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A TWO-DIMENSIONAL PASSAGE MODEL OF TIME FOR TIME TRAVEL

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1. INTRODUCTION

Some philosophers have held that time travel of a certain type is logically impossible. The type of time travel in question is crudely exemplified by the following: the Time Traveller gets into his time machine, throws some switches, and is transported through time back to the time of the French Revolution. This variety of time travel was the basis of H. G. Wells' well-known and very popular novel *The Time Machine*, so I will call it 'Wellsian time travel'. Philosophers have given many different arguments for the logical impossibility of Wellsian time travel, some of them dependent on what these philosophers take to be the nature of time and others dependent on such things as the criteria of identity for persons.

In this paper I want to develop a theory or a model of time which will handle at least some of the objections often raised to Wellsian time travel. This model is a passage model of time, that is, a model which allows motion through time. I will discuss the chief competitor of the passage theory – the so-called manifold theory – in Section 3. After stating the objections to Wellsian time travel and my reply to them in the form of my model of time, I will make some comments on the nature and purpose of such speculations about time, the possibility of changing the past, and the alleged paradoxical situations that are often said to be made possible by time travel.

2. THE WILLIAMS OBJECTION

The first argument I wish to consider against the logical possibility of Wellsian time travel is well-expressed by Donald Williams:

> Time travel, prima facie, then, is analyzable either as the banality that at each different moment we occupy a different moment from the one we occupied before, or the contradiction that at each different moment we occupy a different moment from the one which we are then occupying – that five minutes from now, for example, I may be one hundred years from now.[1]

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To back up his view that Wellsian time travel is thought of (at least by Wells himself) in this allegedly contradictory way, Williams quotes from Wells' novel:

> He may even now – if I may use the phrase – be wandering on some plesiosaurus-haunted oolitic coral reef, or beside the lonely saline seas of the Triassic Age.[2]

Williams' point seems to be that the Time Traveller would have two different temporal designations truly applicable to him at one time. We can say that, for example, *now he is one hundred years in the past.* And Williams would interpret our saying this as saying that the Time Traveller is "at" the moment designated by 'now' and simultaneously "at" the moment designated by 'one hundred years in the past'. But a person can be "at" only one moment at one time. Hence, such statements as the above express logical impossibilities. But such statements are sanctioned by Wellsian time travel. Hence Wellsian time travel is logically impossible.

3. An alternative account of putative time travel

Williams would presumably not deny that we might have some odd cases which give the appearance of being cases of Wellsian time travel. He does not discuss these cases, but it is abundantly clear from his article how he would handle them. Let us take, as an example of such an odd case, the following: the Time Traveller throws the switches on his machine at 2 PM and thereupon disappears from the laboratory (machine and all); at 6 PM he suddenly materializes in the laboratory, expressing relief that he had gotten back from the past in time for dinner. It would be natural for us to say that between 2 PM and 6 PM he was in the past and that, for example, at 4 PM he was one hundred years in the past (thus making a statement which Williams regards as expressing a logical impossibility).

Now, since Williams denies that this case is to be construed as a case of Wellsian time travel, how would he construe it? Consider the following diagram:

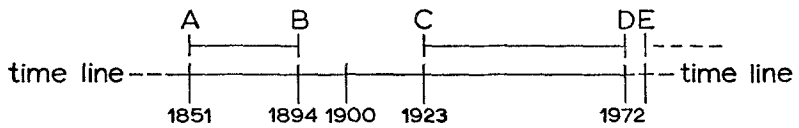

Fig. 1.

The continuous lower line is the time line, while the lines above the time line represent the span of temporal existence of the Time Traveller (or, as we should now say, the Alleged Time Traveller). At point A the individual begins to exist. This individual is indistinguishable from one who is, say, 50 years old. He is not born; he instead begins to exist with all of the characteristics of a 50-year-old man. Among his characteristics at A are what Wellsians would call "memories of his existence between points C and D". This individual goes out of existence at point B and comes back into existence at C with all of the characteristics of a new-born infant (and, of course, with no memories of the period A-B at all). He then goes out of existence at 2 PM today (point D) and comes back into existence at 6 PM (point E) with what both Wellsians and Williams can call "memories of both A-B and C-D". Moreover, his memories are such that his experiences during A-B seem later to him than those during C-D. But Williams would say that this last was an illusion and that in fact his experiences during C-D are later than those during A-B. The important point about this Williams-type explanation of this case is that our putative Time Traveller does not exist at all between 2 PM and 6 PM today. Hence, on this model of the case, the Time Traveller does not exist at both 4 PM today and at 1872 (one hundred years in the past). Thus, this model avoids the alleged logical impossibility countenanced by the Wellsian model.

It should be clear to the reader that Williams-type explanations of these cases are based on a theory of time which does not allow backward movement in time. Williams' own theory actually goes farther than this: he allows no movement in time whatsoever, forward or backward. For him (and for many other philosophers), individuals are spatio-temporal cylinders; what exists at a moment of time is not the individual himself but instead a 'temporal part' of that individual. The individual, then, is the 'sum' of his temporal parts. As Williams puts it, "And each of us proceeds through time only as a fence proceeds across a farm: that is, parts of our being, and the fence's, occupy successive instants and points, respectively".[3] Passage through time is nothing more than these temporal parts "strung along in the manifold".[4] Thus, on this view, there is no movement through time because there is nothing that is at each of two successive times. The individual is not at any one moment but rather is 'at' an interval; and what is at a moment (namely a temporal part of the individual) is not at any other moment and so does not move from one moment

to another. Williams calls this theory of time 'the theory of the manifold' because space and time are regarded (as in Relativity Theory) as forming a four-dimensional manifold. The point I wish to make here is the following. Since the theory of the manifold rejects any motion through time, it rejects the sort of motion involved in Wellsian time travel. But one need not accept the theory of the manifold in order to reject Wellsian time travel. One can reject Wellsian time travel on the grounds that it countenances logical impossibilities (of the sort mentioned earlier) and yet allow movement in time. For instance, one could allow the alleged Time Traveller to move forward in time (from A to B in Figure 1) and still reject Wellsian time travel. So the rejection of Wellsian time travel does not commit one to the currently popular theory of the manifold.

In this paper I do not intend to attack the interpretation of the Time Traveller case which is represented in Figure 1. My intention instead is to develop a model of time which will exhibit the logical possibility of Wellsian time travel and hence of interpreting the Time Traveller case in a Wellsian manner. The question with which I am dealing here is *not* whether we *must* interpret the case in a Wellsian manner, nor whether we *should* interpret the case that way, but instead whether we *can* interpret the case in that way. And by 'can' here, I mean without falling into logical inconsistency and yet taking account of all of the apparent facts of the case. The issue of what we must or should say is likely to depend on larger issues, such as the use to be made of the notions of illusion and reality in philosophy. For the interpretation represented in Figure 1 would have us say, for example, that the person's apparent memories of the period C–D which he has while he is at A–B are in fact not memories at all and are illusory since they concern events which in fact happen to the person after he experiences the events in A–B.

4. THE HARRISON OBJECTION

Now let us turn to the second argument against Wellsian time travel that I wish to consider, one given by Jonathan Harrison. First, here is what I will call 'Harrison's Principle': "The sentence 'I [Harrison] was not at the Great Exhibition [of 1851]', if it can be used at one time to make a true statement, must make a true statement when it is used at any subsequent time".[5] The application of this principle to our case is this: if Wellsian

time travel (back to the Great Exhibition of 1851) takes place at 2 PM on February 25, 1972 – that is, if the Time Traveller leaves at the latter time – then before that moment the use of the sentence in question yields a true statement and after that moment it yields a false statement. But this violates Harrison's principle. Hence Wellsian time travel in such cases is not possible. (It should be noted that Harrison's Principle applies to sentences concerning unique events rather than, say, conditions or states of affairs.)

Now, we must be careful about just what it is that Harrison is trying to show to be impossible. Consider the following passage from Harrison:

> Perhaps travel to the past, though it is not now possible, may become so. Should it happen then its first manifestation will be the arrival of a time machine somewhere on the earth's surface at some time in the future. From the nature of the case, the appearance of the time machine must occur before the invention, construction and departure. Suppose such a machine does arrive at some time in the future, stays for a few days, and then goes. After this event, it will be true to say that certain men, perhaps men not yet born, have travelled to the past. Hence, if anyone after this event were to argue, as I have done, that time travel to the past was impossible, because this would mean altering the truth value of the proposition 'No past event, which can be described as the visit of a traveller in time, has taken place', his argument would fail, not because it is invalid, but because its premiss is untrue.[6]

The time travel described in this quotation would not violate Harrison's Principle for the following reason. Let us suppose that in fact Harrison was not at the Great Exhibition. Then, Harrison believes, it is and will always be, impossible for him to travel back to the Exhibition. For otherwise Harrison's Principle would be violated. But, he also believes, it is possible that for some future event E (future relative to our present now), a person who will be born after E is nevertheless present at E. This does not violate Harrison's Principle since the statement 'That person was at E' will be true when made at any moment after E. The proposition which this statement expresses never has one truth value at one time and a different truth value at another time. If it is ever true that this person was at E, then this is always true.

So what Harrison believes to be impossible is that, given that he has never been to the Great Exhibition, a time machine be invented which can take him back to the Great Exhibition. This is, of course, a very different objection from Williams' objection and does not claim, unlike Williams, that Wellsian time travel *per se* is impossible. Nevertheless, Harrison's objection does put a fairly strict limitation on Wellsian time travel. I think

that many of us who would like Wellsian time travel to be possible would prefer the possibility of just what Harrison claims to be impossible. I think that we would like it to be the case that up to a certain moment we had never been to the Great Exhibition and then (perhaps at the next moment) we are back there. And I want to suggest a model of time which allows this.

5. THE PAST AS A CONTINUANT

The fundamental assumption behind Harrison's view is that the past is fixed and cannot change: If something E did happen at some moment t_i in the past, then for every moment t_j (where t_j is after t_i) it is true at t_j that E happened at t_i. It is this assumption that prevents Harrison from going back to the Great Exhibition, given that he has never been there. I think that Harrison is right in saying that the proposition that it is impossible for *him* to go back to the Great Exhibition does not entail that Wellsian time travel is impossible. But, as we have seen, the assumption that the past is fixed and eternally changeless does make certain Wellsian trips to the past impossible.

What happens if we give up the assumption that the past is fixed and is eternally changeless?

One thing that happens is that the past becomes capable of change. But change takes place over time. How are we to represent this conception of the past as something which can change over time? Consider the following diagram:

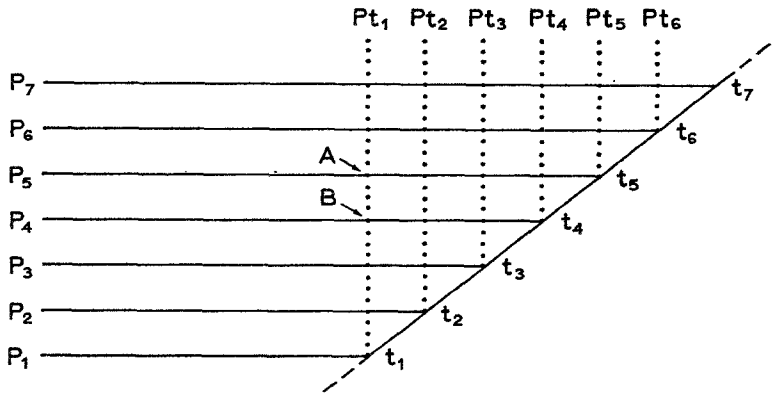

Fig. 2.

Here we have a multi-dimensional theory of time – in particular, a two-dimensional theory – as compared with the usual one-dimensional theory which represents time along a straight line. The moments labelled t_1 to t_7 on the diagonal line are present moments. The line P_1–t_1 (which we can call 'P_1' for short) represents the past when t_1 is the present moment. That is, P_1 is the past at (or with respect to) the present moment t_1. Similarly, P_2 is the past with respect to t_2. The dotted vertical lines indicate the positions of moments in the past. For example, the intersection of P_3 with vertical line Pt_1 is the position of the moment t_1 in the past with respect to t_3. In this example, t_3 is the present moment and the intersection of the two lines just mentioned is the position of t_1 when t_1 is past with respect to t_3.

Now, the point of Figure 2 is that it gives a pictorial representation of the notion that each present moment has a potentially different past associated with it. Before discussing this notion further, let us see how this notion can be applied to Harrison's position. Remember that we have dropped the assumption that the past cannot change. Once we do this, the trips which Harrison claims to be impossible become possible (at least with regard to the considerations Harrison adduces). The only problem, in my opinion, with dropping Harrison's assumption that the past cannot change is that we have to make sense of the resulting notion of time. Harrison and others would doubtless object to dropping this assumption, on the grounds that (i) this assumption is essential to our notion of time; (ii) if this assumption is dropped, an unintelligible concept of time results. One thing that I hope to show in this paper is that the resulting concept of time, though perhaps not our usual concept, is one which is quite intelligible. Moreover, it is a concept which may well represent time as it 'really' is. It is a concept which we may well want to adopt, replacing our usual concept of time with this new one. In my opinion, it is a large part of the task of metaphysicians to develop viable concepts (of time, personal identity, causality, and so on) which we might someday find useful to adopt. Given the concept of time which I will develop, we can deal with Harrison's trip to the Great Exhibition in the following way. Consider the present moment t_4 in Figure 2. P_4 is the past associated with t_4. Now, suppose that t_1 is the time of the Great Exhibition (1851, that is). So the point in Figure 2 labelled 'B' is the time of the Great Exhibition in t_4's past. Suppose further that Harrison is not at B. But between t_4 and t_5,

someone invents a time machine which Harrison enters at t_5 and travels to the Great Exhibition. If time travel into the past takes no time (that is, is instantaneous), then Harrison will arrive at the point labelled 'A'. Thus, the proposition 'Harrison was not at the Great Exhibition' is true at t_4 and false at t_5. In other words, our model of time allows propositions about the past to change their truth-value – because it allows the past to change. Trips which are impossible on Harrison's theory of time become possible on our multi-dimensional theory of time.

I said above that according to our theory of time each present moment has a possibly different past associated with it. We must now further explain the notion of 'different' being used in saying this. One way of construing 'different' is as 'numerically different'. And if we were to construe 'different' in this way, we would be saying that there are many – indeed, an infinite number of – different pasts since there would be one for each present moment. This is *not* the way in which I am using 'different'. Instead I wish to construe 'different' as meaning 'qualitatively different'.[7] I am saying that the past may be qualitatively different from one (present) moment to another.

Earlier I suggested a defense of this theory of time in terms of the metaphysician's duty to construct alternative concepts from which we may select according to our needs and purposes. In saying this, however, I want to emphasize that the theory of time I am proposing is *not* completely different from our ordinary view. In fact, I claim that *my theory embodies a significant part of our ordinary concept of the past.* Far from being paradoxical, my theory is part of, or at least follows fairly directly from, our ordinary views of time. Briefly put, my position is that *the past itself is a continuant.* Being a continuant, the past exists at different times and therefore can be different at one time from what it is at another time. And I claim that this view is a large part of our ordinary view about the past. We normally think of the past as a continuant, as existing at each of several times, as 'there' to be talked about at successive moments. So if there are any readers who feel that my theory is incredibly weird or completely *ad hoc* or far removed from any reasonable conception of time, I would hope that they would pay special attention to what I have just said, since I think that this ought to induce a very sympathetic attitude toward my proposal. However, I am *not* defending my proposal on the grounds that it preserves and elaborates part of our ordinary conception

of the past. I think that the metaphysician performs his function properly even if he proposes a concept which is completely different from our ordinary concepts, as long as it is a concept which could be useful in apprehending and/or understanding the world. My remarks about our ordinary concept have two purposes: (i) the descriptive purpose of merely showing how my proposal relates to our ordinary concept; (ii) the rhetorical purpose of trying to persuade those philosophers who think that philosophy ought to stick to ordinary concepts to take a more sympathetic view of my proposal.

I have said that it is one legitimate function of the metaphysician to invent alternative concepts which we might someday wish to employ. Now, having said this, I must acknowledge that it is reasonable that the metaphysician who engages in this (shall we call it, speculative) function should be required to state some possible circumstances in which we would be inclined to adopt the concept he is developing. It is reasonable to demand that he say something to show its possible utility. Naturally, one way in which I would try to fulfill this demand in the case of the concept of time that I am proposing is to say that if strange machines containing people in futuristic garments and speaking strange tongues (or perhaps using ESP instead of speech) were to appear and were to claim to be from the future, we might very well begin to search for a theory of time that allows their claim to be true. And my proposal would be one theory at least worth investigating, and perhaps adopting, to replace our old, linear, and one-dimensional theory of time. In other words, our old, linear view of time was developed to handle a rather limited set of phenomena. If new phenomena of the sort just described were to occur, we might well want to discard the old, limited concept and replace it with a more inclusive and flexible concept. This same kind of point has been made by many philosophers who have argued that conceptual truths are in fact empirical "though canonized by long usage and convenience [and, one should add, by the limited range of phenomena so far experienced] into definitions."[8]

6. The Reply to the Williams Objection

Now let us see how the two-dimensional theory of time allows us to handle the Williams objection to Wellsian time travel. Suppose that the Time Traveller starts at t_4 – that is, he gets into his machine at t_4 and

throws the appropriate switches. Let us also suppose that he wishes to go one hundred years into the past, and let t_1 be one hundred years earlier than t_4. Suppose, further, that this particular time machine requires five minutes to transport the Time Traveller one hundred years into the past. Let t_5 be five minutes after t_4. Given these conditions we can locate the temporal position of the Time Traveller at his arrival in the past, namely the point 'A' on Figure 2. He is (at A) one hundred years in the past. But he is not one hundred years in the past at just any time. Instead he is one hundred years in the past *relative to* t_5. The point I wish to make here is that on this conception of time, one has to specify *two* times when talking about time travel into the past (or into the future). First, one has to specify the past at a certain present. We have done this by specifying that we are talking about the past as it is at t_5. Second, one has to specify the Traveller's location in the past at that present. And we do this by saying 'one hundred years from the time from which he started' (in this case, t_4). Since *two* temporal specifications are needed, the statement which Williams derided, namely 'Five minutes from now, he will be one hundred years from now', makes perfectly good sense. Five minutes from t_4, the Time Traveller will be one hundred years from now in t_5's past. To put this another way, the distance he will travel into the past is given by the distance between t_4 (which is 'now') and t_1 (which is one hundred years from t_4); the time that it takes him to travel this temporal distance is given by the distance between t_4 and t_5 (namely five minutes). Thus, Williams' alleged impossibility dissolves.

7. Does time travel take time?

I have told the story in the previous section in such a way that the trip into the past took time to complete. In particular, it took five minutes to go back one hundred years. I did this in order to fit the case to Williams' example of a supposed impossibility. Somebody may now pose the following objection: "You can make sense out of a Williams-type statement (that is, a statement which mentions two times as above) only if time travel takes time; if time travel is instantaneous, then Williams is still right."

The objection is not sound. To see this, we will use the following diagram:

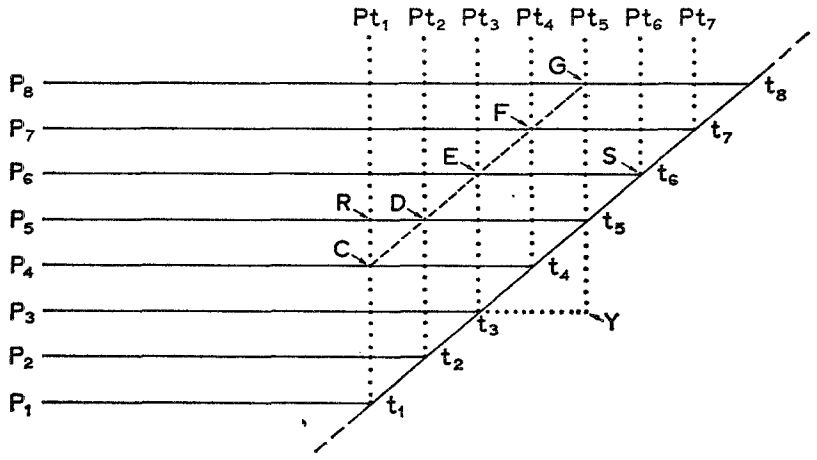

Fig. 3.

Let t_1 and t_2 in Figure 3 be one year apart, and similarly for the distances between the other neighboring moments. Our Time Traveller leaves at t_4 in order to go three years into the past (that is, back to t_1). Assuming that time travel is instantaneous, he will arrive at the position 'C' in Figure 3. (That is, he will arrive at t_1 in t_4's past). Let us now assume that he stays in the past *at that same position relative to the passing years* for at least four years. Then his temporal locations during this interval lie on the dotted diagonal line in Figure 3. That is, he successively occupies positions D, E, F, and G. At D, he is three years from the present moment t_5; at E, he is three years from t_6; and so on. In other words, the dotted diagonal line represents the situation of the traveller who goes back to a certain point in the past and then lives through past events at the normal rate from that point on. Now, we can make not only meaningful but also true Williams-type statements about this traveller. For instance, at t_4 (as the present moment) we can say 'One year from now, he will be two years from now'. This is a true statement for the following reason: 'now' is taken to refer, in both occurrences, to t_4; one year from t_4 (that is, one year after the traveller begins his trip), the traveller will be at position D; to be at position D is to be at t_2 in t_5's past; but t_2 is two years away from t_4, just as the Williams-type statement asserts; hence the statement is true. Thus, the objection is not sound. We can make sense of Williams-type

statements independently of whether time travel does or does not take time.

8. THE RELATIVITY OF PAST, PRESENT, AND FUTURE

In my latest story, the Time Traveller stays in the past for a while. He lives through past events at the same rate as his then contemporaries, for example, a man we might call 'Tom' who likewise occupies positions C through G but who has never engaged in time travel. Tom obviously believes that he himself is living in the present and would regard the Time Traveller as arriving from the future. On the other hand, the Time Traveller regards himself as living in the past and as having arrived from the present. So the question arises: are Tom and the Time Traveller now living in the present or in the past?

One line of thought on this problem would demand that the answer to this question be the same for both persons. That is to say, it would demand that if we were to say that Tom is living in the present, we would then have to say that the Time Traveller is living in the present too. I think that there are sufficient differences between their situations, though, that we should say that Tom is living in the present while the Time Traveller is living in the past, even though they co-exist at one and the same moment. The salient difference between them is simply the fact that Tom has never engaged in time travel. This may seem like begging the question. For by saying that Tom has never engaged in time travel, I may seem to be saying that Tom has never gone to the past; and this already assumes that he is always in the present. So to say that Tom has never engaged in time travel is to say the same thing as that he is in the present and not to provide a ground for saying the latter. Nevertheless, there is a vital difference in their situations which we can represent on our two-dimensional time charts: Tom's time line is straight, while the Time Traveller's is bent. But is this any more than another begging of the question? Can we describe the differences in their situations without assuming what we want to establish? I think there is no begging of the question here. By saying that the Time Traveller's time line is bent, we are only saying that moments are arranged consecutively and that the Time Traveller does not live through consecutive moments at some points in his history. In particular, the Time Traveller lives through such moments as t_3 *twice* (one time as the present and the next time as the past). I think that this

fact is describable independently of the notions of past and present and can therefore be used as the ground for the claim that Tom is living in the present while the Time Traveller is living in the past.

But now, even more serious troubles confront us. If Tom is living in the present, then why isn't his time line coincident with the main diagonal line in Figure 3? After all, it is this main diagonal line which represents the present. In fact, the impression given by the two-dimensional diagrams I am using is that there is something like an Absolute Present – represented by this main diagonal. And Tom should certainly be living along this main diagonal, for he is living in the present.

Let us begin by pointing out a few features of our diagrams. First, while the expression 'the Absolute Present' may have several different meanings, there is one central meaning of that expression as follows: a moment is a member of the Absolute Present if and only if that moment is always present and never past or future. Now, in this sense of that expression, there is no Absolute Present represented in our diagrams. For every moment that lies along the main diagonal will also lie on the P_1–P_i past lines. To give a concrete example, t_4 is a present moment on the main diagonal and is also a past moment as represented by the points along line Pt_4. But if the main diagonal in Figure 3 does not represent the Absolute Present, then what does it represent? Clearly what it represents is *the Time Traveller's present*. If we made a diagram to represent Tom's present, the Time Traveller would be represented as coming from the future (that is, from points to the right of the main diagonal).

So our diagrams are made from a particular person's point of view – in the cases of Figures 2 and 3, from the Time Traveller's point of view. Moreover, I have been talking about this or that person's present (or past). Thus, what I am doing is relativizing the terms 'present', 'past', and 'future' to persons. The ultimate consequence of this view is that there is no such thing as *The* Present or *The* Past. There is only *His* Present or *His* Past. This view – the relativization of past, present, and future to persons – enables us to avoid a certain objection. If we said that Tom was living in the present while the Time Traveller was living in this past, then it follows that one and the same moment is both past and present (since Tom and the Time Traveller exist at the same moments when the Time Traveller is on his trip). And it would be objected that 'past' and 'present' are mutually exclusive adjectives such that if one applies to a certain

moment, the other cannot apply. In fact, this point – namely the mutually exclusive character of past and present – was the basis of McTaggart's famous proof that time is unreal. McTaggart tried to show (among other things) that our concept of time is such that both (i) a single moment could not be both past and present, and (ii) single moments had to be both past and present, thus resulting in a contradiction and hence in the unreality of time. However, my view that past and present are relativized notions escapes all such objections. For there is no contradiction in one and the same moment being past *to* one person and present *to* another.

This technique of relativizing past, present, and future can also be used to answer more complex questions about time travel, questions that are practically invited by my two-dimensional diagrams and to which we must be able to give reasonable answers. As an example of such questions, consider the following complex time trip: the Time Traveller starts from t_4 and goes back to t_1 (position C); he then continues to live through time at the normal rate along the dotted diagonal until he reaches position E; at E he decides to get back into his time machine and go forward to t_5. The question is this: in his trip to t_5, will he arrive at t_5 on the main diagonal (t_5 as one of his present moments), will he instead arrive at position S (which is t_5 in t_6's past, that is, t_5 of the past he is already in), or will he perhaps arrive at position Y which is t_5 in t_3's future (this being a possibility because he is starting from E which is t_3 as a past moment)? This same question can be put by asking whether the Time Traveller will arrive at a past moment (S), a present moment (t_5), or a future moment (Y).[9]

One point to notice about this trip is that it is not clear what the starting point of the Time Traveller's trip to t_5 is. Is the starting point t_4 (the start of his travels) or is it instead E (t_3 as past) which is the start of the latest leg of his journey? In any case, one is tempted to say that since his latest destination (t_5) is after both of these potential starting-points, he is travelling to a future moment with respect to these starting-points. There is a complicating factor, though, which should prevent us from accepting this relativized solution too readily. The complication is that when the Time Traveller is at E and begins his new journey to t_5, he is also – in some sense of 'at' – at t_6. For E is in t_6's past. And to be in t_i's past is in some way to be at t_i, a way in which one is not at some other present moment. Now, t_5 is past with respect to t_6. So there is a respect in which t_5 is a past

moment and in which the Time Traveller, in travelling to t_5, travels to a past moment (rather than a future moment as suggested above). That is, he is staying in the past during this trip.

So it all depends on what we take as our reference point. Our reference point will determine whether the Time Traveller's destination is past, present, or future. I am not ruling out the possibility of cases in which we choose a reference point and still don't know what to call the destination. In fact, we may have one of these indeterminate cases here; if we choose E as the reference point for the trip to t_5, we are in the following quandary: E as t_3 is past with respect to t_5, but E as a moment in t_6's past is future to t_5 since t_6 is future to t_5. Nevertheless, there will be cases in which choice of a reference point answers the question. For example, if our reference point is t_6, then the Time Traveller's destination is past; for all of the possibilities – S, t_5, and Y – are past with respect to t_6. This latter result agrees with what any follower of Wells would say, too; from the standpoint of the people at t_6, the Time Traveller is still merely junketing around in the past (that is, their past).

9. Compound temporal designations

At this point it may be convenient to point out that we can use compound temporal designations to talk about the two-dimensional model of time. By 'simple temporal designations' here, I mean the terms 'past', 'present', and 'future'. These are the terms we use in connection with the old, one-dimensional model. Now, consider Figure 3 again, and in particular, suppose that we are at t_5 (that is, we are taking t_5 as the present moment). Horizontal line P_3 represents t_3's past. But t_3 is itself past when t_5 is present. So, with respect to t_5, line P_3 represents a *past past*. This distinguishes P_3 from P_5; for P_5, being the present's past, is a present past. Similarly, we have future pasts, present futures, future futures, and so on, on this two-dimensional model.

10. The fixed and unchanging character of the past on the two-dimensional theory of time

Earlier, in Section 5, I showed that my theory of time is not totally at odds with our usual conception of time. I showed that the notion of the

past as a continuant is part of our ordinary conception and that this notion forms the backbone of my theory. And I said this partly in an effort to make readers more sympathetic to my theory. I said this partly to make my theory seem less weird and incredible to readers who have grown up with the ordinary, one-dimensional theory. But now, the therapeutic value of Section 5 has probably worn off, especially after my talk about past pasts and future futures. My theory is probably coming to seem very weird again to many readers. So I believe it important at this point to exhibit another way in which my theory preserves something very close to one of our ordinary beliefs about time and the past. Hopefully, this will renew the reader's sympathetic attitude toward this theory, as well as shed further light on the theory itself.

In our ordinary notion of time, most of us think of events as happening at a present moment and then rolling off down the time line to be stored 'eternally' – fixed and unchanging – in the warehouse of the past. It is this view, as I said earlier, that is expressed in Harrison's Principle. I have said that my two-dimensional model dispenses with this idea and that dispensing with this is what makes Wellsian time travel possible to any point in the past. Now, it may seem to many people that to dispense with this idea is to pay too high a price for the possibility of Wellsian time travel. These people may simply balk at this, though I am not sure how they would justify balking (except by appeal to an old model of time whose main virtue is that they have been using it since they were children). That events are eternally fixed and unchanging in the past may be taken by people to be a touchstone of adequacy for any model of time and as something not to be argued but instead assumed. In view of the likelihood of this attitude, I think that it is important to point out that the two-dimensional model allows for the fixity and unchanging quality of past events. On the two-dimensional model, if an event exists at some past temporal location, then it always – fixedly and eternally and unchangingly – exists at that past temporal location. What I have just said in the previous sentence sounds, of course, very much like Harrison's Principle. And so it sounds as if in saying this, I am accepting the unchanging quality of past events and yet denying Harrison's Principle (see Section 5 where I abandon this Principle) and therefore contradicting myself. But in fact I can insist on the fixity of past events and at the same time deny Harrison's Principle without inconsistency. I can do this because I stipulate that the

past events be temporally located or specified by the use of *two* temporal coordinates, not just one coordinate as in the old straight-line model of time. The temporal specification of past events on my model requires the use of two coordinates because we need to know at what present time they are past. Nevertheless, it must be stressed that once the two temporal coordinates are given, a fixed, unchanging past event has been specified.

In the one-dimensional model, we locate events temporally by using coordinates of the form 't_i'. In the two-dimensional model we use coordinates of the form 't_x–t_y', where t_x indicates the past moment and t_y indicates the present moment. Thus, the temporal specification of some event E might be t_1–t_4, where this means that the event E is located at the moment t_1 in t_4's past.[10] Now, let us see how the parallel to Harrison's view works. Harrison says that if the Time Traveller has not already been to t_1, he cannot get there by time machine; to get there, he must have always been there. On our view, he can be absent from t_i on some of the P_i horizontal lines and yet be at t_i on others of these lines. Yet, the parallel holds: if the Traveller is not already at t_x–t_y, he cannot get there by time machine on our model.[11]

Now I am not saying that this parallel must hold, that anyone who thinks about time two-dimensionally in this way must agree that if the Traveller is not already at t_x–t_y, he cannot get there. The consequences of not agreeing to this and yet still using the two-dimensional model must be worked out. Perhaps working it out will require higher orders of dimensionality and force a shift from a two-dimensional model to a three- or an n-dimensional model. All I want to claim now is that the parallel can hold within the two-dimensional model and that this brings our model closer to the ordinary view of time. But it must not be overlooked that our model represents a positive gain over the ordinary view. For on our model the Time Traveller can go back to the Great Exhibition of 1851 even though he was not there previously to the time at which he begins his journey. If he leaves in 1972, he can get back to 1851 even though it was true in 1971 that he was not at 1851. This is what Harrison denies and what our view affirms. But we can (though perhaps not 'must') admit that if it is not true in 1971 that the Time Traveller is already at the temporal location '1851–1972', then he cannot leave 1972 to go back to 1851. So I am admitting that although I have removed Harrison's restrictions on

possible time trips, my own model of time may contain analogous (though clearly more liberal) restrictions on such trips.

11. Changes in the Past

This model of time, which treats the past as a continuant, clearly allows the past to change. The possibility of Wellsian time travel and the possibility of the past changing are two different topics. But these two topics are closely related, as I hope to show in this section.

As an example of a change in the past, we might use this: at present moment t_4, moment t_1 is in the past; at t_1 Jones reached into his pocket and drew out a quarter to buy a newspaper; we may suppose that in the past as it is at t_4, Jones has two quarters in his pocket and drew out the first of these; now, the change in question takes place with respect to t_1 between moments t_4 and t_5: at t_4, Jones had drawn out the first quarter at t_1, whereas at t_5, Jones had drawn out the second quarter instead.[12]

Some people believe that changes in the past cannot occur, that all changes must occur in the present. Miss Anscombe, in support of the view that changes in the past are impossible, argues that any change must be datable and that changes in the past are not datable.[13] But we can see that our model of time allows the dating of such changes and hence, as far as the Anscombe argument is concerned, allows changes in the past. For example, the date of the change from one quarter to another in the Jones example is t_5 – or, perhaps, the interval between t_4 and t_5. That is when the change happens. Of course, the expression 'when the change happens' is ambiguous. It could be used to refer to the past moment – that is, to the *temporal location* of the difference in states of affairs which constitutes the change (in our example, t_1) – or it could be used to refer to the *date* of the change (the interval t_4 to t_5). Our model of time makes this distinction possible. If we thought of time as one-dimensional – as laid out on a line – instead of two-dimensional, we could not make this distinction, and the Anscombe objection would hold good. In fact, on the one-dimensional model we would run into all sorts of contradictions (reminiscent, again, of McTaggart's arguments against the reality of time). Such contradictions are, no doubt, the ultimate thrust of Miss Anscombe's objection, though she does not put it in this way. An example of such a contradiction would run as follows: the putative change in the past occurs at t_1; t_1 must be a

past moment in order for this to be a change in the past; but all changes must occur in the present (that is, they must be 'at' a present moment when they occur); so t_1 must be a present moment when the change occurs; but it follows from this that t_1 must be (simultaneously, as it were) both past and present; but (on the linear, or one-dimensional, model which we are presupposing) this is contradictory; in fact, on that model 'being past' partly means 'not being present'. It is clear that our two-dimensional model avoids these contradictions, as well as the Anscombe objection.

But, equally important, there is a truth in the Anscombe position *and this truth is preserved by our model.* The Anscombe position invokes the principle that the date of every change is the date of the present moment when the change occurs. This is preserved by our model because the date of the change in the Jones example is *not* t_1 (the past moment) but instead t_4 to t_5; and t_4 to t_5 indicates the present moment when the change occurs. t_1 is not the date of the change but instead only the temporal location of the change. Thus, on the two-dimensional model there are two ways in which a change can be *at* a time, and these must be kept very distinct from one another. But I do want to emphasize that much more must be said about the way in which a past event or state of affairs is at a present moment. In what manner does the past now exist? Is this perhaps a totally misleading way of looking at the past? These are examples of the fundamental sorts of questions which examination of the two-dimensional model may help to answer.

It may be asked: what could cause a change in the past? One answer would be: a time traveller. If the Time Traveller is not in the past with respect to t_4 and arrives in the past with respect to t_5, then the past at t_4 is different from the past at t_5. A change in the past has taken place at the *date* t_4 to t_5 and at the *temporal location* which is the terminus of the Time Traveller's journey into the past. What I am saying here is that the Traveller's arrival in the past constitutes in itself a change in the past.

12. Other objections to Wellsian time travel and the reply to them

I want to finish with a brief statement about a series of objections which have been raised to time travel. These objections all have the same character, namely attempting to show that the Time Traveller could cause events

to happen where this would lead to paradoxes and even to logical contradictions. One example will serve to stand for the rest: a time traveller returns to the time of his youth and accidentally murders his younger self. Such cases are usually offered as objections to the possibility of time travel. My own view is that they show nothing about the possibility of time travel. What they show, if anything, is the impossibility of certain sorts of events happening in the past.[14] For example, the case just mentioned shows, if anything, that it is impossible for this traveller to murder his younger self.[15] Such cases exhibit restrictions on the traveller's activities but have no implications concerning Wellsian time travel itself.

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NOTES

[1] Donald C. Williams, 'The Myth of Passage', in Richard Gale (ed.), *The Philosophy of Time*, Anchor, 1967, p. 105. Williams' article appeared first in *The Journal of Philosophy* **48** (1951). It is also to be found in D. C. Williams, *Principles of Empirical Realism*, Thomas 1966; in Sidney Hook (ed.), *American Philosophers at Work*, Criterion Books 1956.

[2] *Ibid.*

[3] *Ibid.*

[4] *Ibid.*

[5] Jonathan Harrison, 'Dr Who and the Philosophers or Time-Travel for Beginners', *Aristotelian Society Supplementary* **XLV** (1971), 2.

[6] Harrison, *op. cit.*, pp. 6–7.

[7] Just as some philosophers have been accused of 'spatializing time', so too I will probably be accused of 'substantializing time', since it is a common view that substances are the subjects of qualitative change.

[8] D. J. O'Connor, 'The Identity of Indiscernibles', in M. Loux (ed.), *Universals and Particulars*, Anchor Books 1970, p. 231. O'Connor himself describes situations in which we would be inclined to give up such apparent necessary truths as 'two or more bodies cannot occupy the same place at the same time'.

[9] The reader must keep in mind that E and Y *are* t_5, though *as* past and future respectively.

[10] Of course, in a complete notation, we may need some way of indicating whether the event in question is past or future to t_y. But here I am dealing only with past events for the sake of simplicity. This notation is easily extended as needed.

[11] There is a very general parallel here between our theory and the Special Theory of Relativity. To obtain an invariant quantity, time is added to the three spatial coordinates as a fourth coordinate in Special Relativity. In our theory we add a second temporal coordinate to obtain invariance. But this analogy is very general and cannot be pushed very far.

[12] I am purposely trying to use an example in which the change in the past will have

few, if any, effects on later moments for the sake of simplicity – hence the triviality of the quarter example.

[13] G. E. M. Anscombe, 'The Reality of the Past', in Max Black (ed.), *Philosophical Analysis*, Prentice-Hall, 1963, p. 48. I have discussed Miss Anscombe's argument and the topic of changes in the past in my *Scepticism and Historical Knowledge*, Random House, 1965, Chapter Ten.

[14] I doubt that it shows even this. The usual reason given for the impossibility of the Time Traveller killing his younger self is that then his life would have ended before the time at which he did the killing. But this is no objection on my model of time. Suppose that the Time Traveller leaves t_5 (on Figure 3) and arrives at D; at E he kills his younger self and immediately returns to t_6. His actions have produced a change in the past. Nevertheless everything along the main diagonal remains as before, including his continuous existence to and beyond t_6. Thus, there is no impossibility here. (I owe this point to Robert M. Adams.)

[15] If we assume that it is impossible for this traveller to kill his younger self, some people are inclined to ask such questions as this: "But how can the laws of logic prevent him from killing his younger self? Do they cause his finger to slip on the trigger or the bullet to fly apart in mid-air?" The implication of such questions is that the laws of logic cannot prevent such actions. But such questions are like asking: "How do the laws of logic prevent the geometer from trisecting the angle or squaring the circle? Do they, for example, cause his ruler to slip at a crucial moment every time he tries it?"