TIME: A PHILOSOPHICAL ANALYSIS

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for Bonnie, Galen and Morley

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INTRODUCTION

This book is intended as an exposition of a particular theory of time in the sense of an interrelated set of attempted solutions to philosophical problems about it. Generally speaking there are two views about time held by philosophers and some scientists interested in philosophical issues. The first called the A-theory (after McTaggart's expression A-determinations for the properties of being past, present or future) is often thought to be closer to our commonsense view of time or to the concept of time presupposed by ordinary language. It includes at least the following theses, (a) Logic ought really to include tensed quantifiers for existence on one of its important usages means, present existence. More generally, we can't reduce all tensed locutions to tenseless ones. (b) The distinction between past, present and future is an objective one. It is not, for example, dependent on our consciousness of change; some A-theorists hold also, that the distinction, in effect, is an absolute one. (c) Time is asymmetrical in a number of respects, for example, (i) there are ontological differences between past, present and future; hence (ii) reference to past and present individuals is logically different (for example we cannot assign proper names or constants to particulars which do not yet exist); (iii) indeterminism is true of the future but not of the past, and sometimes as a corollary to (iii), (iv) causal chains propagate only from the present to the future. (d) Space and time are not exactly analogous. This follows from the above to the extent that space is considered to be symmetrical; it also comes out in the typical denial of A-theorists that individuals are just four-dimensional solids, so that their temporal parts are on a logical par with their spatial parts. (e) There is such a thing as objective temporal flow or becoming and real change requires this. B-theorists, on the other hand, who often claim that their theory is more scientific than the A-theory, since it is partly inspired by the Minkowskian geometry of the Special Theory of Relativity and, to a lesser extent, by certain considerations based on mathematical logic, typically hold the following. (a) Tensed locutions to the extent that they

are correct at all can be reduced to tenseless ones, and existence is adequately expressed by the ordinary quantifier plus the use of dates. (b) The distinction between past, present and future is subjective; the now is simply the time of which we happen to be conscious. (This last thesis is sometimes formulated in a purely linguistic way in which case it follows from (a)). (c) Time may be asymmetrical but this is so in a weaker sense that that claimed by the A-theorists (it consists in local entropy increase). (d) Often B-theorists hold that the only genuine causal relation (i.e., the only one not open to Humean objections) is symmetrical and thus the A-theorists claim mentioned under (c) (iv) above cannot even be usefully formulated. (d) The spatial and temporal parts of a particular can be treated in logically similar, if not identical ways. (e) Temporal flow is either altogether mythical or subjective. Certain other questions, e.g., could there be more than one time are to some extent independent of the dispute between A- and B-theorists. One of the main purposes of this book is to argue that neither the A nor the B theory is correct in its entirety, but that certain theses, some connected with the one view and some with the other are true and that these theses form a consistent whole; in general I argue that the A-theorists are right about (a) and (b), the B-theorists partly right about (e) and that a somewhat new solution is needed to the problems suggested by (c) and (d). Both A- and B-theorists can be indeterminists although there is a tendency of B-theorists to be determinists. Indeterminism is defended here. The theory presented in this book is therefore to some extent a third alternative, and it tries to deal in greater detail with certain issues (e.g., retrocausation) than do other books and articles that I have read.

A word is in order concerning the choice of topics. The problems dealt with have to do with the qualitative properties of time. The philosopher has less to contribute to the technical problems concerning the metric of time than does the mathematician and the physicist, although there are philosophical problems in this area and purely philosophical contributions have been made. For these I refer the reader to the excellent discussions of Reichenbach, Grünbaum and van Fraassen. Professor Grünbaum has undoubtedly made a greater contribution to our understanding of space and time than any other contemporary philospher. This partly explains the choice of topics in the present work; some are treated

because of a disagreement (however slight) with Grünbaum's views, some because he treats them very briefly (for example retrocausation and cyclical time), and other topics are completely neglected because I believe Grünbaum has solved the problems involved (here an example would be Zeno's paradoxes of motion). I have neglected phenomenological analyses of time because it seems to me (however wrongly) that they are subject to the general criticisms of such programs which follow from Wittgenstein's private language argument.

Questions about time involve questions about truth, events, causation, the reducibility of one concept to another, identity, the nature and limits of conceptual schemes and many others. Thus any book on time necessarily has to deal with problems in different areas of philosophy: metaphysics, formal and philosophical logic and the philosophy of science. The present book is not an essay in the philosophy of science in the usual sense it does not deal with methodological or epistemological issues, but it attempts to take into account some of the things scientists have said about time.

Analytical philosophy tends very roughly these days to fall into two camps, ordinary language philosophy or conceptual analysis and formal logic and philosophy of science. I hope to have learned something from both types of philosophy and the discussion is not restricted to the common-sense view of time. Some of the results are consistent with it, others not.

It might be thought that some of the results arrived at in the present work by philosophical means cannot be correct on the grounds that they are inconsistent with certain interpretations of Einstein's General Theory of Relativity (hereafter referred to as the GTR). This, I believe, is worth discussing at the outset. (At this point I will assume an elementary knowledge of two-dimensional embedding diagrams used to represent Minkowski space-time, as the above objection would hardly occur to someone not familiar with these. An introduction to this sort of this is given in Chapter III.) As is now well known there are several solutions to the field equations of the GTR which in various senses of the term permit time-travel. (It is important to note that the expression time-travel is used in significantly different ways.) Gödel space-time, for example, contains closed time-like curves through each point.[1] What this entails is that, if

the universe conforms to Gödel's model, it is possible to travel from any point in space-time to any earlier point. Nonetheless in taking such a journey a person would always be travelling in space in the ordinary sense and in a future oriented direction. The reason for this is that the possibility of a time-travel like phenomenon in this case is due to the curvature of space-time itself and does not involve some utterly mysterious method of getting outside one's own time altogether and then travelling to a different point in it. A general point about the empirical equivalence of some spatial and temporal topologies ought to be noticed at this point. I will introduce this by means of a non-technical example. Consider a simple circular time on which we have located form events, *A, B, C* and *D*. The most obvious interpretation to put on this idea is that these (and all other) events eternally recur. But this is precisely equivalent to a linear time of this sort: *A, B, C, D, A, B, C, D, A*... etc. in the sense that no possible physical observation could distinguish between them. (They are not mathematically equivalent.) Hence a positivistic philosopher of science such as Reichenbach would argue that the distinction between two such times is empty.[2] However we do not have the same situation in the case of Gödel's closed time-like curves (hereafter referred to as CTL). In some models CTLs can be removed by providing a reinterpretation in a covering space (a technical analogue of my non-technical example above), but this is not so with regard to Gödel's space-time[3]. As well as seeming to permit time-travel in a sense which is inconsistent with one of the results arrived at in the last chapter of the present work, such models would entail that causes can occur before their effects. The latter might appear to conflict with the results of the first two chapters.

The Kerr solution to the GTR equations theoretically permits travel via rotating black holes around singularities into what are usually described as other universes, i.e., space-times connected to our space-time only by singularities. In the folded Kerr solution (so-called because it is represented by the Penrose diagram of the Kerr solution folded in the shape of a cylinder) it is possible to travel from our universe to another and then back to past or future times in our space time. The location of the latter depends on the location of singularities.

Another, at least apparent, possibility is this. There are solutions to the GTR equations such that their models have an over-all cosmological

time (as opposed to particular time-like lines) which is circular. All of these are variants of rolled up Minkowski space-time.[4] Given an astronaut who had a rather extended life-time it would be possible in principle to travel round space-time to the temporal point at which he began.

The point for our purposes is simply this. Although the above described models are mathematically consistent with certain interpretations of the GTR they are rejected by the majority of physicists for reasons precisely analogous to those given in the first two and last chapters of the present book. Models permitting causal anomalies simply lead to outright logical contradictions (not just physical oddities) except in universes which are purely deterministic.[5]

NOTES

1 K. Gödel, "An Example of a New Type of Cosmological Solutions of Einstein's Field Equations of Gravitation," *Reviews of Modern Physics,* vol. 21, No. 3, July 1949, pp. 447-450.

2 H. Reichenbach, *Space and Time,* New York: Dover, 1958.

3 F. J. Tipler, "Rotating cylinders and the possibility of global causality violation," *Physical Review D,* Vol. 9, No. 8, 15 April, 1974, pp. 9, 22-3-2206.

4 J. Earman, "How to Talk About the Topology of Time", Nous 11 (1977), pp. 211-226, p. 221.

5 S. W. Hawking and G. F. R. Ellis, *The Large Scale Structure of Space-Time,* Cambridge, 1973, p. 189.