Because A is existing in a causal loop it seems that there is no explanation of A's origin, so it makes as much sense to say that the older A just appeared out of nothing and killed the younger A. This is a view that I will not defend because I

want to avoid the unusual implication that a 40-year-old man can just randomly come into existence. The type of reverse causation that I will defend below seems to be better suited to avoid such implications. Below I will discuss the effects of reverse causation and consider whether or not the existence of A is logically possible at all. But I will not consider the possibility that A's origin can remain a mystery and that A could indeed kill his earlier self.[8]

Causal Loops

Another objection that can be raised against the possibility of backwards time travel has to do with causal loops. A causal loop is a loop in time in which it is not obvious where certain objects or information originate. A causal loop occurs in the following scenario: Suppose a time traveller went back in time and spoke to his earlier self. Also suppose that the time traveller told his earlier self how to build a time machine. As Lewis says, "That information was available in no other way. His older self knew how because his younger self had been told and the information had been preserved by the causal processes...of memory traces." The question is, "Where did the information come from in the first place? Why did the whole affair happen?" (Lewis: 149)

Lewis's response to such a loop is rather disappointing:

> There is simply no answer. The parts of the loop are explicable [;] the whole of it is not. Strange! But not impossible, and not too different from inexplicabilities we are already inured to. Almost everyone agrees that God, or the Big Bang, or the entire past of the universe, or the decay of a tritium atom, is uncaused and inexplicable. Then if these are possible, why not also the inexplicable causal loops that arise in time travel? (Lewis: 149)

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[8] For further discussion of the objection regarding the possibility of changing the past see the works by Cook, Dwyer, Horwich, Lewis, and Thom.

At first glance this response appears to be insufficient. However, it seems to me that this answer is in fact correct, strange indeed, but correct. But I do believe that it requires some further explanation to see why.

The issue that arises from discussion of causal loops is reverse causation, which I will deal with shortly. For now, however, I will say simply that there appear to be no logical problems with causal loops that would immediately entail the absurdity of time travel. Despite some other problems (viz., the unknown origin of the information in this scenario) time travel seems to remain logically sound. I will address the concept of causal loops in more detail when I discuss reverse causation. For now I will say that it is indeed true that causal loops are strange, but there does not seem to be any reason to say that they are impossible.

The Rocket Probe Paradox

The final objection that I will deal with in this chapter has to do with a neat little puzzle developed by John Earman. Timo Airaksinen paraphrases Earman's puzzle as follows:

> Suppose there is a rocket carrying a (time-travelling) probe and containing a sensory device connected to a switch. This switch, when in the 'on' position, prevents the firing of the probe. In the 'off' position it permits the firing. The sensory device is programmed to detect the probe returning from its time travel. Contact with the probe locks the switch in the 'on' position [i.e., so it can't fire]. Now, if the probe is fired into the past, the switch must have been in the 'off' position. The rocket in the past will contact the probe, which will result in the switch shifting to the 'on' position. This will prevent the firing of the probe in the present, which is a contradiction. To repeat, if the probe is fired (into the past), the switch is on and the probe cannot be fired; if the switch is off, the rocket fires the probe which, however, was *not* fired (according to the hypotheses). (Airaksinen: 117)

Earman's response to the question of whether or not the probe is fired is that "We find that the answer is that it is fired if and only if it is not fired, which is a contradiction if standard logic holds" (Earman, 1972: 231).

This puzzle is similar to the problems dealing with causal loops, and it seems that we ought to say, as Airaksinen says, that "the causal chain must break" (118). I argue that this puzzle is more similar to the case discussed above regarding Tim and his desire to kill his grandfather. In other words, I suggest that this rocket puzzle is simply impossible. Like Tim's inevitable failure, the rocket cannot work as planned.

As we have seen, in Tim's situation it is not the case that he *will* fail and that something *prevents* him from killing his grandfather -- it is that he *already* failed and that something *prevented* him in the past from killing his grandfather. The problem is that people tend to think that the time traveller *will* visit the past, but in actuality, the time traveller will have *already* been there. Tim failed for whatever reason, but his efforts were thwarted before he even conceived of the possibility of killing his grandfather and before he ever built his time machine. The same goes for the rocket puzzle. It is not the case that the rocket *will* inevitably fail. It *already* did fail. (This may seem puzzling or perhaps unsatisfactory. It will become clearer when I discuss the possibility of reverse causation and what it means for causal loops. This is so because the arrival in the past of a time travel is simply an effect of a cause in the present. Time travel, as we shall see, is, in effect, little more than an occurrence of reverse causation.)

Despite Earman's insistence that "we do have good evidence that in our world, rocket ships can be programmed in a manner similar to the one envisaged" it does not

follow that the rocket ship or program will function as intended. Even if such a probe can be successfully designed, built, and programmed, it must inevitably fail (just as Tim must). In fact, it would be more appropriate to say that the probe has already failed, just as Tim must have already failed; failed even before it was attempted. What is suggested in Earman's puzzle is analogous to designing a program to square the circle, or trisect an angle, or perform some other impossible task. In this sense, it seems that Earman's puzzle is actually an unfair attack against time travel. Such a machine cannot possibly work. But its impossibility does not also entail that time travel is impossible. The only way that this puzzle could entail that would be if it could show that time travel necessarily entailed the possible success of such a machine, which it does not.

Furthermore, to help understand *why* this type of machine cannot possibly work, we can appeal once again to the Gödelian model. The type of time loop or causal loop that is possible according to Gödel's solutions would make it impossible to successfully operate such a machine as that in the rocket puzzle. What we are talking about in this puzzle is a causal link designed to thwart itself. In a causal loop we have transitive causation of the sort $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$ (note that the '$\rightarrow$' is a causal relation, i.e., A causes B, etc.). In this case we have a different scenario than Earman's. Here we have the signal arriving (A), the sensor receiving the signal (B), the switch *enabling* the probe to be sent (C), the sending of the signal (D), and the signal arriving in the past (A). This is a causal loop that is void of any contradictions. (The only question is the origin of the signal. I will deal with this in Chapter III.) What Earman does with his puzzle is change

one of the variables to break the causal loop and thus, unbeknownst to him, make the entire situation a practical impossibility. His causal relations run as follows: $A \rightarrow B \rightarrow \sim C \rightarrow \sim D \rightarrow \sim A$. His error is that his puzzle requires that $A \rightarrow \sim A$ (i.e., A causes ~A), an impossible expectation.

Summary

In this chapter we have seen that there are some mathematical and physical objections to time travel. We have also seen that these physical objections seem to make time travel utterly impracticable. However, we have not yet seen that it is physically impossible or logically impossible.

I have discussed numerous logical objections to time travel based on worries about conceptual absurdity, Leibniz's Law, personal identity, changing the past, causal loops, and paradoxical puzzles. I have shown that none of these objections deal a fatal blow to the logical possibility of time travel. In other words, none of these objections show that time travel entails a logical absurdity. I have shown that to refute these objections one need only work to clarify the notion of Gödelian time travel. I have defended time travel by appealing to such notions as the distinction between personal time and external time, getting clear on what time travel would mean (viz., that a time traveller has *already* been to the past, not that he *will* visit the past in external time), and explaining in more detail the concept of time travel that Gödel concluded was a physical possibility.

In the next chapter, I will consider some more interesting and potentially more devastating consequences of time travel. I will discuss how time travel entails reverse causation and consider whether or not reverse causation is logically possible. I will discuss also how time travel might entail fatalism, on the ground that reverse causation seems to entail fatalism.

Chapter III

Reverse Causation

In the previous chapter, I showed that many of the logical objections to the possibility of time travel can be dealt with adequately. However, as I alluded to in Chapter II, some of these queries about time travel seem to require the positing of something further in order to satisfy the opponent's concern about time travel. It seems, in fact, that many of the replies to the foregoing objections (especially objections about changing the past, causal loops, the rocket paradox, and even personal identity) implicitly rely on the possibility of reverse causation. In this chapter I will explore the notion of reverse causation and determine whether or not it is vital to a conception of time travel, and also whether or not it is itself logically possible or simply absurd. I will consider many arguments surrounding this issue and will attempt to apply these to our conception of time travel.

I will discuss the argument that if time travel requires reverse causation, and if reverse causation is itself logically impossible, then time travel (except for some more radical version of time travel, e.g., one involving closed time) is logically impossible. Up to this point I have shown that many of the common objections to time travel are mistaken and fail to threaten the logical possibility of time travel. Now, however, I will address a thesis -- that reverse causation is possible -- that has many vehement opponents and which faces stronger objections. Also, the possibility of reverse causation seems to be even more counter-intuitive than any of the previous objections to time travel. In this

chapter I will show that reverse causation, despite its counter-intuitive consequences, is not logically impossible. I will also show, again despite our intuitions, that its logical possibility is entailed by the logical possibility of time travel as well.

Reverse Causation

David Lewis says that "...travel into the past necessarily involves reversed causation. For time travel requires personal identity" (Lewis: 148). Lewis means that for a time traveller to arrive in the past and to be the same person which left the present there must be some continuity of his personal identity from present to past. In other words, present states of affairs (viz., our time traveller's identity) are the cause of past states of affairs (viz., our time traveller's identity in the past). In this same context, Lewis also refers to causal loops or causal chains, and, as we have seen above, he states that they are inexplicable just like the origin of the universe. He believes that reverse causation is necessary for time travel and that both are logically possible.

Another example of reverse causation, one that avoids questions of personal identity, deals with the time travelling device or time machine. The manipulation of dials in this time machine is considered to be the cause of our time traveller's arrival in the past. There seems to be no way to avoid this implication and therefore we are forced to conclude that time travel does indeed require reverse causation. Therefore the question that we are faced with is whether or not an effect can precede its cause.

Many argue that it is absurd to suggest that an effect can precede its cause. They think that it would require a drastic change in the meaning of the terms 'cause' and

'effect' or of 'past' and 'future.' Others think that even if reverse causation does require a change in word-usage, it is not a drastic change; and that change does not result in logical absurdity. I will now consider arguments for and against reverse causation.

Defending Reverse Causation

A typical defense of reverse causation begins with a scenario involving reverse causation and an ensuing examination of what it must involve. There are several of these reverse causation examples in the literature. I will mention only a few here.

Michael Dummett provides an example in which "a chief [is] belatedly dancing to secure brave behaviour among his tribesmen" (Mellor: 177). Dummett's example is as follows:

> Suppose we come across a tribe who have the following custom. Every second year, the young men of the tribe are sent, as part of their initiation ritual, on a lion hunt: they have to prove their manhood. They travel for two days, hunt lions for two days and spend two days on the return journey; observers go with them, and report to the chief on their return whether the young men acquitted themselves with bravery or not. [...] While the young men are away from the village the chief performs ceremonies--dances, let us say--intended to cause the young men to act bravely. We notice that he continues to perform these dances for the whole six days that the party is away, that is to say, for two days during which the events that the dancing is supposed to influence have already taken place (Dummett, 1964: 348-349).

Furthermore, every time the chief fails to dance for the last two days, it is reported that the young men were not brave, and every time the chief continues to dance during those two days it is reported that they were brave. The chief, and indeed the other natives, believe that the dancing, even the belated dancing, causes the young men to be brave. The scenario further suggests that the chief's dancing *causes* the young men to have been

brave and also that the chief and others have strong empirical evidence to support their beliefs.

Similarly, Dummett offers another argument that Bob Brier paraphrases as follows:

> A man always wakes up three minutes before the alarm of his clock goes off. Frequently he does not know whether the alarm is set, and if so, for what time. An instance might even be stipulated in which the man wakes up and, for some irrelevant reason, a friend walks into his room and sets off the alarm exactly three minutes later. In such a case it might be said that the man wakes up because the alarm clock is going to go off (Brier: 360).

Brier offers another scenario involving a magician who has a spell for causing clear weather. Normally he uses the spell for future dates, but when he tries it on a past date in a particular town, he finds out later that it was indeed a clear day on that date in that town. "Further, every time he tries his spell in this manner, he learns that there was good weather" (Brier: 360).

These scenarios seem absurd at first. However, once we neglect the fact that they appear to depend on magic or some other mystical power (for we could substitute more acceptable scenarios, e.g., the alarm clock example or, even better, physics experiments involving atomic particles), we can use them to help us understand how a defense of reverse causation works. Dummett argues that these scenarios are entirely possible and that the only argument that is successful against their logical possibility commits the same fallacy as the fatalist's argument for fatalism.

Arguments for fatalism typically run as follows: Either I will be killed in battle or I will not be killed in battle. If I will be killed, then nothing I can do now can change

that. If I will not be killed, then nothing I can do now can change that. Therefore, nothing I can do now can affect whether I am killed in battle. Similarly, arguments against reverse causation run as follows: Either my brother was killed in battle or he was not. If he was killed in battle, then nothing I can do now can change that. If he was not killed in battle, then nothing I can do now can change that. Therefore, nothing I can do now can affect whether he was killed in battle.

Dummett believes that this argument for fatalism is fallacious. He says that the problem is that a fatalist infers from 'You will not be killed' to 'If you do not take precautions, you will not be killed' to 'Your taking precautions will not be effective in preventing your death.' This, however, is invalid according to Dummett. He says it is impermissible to pass from 'If you do not take precautions, you will not be killed' to 'Your taking precautions will not be effective in preventing your death.' People do indeed want to say that the taking of precautions can be effective in preventing one's death. Dummett says that for the logical step above to "be permissible, the truth of 'If you do not take precautions, you will not be killed' would have to be incompatible with that of 'If you do not take precautions you will be killed'; but, on the sense of 'if' on which the first step was justified, these would not be incompatible" (Dummett, 1964: 348). Therefore, the fatalist's argument is fallacious.

Dummett believes that a similar fallacious argument can be put forward concerning the tribal chief in the scenario I mentioned above. In this situation the opponent of reverse causation puts forward an argument that is closely analogous to the fatalist's argument. An opponent says to the chief on the last two days:

> Why go on dancing now? Either the young men have already been brave, or they have already been cowardly. If they have been brave, then they have been brave whether you dance or not. If they have been cowardly, then they have been cowardly whether you dance or not. [...] Thus your continuing to dance will in the one case be superfluous, and in the other fruitless: in neither case is there any point in your continuing to dance (Dummett, 1964: 350).

Dummett provides the following response to this objection:

> The chief can reply in exactly the way in which we replied to the fatalist. He can say, 'If they have been brave, then indeed there is a sense in which it will be true to say that, even if I do not dance, they will have been brave; but this is not incompatible with its also being true to say that, if I do not dance, they will not have been brave. Now what saying that my continuing to dance is effective in causing them to have been brave amounts to is that it is true both that, if I go on dancing, they have been brave, and that, if I do not dance, they have not been brave. I have excellent empirical grounds for believing both these two statements to be true; and neither is incompatible with the truth of the statement that if I do not dance, they have been brave, although, indeed, I have no reason for believing *that* statement' (Dummett, 1964: 350).

What Dummett is saying is that the statements (1) "if I go on dancing, they have been brave" and (2) "if I do not dance, they will not have been brave" are compatible with the statement (3) "even if I do not dance, they will have been brave." It seems that on the face of it statements (2) and (3) are contradictory. Has Dummett made an error or are these indeed compatible? It seems that there is compatibility in these two statements. Their compatibility depends upon the conditional (3). Dummett's more complete version of (3) is (3*) "if they have been brave, [then] even if I do not dance, they will have been brave." In (3*) there is more empirical evidence than in the other statements (i.e., that they have indeed been brave). What this means is that there is now evidence to suggest that the causal connection the chief believed to exist between his dancing and the young men's bravery does not actually exist. However, in the scenario provided, there is ample

empirical evidence to suggest that the causal connection does indeed exist. For every time the chief fails to dance on those final two days the young men fail to have been brave. This is why the chief says that he has no reason to believe (3) even though he admits he would be compelled to believe (3*). In this sense, these three statements are indeed compatible (i.e., (1), (2) and (3*)).

The fatalist believes that these three statements remain incompatible. The error that she commits is that she understands (3) to be equivalent to (3*). What this confusion does is lead her to import (3*) every time she uses (3) which leads her to confuse the claims that are being made. Indeed (2) and (3) are incompatible, but (2) and (3*) are not incompatible. The reason for this lies in the empirical evidence offered in (3*) that (3) does not have. Again, (3*) is saying that the young men have already been brave, while (3) has no such evidence. When this evidence is introduced it simply requires the reevaluation of the causal connection between the dancing and the bravery, but it does not follow that the dancing has no effect on the young men's performance. I should note again however, that this type of affecting is not such that one can change a past event. It is simply a logical means to explain the occurrence of some past events. In other words, there may be some events in the past that have no causal explanation other than some later event, hence reverse causation.

In this way Dummett believes that it is reasonable to conclude that his response to this fatalistic argument against reverse causation is correct to the same degree that his response to the fatalist's argument is correct.

Indeed this response seems to parallel the arguments against the fatalist, and it seems to be correct. It gives support to the thesis that reverse causation is logically possible, although of course it does not suggest or give evidence for saying that reverse causation occurs; but this is not my present project. There still remains, however, a further possibility that might assist an opponent of reverse causation. One might point out that there is an immense difference between the past and the present, namely, that the past is fixed and the future is not. The fatalist is trying to prove the counter-intuitive claim that the future is fixed and that nothing we can do now can change anything that will happen. The opponent of reverse causation, however, does not need to prove that the past is fixed, because there is general consensus that it is fixed. It is true that nothing we can do now can change the past.

Dummett mentions a second objection that echoes the concern over the difference between the past and the present. It is an epistemological objection that has to do with the chief's having the potential to *know* whether or not the young men have been brave before he dances on the last two days. "If the dances are capable of bringing it about that the young men have acted bravely, then they ought to be able to do that even after [the chief learns] that the young men have *not* acted bravely." This objection is a bit unfair because it places a burden on the chief to bring about an event that cannot be brought about. In this case we are dealing with the effecting of a past event, but the same conditions apply to future events as well. It is impossible to bring about an event that will not be brought about.

One is unable to prevent from happening what *will* happen. And knowledge of what *will* happen simply tells one what will happen and that one will be unable to prevent it and thus ought not to try. This, however, does not mean that one's actions are ineffective in bringing about that very event one foreknew or any other event (i.e., fatalism does not follow). Notice also that the knowledge makes no difference in cause and effect relationships, whether they are forward or backward causal relationships.

Unfortunately for defenders of reverse causation, there is not a direct similarity between affecting the future and affecting the past. It seems, in principle at least, that one can know everything that has happened and thus know better than to try to change anything in the past. Similarly with the chief. Once he knows that the young men have been brave it seems redundant to attempt to make them to have been brave. However, reverse causation advocates can appeal to the possibility that that prior event could be caused by the posterior one. In other words the later dancing causes the earlier bravery. Notice also that this means that if the men have been brave (and the dancing was in fact the cause) then the chief will necessarily dance regardless of his knowledge of the young men's bravery. This is not fatalism. It is simply determinism. This means that an event cannot happen without its cause, regardless of when in time that cause happens. This is why the chief will necessarily dance, assuming the young men have been brave, if in fact the dancing is the cause of their bravery. Again, we can see that there is no contradiction or logical problem in suggesting that a cause may come after its effect.

In light of these examples and of Dummett's discussion, it seems that reverse causation is not easily dismissed. What I have described seems to remain quite coherent

and thus suggests that reverse causation may be a legitimate form of causation. Now I will see whether or not there are any further logical problems with reverse causation and evaluate them accordingly.

Before proceeding, I should point out that reverse causation is not as straightforward as it might appear. I want to reiterate that defenders of reverse causation are not trying to show that the past can be changed. They are simply trying to show that an event might be caused by nothing other than a subsequent event. In other words, events that have already happened and cannot be changed in any way might not have been caused by anything temporally prior to them. Rather they might have been caused by something temporally posterior. Notice, however, that this implies that certain present events might have a cause in the future (i.e., they are not caused yet, temporally speaking). The young tribesmen are brave today because their chief *will* be dancing for them tomorrow (notice that it is not the tribesmen's knowledge of the chief's future dancing that inspires them to be brave; the dancing itself causes them to be brave). How this might work is not one of my present concerns, although it does appear rather difficult to offer such an explanation.

Objections to Reverse Causation

Initial objections to reverse causation are often based on logical considerations. One objection states that it is logically impossible for an effect to precede its cause because by definition or by the rules of logic, an effect always follows its cause. Another common objection is that reverse causation appears to result in a change in the past. Yet

another is to say that what appears to be a correlation that is best described as reverse causation is really only a series of coincidences.

The initial objection is correct that an effect cannot precede its cause as a matter of logic. However, it is quite easy simply to alter our notions of cause and effect in such a way as to leave out temporal order. We can define a cause as being a sufficient condition for the effect and an effect as being the consequence of a sufficient cause. If we can abandon the requirement of temporal order, we can still make sense of cause and effect, and we can still say that an effect can precede its cause.[9]

Antony Flew objects to the possibility of reverse causation on each of the grounds mentioned. He criticizes the examples that are provided to describe a case of reverse causation by saying that they are based simply on observation. He means that there is only an observed correlation between the two events and that if experiments were performed one would be able to confirm the real (i.e., the prior) cause (according to Flew). Flew thinks that these experiments would show that the whole situation is merely a coincidence (Flew, 1954: 56). This objection, however, does not make it clear why reverse causation should be ruled out. Flew wants us to experiment and work harder to determine the causal powers of the two events and which caused which or if there was some common cause of both. He is not successful, however, in showing that it is logically or physically impossible for the correlation observed in reverse causation to

[9] Some may wish to apply the personal time and external time distinction to these cases. A defender of reverse causation or of time travel may simply want to reply that causation has to do only with personal time. I have not discussed this line of reasoning because it seems to be a bit weak compared to some of the other objections and replies. Also, resorting to only personal time for explaining reverse causation may not work in any cases other than those dealing with personal identity.

hold true. In the examples provided, saying that it is merely coincidence would be the equivalent of saying that it is only a coincidence that rocks fall downward rather than upward.

Flew also objects to reverse causation on the grounds that it results in bilking or a change in the past. Since changing the past is impossible and reverse causation results in changing the past, reverse causation must be impossible too. I should point out that many philosophers[10] have made it clear that reverse causation does not involve *changing* the past. Rather it involves *affecting* the past. But Flew also rejects any notion of affecting the past. In response to the suggestion that reverse causation involves affecting but not changing the past Flew has this to say: "This I find quite breathtakingly perplexing. For what is this 'distinction between changing the past and affecting the past'?" (Flew, 1973: 365). Flew thinks that to affect the past is to make something happen that would not have otherwise happened, which he believes is the same as changing the past.

The mistake that Flew is making is that he fails to see that to affect the past is just to cause something to happen *the way it actually did happen*. This does not involve any change in the past. The past is fixed and beyond any capacity to be changed. Almost all agree with that. But affecting the past is different. To better understand this, it may be helpful to invert our understanding. Let us look at it as if there is a present event that appears to have no explanation (e.g., a time traveller arriving from the future). In a few years we discover that someone had attempted to travel back to the time in question but was assumed to be lost and dead. We can now say that the later event was the cause of

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[10] See specifically the work of Brier, Brown, and Dwyer.

the earlier event and also that this is the best causal explanation of the whole situation. When we look at it this way, we don't want to say that the time traveller changed the past. We want to say that some future event *caused* or *affected* a past (present) event. In this sense the future event affected the past (or the present) but it did not change it. The past (or present) simply happened (or happens) the way it *did* (or does) happen.

Richard Swinburne also opposes any notion of reverse causation. He believes that reverse causation is impossible because it would involve changing the past: "The most basic and important thesis about time... is that the past is determinate of logical necessity, that is, that -- of logically necessity -- the actions of agents and other causes can only affect the present or future states and not past ones" (Swinburne: 158). Swinburne points out that the type of reverse causation he is talking about is not the trivial sense in which A's actions determine whether or not it was true in 1950 that the all-time greatest pianist (viz., A) was born in January of 1950 (i.e., A's later actions produce soft facts about 1950). The type of reverse causation that Swinburne is rejecting is the suggestion that someone can do something today to make it not have rained yesterday. Swinburne insists that "It is therefore not logically possible that a man could affect a past state by his present action. Actions can only have present and future effects -- and they could only have present effects if influences could be propagated with infinite velocity. [...] I conclude that of logical necessity no cause can follow its effect and hence that of logical necessity the past is determinate" (Swinburne: 167-168).

It seems, however, that Swinburne has missed the point made by defenders of reverse causation. He seems to think they are trying to say that we can now do things to

cause something else to have happened in the past other than what actually happened. He fails to understand that the defenders are trying to show only that it is logically possible that some events can be explained only by reference to subsequent events.

Swinburne also rejects any possibility of time's being closed. We should note that closed time is the entire premise upon which Gödelian time travel is based. But Swinburne points out that closed time is not the same as a cyclical universe or cyclical time. "To say that the Universe is cyclical is to say that after so many years its state is exactly similar to what it was and an exactly similar series of events take place again. S_1 is followed by S_2, S_2 by S_3, S_3 by S_1, S_1 by S_2, and so on *ad infinitum*. [...] The point is that S_1 comes again at a later temporal instant, not at the same instant" (Swinburne: 170). (I will briefly mention closed time along with other interesting possibilities surrounding time travel in the next chapter.)

Finally, Swinburne rejects time travel on the basis of his arguments against reverse causation. He says that "The logical principle of causes not following their effects rules out [backward time] travel -- I cannot get to the past" (Swinburne: 187).

Swinburne bases his conclusions largely on logical considerations. He argues that causes precede effects by logical necessity. He dismisses supposed examples of reverse causation simply by saying that they are best explained in other ways, namely as being coincidences. However, what opponents would ask Swinburne is *why* it is logically impossible for an effect to precede its cause: how does the concept of cause make reverse causation impossible?. And it seems that Swinburne does not have an adequate reply.

Further Considerations for Reverse Causation

It seems to me that there is a further issue that must be discussed, one mentioned only briefly in the literature: the differences between the past and the future. There is general consensus that the past is fixed and is completely beyond our control. There is also general consensus (although less of it) that the future is not fixed and that we indeed have a great amount of control over what happens in it. The point is that there is no problem in our understanding of causes being prior to effects, but that there is a problem in our understanding how an effect can be prior to a cause.

Let us look at space-time on a traditional time line where time is represented on the y-axis of a two-dimensional map. Suppose that we were living normally in 1800. All of a sudden a metallic object comes from the sky and lands in front of us. A man emerges from the device wearing unusual clothing. One of the first questions we would want to ask this man is, 'Where did you come from?' When he replies that he came from 1997 we are very puzzled. What does it mean for someone or something to come from the future? What does it mean for something here and now to be caused by something else that doesn't occur for almost 200 years?

Let us change this scenario a bit. Suppose that we go outside now, in 1997, and suddenly a metallic object comes from the sky, lands, and a woman comes out wearing unusual clothing, saying that she is from the 23rd century. What can it possibly mean for us to say that she comes from the future? Where is the future that she can come from it? How does this conception of space-time work? Perhaps that is the answer to this quandary. She simply originates from a *different* space-time location than we do. Such

an explanation allows us to make sense of reverse causation and time travel. It seems that despite our strong intuitions against reverse causation and time travel, there remains nothing that is logically impossible about it. There are, however, some further things to consider.

The type of reverse causation mentioned in these two time travel cases may indeed be impossible. This impossibility, however, may not be a logical one. It may be only a practical or physical one. The causes that would be required to enable someone from a future space-time coordinate to visit us here and now may be so complicated that they are utterly impossible, but only in a physical and practical sense. The logical possibility seems to remain unscathed.

Summary

In this chapter we have seen that to make sense of time travel we need to appeal to the notion of reverse causation. In order for time travel to be possible, reverse causation must also be possible.

I have shown that arguments against reverse causation fail to show that it is logically impossible. Objections to reverse causation seem to be based on the fact that reverse causation seems to be very counter-intuitive, but they do not show that it is impossible. I have shown that the objections based on the logic of cause and effect, other explanations for the correlation (viz., coincidence), and the claim that reverse causation would entail changing the past all fail to show that reverse causation is impossible. Time travel remains a logical possibility, despite the fact that it is very counter-intuitive.

Chapter IV

Fatalism

Chapters II and III showed that there are many logical objections to the type of time travel in question and that none have stood up to scrutiny. From these observations I concluded that time travel remains a logical possibility despite the fact that many (perhaps most) people find it counter-intuitive. In this chapter, I intend to discuss one of the main reasons why time travel and its dependence on reverse causation are deemed counter-intuitive, which is the belief that it implies that fatalism must be true.

As we have already seen, the only way that sense can be made of backward time travel is to posit reverse causation and say that a time traveller arrives in the past the first and only time that it (i.e., the past) happens (possibly even before his birth), and that he is caused to arrive in the past by some later event (i.e., reverse causation). This, however, seems absurd. But what is it that is absurd about it? We have seen that any perceived absurdities based on the paradoxes mentioned do not stand up. We have seen that perceived absurdity on the basis of reverse causation does not stand up. So what is left? It seems that the absurdity that remains is not of a logical sort. It is not such that one would be forced, by the rules of logic, to abandon the notion of time travel. Rather, the type of absurdity that remains is simply that there are implications that seem downright unacceptable and counter-intuitive. The implication of this sort that I am primarily concerned with in this chapter is that time travel seems to entail fatalism.

What is Fatalism?

Fatalism is the view not only that one's actions are outside of one's control (as in determinism) but also that one's actions are completely independent and uncaused events (unlike in determinism). In Dummett's words, fatalism is "the view that there is an intrinsic absurdity in doing something in order that something else should subsequently happen; that any such action--that is, any action with a further purpose--is necessarily pointless" (Dummett, 1964: 345). This does not mean that someone forces you to act in a certain way. It means that all events are random occurrences that happen in a certain unavoidable and unpredictable way. Given the nature of this view, even if it is true one would still *feel* free to act in whatever way one pleased and one's actions would *seem* voluntary, even if they are not. According to a fatalist, one cannot help to do what one does. One *will* act in a certain way and will not be able to refrain from so acting. It is simply the view that what will happen will happen (with or without cause) and no one can do anything about it.

How Time Travel Might Entail Fatalism

How time travel entails fatalism has to do with the manner in which time travel must work. As we have seen, a time traveller must arrive in the past (i.e., his destination) when it (i.e., the past) happens the first and only time. To understand how time travel might entail fatalism consider the situation depicted in figure 2. In figure 2, we have person A who was born in 1850 and lives until 1920. We also have person B who was born in 1950 and is still alive in 1997. Suppose that in 1997 B builds a time machine and

travels back to the turn of the century, lives there for some time and encounters A during that time. Now understand that A lives only once, lives only during the years between 1850 and 1920, and has never travelled in time. According to our model, A encounters B around 1900. A does not know where B came from and B does not tell him. We know that B came from the future (as a result of reverse causation and a time loop), but from A's perspective B simply appears out of nowhere. To be consistent with the type of time travel we have in mind throughout this work, we must say that it was B and not anyone else (i.e., not someone who looked and acted like B) who encountered A in 1900.

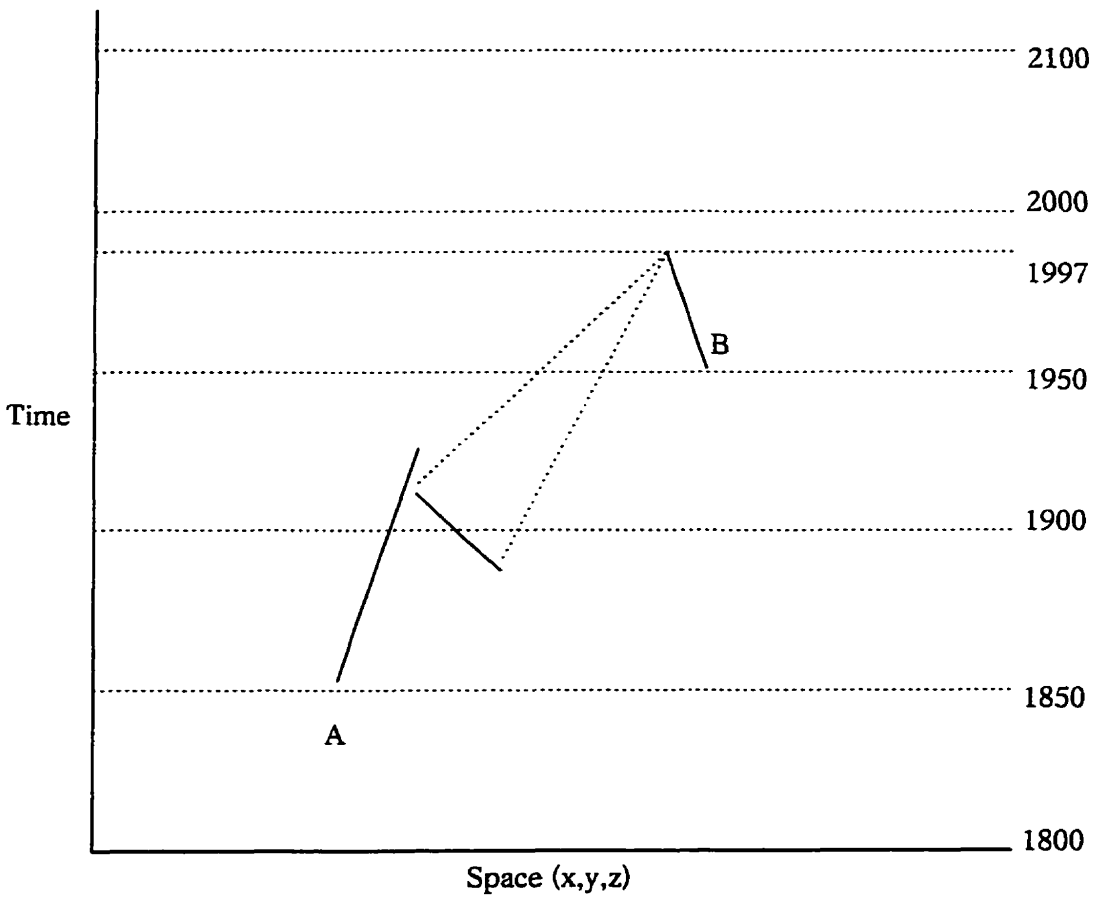

Figure 2

To see how this problem helps to clarify how time travel might entail fatalism we have to look at time travel from a perspective slightly different from the one to which we may be accustomed. We often tend to look at it from the perspective of the time traveller, B, and neglect to look at it from the historical perspective of A who encounters our time traveller. The issue is what it would mean for A to experience an encounter with B. A lives only once and he experiences 1900 in only one way. Let us assume that the way in which A experiences 1900 is *the way* (or at least part of the way) that 1900 happened. In other words, A's experience of 1900 is an accurate experience of the local happenings of the one and only 1900 (i.e., the 1900 of our most accurate history books). This means that B was there in 1900, to be encountered, the first and only time that 1900 took place.[11]

Opponents to time travel argue, based on this situation, that time travel must entail fatalism. It is quite fair to say that if B was present in 1900 before he was even born, then it was fated that he somehow travel back in time to 1900 from 1997 (or from some other time) because it was his fate to be present in 1900. It seems that there would be no way for B to avoid this fate or else he would not have, and could not have appeared

[11] An important point that should be mentioned has to do with what it means for someone to come from the future. It seems that to appear from the future automatically implies that the interval of time between the present (in this case 1900) and the future time from which B comes (1997) must have occurred (will occur?) in some sense for *B exists in 1900 only because he existed in 1997.* How else could B ever come into existence (apart from divine intervention)? This problem seems to have been dealt with fairly well in our discussion of reverse causation. As we have seen, since it is logically possible for some event (e.g., a simple atomic event) to precede its cause (perhaps only by seconds), it would also be *logically possible* for a larger, more complicated event (e.g., a time traveller's arrival in the past) to precede its cause (by seconds or perhaps by a very large amount of time). Notice however, that its logical possibility does not mean that it will or even physically could be accomplished.

to A in 1900.

This, opponents argue, means that some form of fatalism must be true. Given our scenario, it is true in 1900 that A *will* travel back in time at some future external time and will do so *necessarily*. If A mysteriously appears in 1900, apparently out of nowhere (due to reverse causation), then A will be unable to avoid travelling back to 1900 from 1997. This would be A's fate. Neither A nor anyone else will have any control over A's fate. If A was present in 1900 then he necessarily got there from somewhere. If he was not born until 1950, then he must have been fated to travel back to 1900.

Can Time Travel Avoid Fatalism?

Can time travel avoid the implication of fatalism? I believe that it can. Recall from Chapter III that a traditional argument for fatalism runs as follows: either I will be killed in battle or I will not be killed in battle. If I will be killed, then nothing I can do now can change that. If I will not be killed, then nothing I can do now can change that. Therefore, nothing I can do now can affect the future. A simple response to such an argument might be to point out that all the fatalist is asserting is a tautology or a redundant logical truth. That is, he is not saying anymore than what will happen will happen. This redundant premise does not lead one to the conclusion that nothing can affect future events. All it means is that what is *going* to happen is *going* to happen. Either I will go into town tomorrow or I won't. It might be true today that I *will* go into town tomorrow, but the truth of that statement is contingent upon my actions tomorrow. Future events will definitely happen the way that they will happen, but that does not lead

to the conclusion that nothing I do now can affect future outcomes. Future events are contingent upon present and past events. In some cases a present or past event will cause and guarantee a certain future event, but that does not mean that that event was an unavoidable fate and that fatalism is true. Fatalism is nothing more than a redundant logical truth equivalent to $A \rightarrow A$. I should point out, that I when I say that fatalism is mistaken, I am not also saying that determinism is false. Determinism is not a tautology or redundant logical truth in the sense that fatalism is. Determinism is simply the view that every event has a cause that is a necessary and sufficient condition for the occurrence of the event (i.e., had cause C not occurred, event/effect E would not have occurred). This, however, simply means that things do not happen without a reason or, in other words, that events are not simply random occurrences.

Notice that the argument for fatalism from time travel is slightly different. For it depends on the fact that time travel must involve backwards or reverse causation. I believe that the argument that time travel entails fatalism is as weak as the traditional argument for fatalism. Time travel fatalists (i.e., those who are opposed to time travel on the grounds that it entails fatalism) argue that since the effect (viz., the time traveller's arrival in 1900) happens, then the cause *will necessarily* happen. This again is tautological. Of course if an effect happens, then its cause *will have* happened or its cause *will* happen. In the case of reverse causation, when an effect happens, then subsequently its cause *must* happen. The fatalist is right to say that this subsequent causal event will necessarily happen. However, the fatalist is wrong to use this as a reason to

conclude that reverse causation and time travel entail fatalism. I must agree that of course what will happen will happen. Also, I must say that of course if an effect happens, then its cause must also happen. But none of this is to say that the cause was fated to happen or that the cause was fated not to happen in the fatalist's sense. I agree with determinism that it is true that once the effect has happened then it is necessary for the cause to happen or have happened, but what I am saying is that it is not necessary that the effect happen and therefore it is also not necessary that the cause happen or vice versa. Once the effect has already happened, the cause cannot help but happen or have happened, but that is no more fatalism than to say that once a cause happens then necessarily its effects will happen (as in normal forward causation).

In this sense time travel may *seem* to entail fatalism, but it is not so simple as that. If a time traveller arrives in 1900, he does so because of future events. This means that his arrival in the past is completely dependent upon future events. If he arrives, then it is a safe bet to say that he *will* leave 1997. If he does not arrive, then it is a safe bet to say that he *will not* leave 1997 (at least not with 1900 as his destination). The point is, that arriving in the past is not beyond the time traveller's control. It simply means that the effect (i.e., the arrival) is linked with the cause (i.e., the departure) in such a way that they depend on each other. As I have said, this is no different from a cause in *normal* forward causation entailing that an effect will ensue. The only difference is that the cause is reversed. However, neither time travel nor reverse causation entail fatalism.

More Practical Problems with Time Travel

All of this may point to a further practical problem with time travel even though its logical possibility remains. It may be that it is impossible for a cause to precede its effect by a time interval great enough to make time travel worthwhile or even noticeable. What I mean by this is that it is logically possible that many of us are frequently travelling backward in time, but that we are only covering a few hundredths of a second or perhaps as many as a few seconds at a time. Perhaps such a theory could explain experiences of *déjà vu*. Such short intervals may go completely unappreciated as cases of time travel, but the possibility is a real one. However, even though it is logically possible that these tiny time intervals may be increased substantially (perhaps to years or even centuries), it may remain physically impossible for reverse causation to work over a great interval of time. And even if it is *physically* possible, it may be that it would be *practically* impossible because of what may be required to accomplish such a trip.

Backward time travel does not entail the unwelcome consequence of fatalism, and neither does it involve any other logical problems or inconsistencies. Those who argue that time travel entails fatalism make the same mistake as those who argue in favour of fatalism in general. Their logic fails when they make an erroneous jump in reasoning (an invalid argument) from true premises to a potentially true conclusion. This casts doubt on their argument and makes it such that we are not logically compelled to accept their conclusion of fatalism.

In the next and concluding chapter, I will briefly consider some of the implications of what I have discussed. I will discuss the type of time travel that remains

after making adjustments for all of the objections that are raised against it. I will conclude that time travel remains a logical possibility, but that it is not the type of time travel that is common in science fiction. It is a much more limited type of time travel and it may even be entirely impractical or be considered futile and purposeless.

Conclusion

According to this essay, backward time travel remains a logical possibility. In this project, I attempted to define backward time travel and to refute many of the common philosophical objections that are raised against it. I demonstrated that the objections raised against backward time travel are unsuccessful and that time travel remains logically possible.

In Chapter I, I worked towards a clear and precise working definition of backward time travel. I considered many different possible perspectives on time travel and, following Lewis, worked towards the following definition: backward time travel is a discrepancy between time and time. I narrowed this definition even more by suggesting that time travel is an occurrence in which a time traveller leaves the present and, continuing to age, arrives at some point in time that does not coincide with his personal time. So to travel backward in time, one must continue to age and must arrive at some point in the past relative to one's personal time.

In Chapter II, I raised and refuted many logical objections that are made against time travel. I dismissed the claim that time travel is conceptually absurd by appealing to the distinction between personal time and external time. I rejected the notion that time travel would involve a violation of Leibniz's Law with respect to personal identity by appealing to the distinction between personal time and external time as well as to other features of personal identity.

We have seen that time travel cannot involve changing the past nor does it imply any change in the past. This became especially clear when we considered what it means to travel in time. That one travelled backwards in time simply means that a future event caused a past event. This means that the time traveller was in the past when the past occurred the first and only time (i.e., there is no duplication of times) and that he was caused to be there by some event that happened later than his arrival in the past.

This introduction of reverse causation led to further discussion of this topic in Chapter III. Having considered the arguments for and against reverse causation, I concluded that there is insufficient evidence to discount its possibility. Thus I affirm that reverse causation still remains a logical possibility. In Chapter III, I discussed Dummett's arguments in favour of reverse causation and found that they are persuasive. They showed that the arguments against reverse causation commit the same fallacy as the arguments in favour of fatalism. In light of this, it seems that reverse causation remains unscathed.

In Chapter IV, I discussed fatalism in more detail. Many seem to think that time travel would entail fatalism. They think this way due to the following line of reasoning: because the time traveller arrived in the past and was there when the past happened, then he could do nothing in the future that would enable him to avoid going back in time (nothing to avoid his fate). I argue that while he cannot avoid going back in time this in no way entails fatalism. The time traveller's arrival in the past is caused by his departure in the future. This means that there is a cause and effect relationship between the arrival and the departure. As with any cause and effect relationship, once the cause happens the

effect necessarily must happen or have happened. Also, once the effect has happened, the cause must have happened or must happen. But the determinism involved in causal relations is in no way the same as fatalism, and neither does it entail fatalism.

Final Thoughts

I concluded Chapter IV by briefly mentioning some problems that may persist with time travel. These problems tend to lie largely in the practicality of time travel, and I shall conclude this work by discussing these impracticalities and by clarifying the only type of time travel that appears to have any practical possibility whatsoever.

Despite the fact that I have shown that reverse causation and time travel seem to remain logical possibilities, this does not mean that they do indeed occur or that they even could occur at all. The main problem may have to do with coincidence: the extent to which so many causes would have to coincide to make time travel possible for humans. According to Horwich, "Gödelian time travel would imply massive coincidence: a phenomenon of the sort we know from experience to be absent from our world. We can infer, therefore, that Gödelian time travel will not take place. It is epistemologically impossible" (Horwich, 1995: 263).

As I have said, time travel would seem to work best at an atomic level. We can more easily conceive of an atomic particle's reacting from some event that will happen a few seconds later. Notice, however, that as we try to conceive of a longer period of time (e.g., 100 years) such atomic activity becomes harder to believe in. To get from this atomic activity to the time travel in question we would have to conceive of enough

similar atomic reactions to cause an entire human body to travel backwards in time a few seconds. Then we would have to extend that period of time to a few years and even a few centuries in order to make sense of the type of time travel in question. According to Horwich the coincidence would have to be massive.

In light of all of this, Horwich concludes that "we may infer that closed causal chains do not and will not occur - but we cannot conclude that a spacetime structure permitting them is not actual" (Horwich, 1995: 267). In other words, time travel will not happen, but it is still logically possible.

Therefore we can conclude that time travel remains a logical possibility largely because reverse causation remains a logical possibility. However, the logical possibility of time travel does not mean that it will actually occur or even that it could actually occur. The magnitude of coincidence is simply too great. Despite time travel's logical coherence it should remain outside of our grasp for quite some time.

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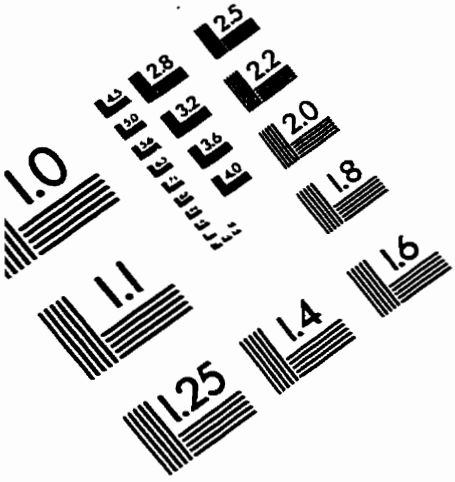

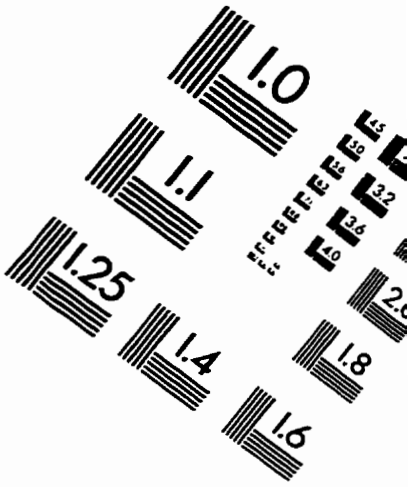

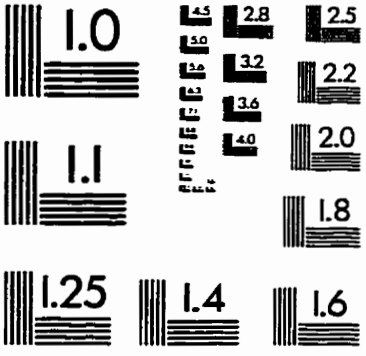

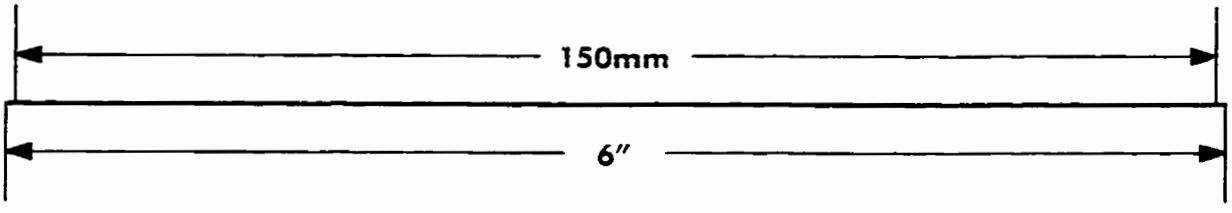

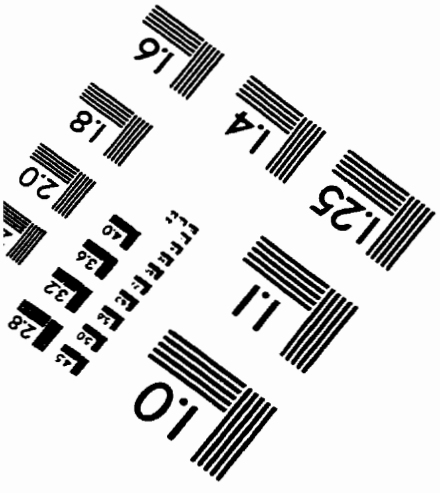

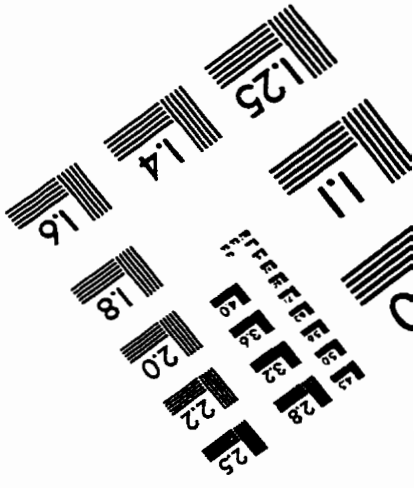

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