CHAPTER 5.2

The Tenseless Theory of Time

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1 Attractions of the Tenseless Theory of Time

Strictly speaking, the tenseless theory of time is not a theory of time (or space-time) in the way in which, for example, the special theory of relativity is. It has to do with the unimportance for ontology of words such as 'past', 'present', 'future', 'now', and the temporal inflections of verbs, and the tensed 'is', 'will be', 'was', etc. I shall include 'past', 'present', 'future', and 'now' as tenses, no less than the inflections of verbs. I shall distinguish the tenseless 'is' as in '7 plus 5 equals 12'. Some philosophers say that 7 plus 5 always was, is, and always will be equal to 12. It seems to me a pity to sully the purity of mathematics by bringing in time references, even trivial ones. I shall also contend that a tenseless idiom is most appropriate for physical theory. A tensed locution could avoid the tensed inflections of verbs but would say 'is future', 'is present', and 'is past' with tenseless 'is'. I have been told that Chinese is like this in eschewing tense inflections on verbs. Opponents of the tenseless theory tend to be influenced by the phenomenology of our immediate experience of time, whereas I distrust phenomenology. I hope that such phenomenology can be explained away. There can be metaphysical illusions (Armstrong 1968 and Smart 2006.) Note that I am using the word 'phenomenology' in a relatively sensible way, not as used obscurely by a certain school of German philosophy.

Opponents of the tenseless theory do not treat tenses and words such as 'past' as indexicals, as are 'I' and 'you' and 'here' whose reference depends on who utters them and the time of utterance. The opponents of the tenseless theory generally treat such inflections and words as referring to intrinsic properties in respect of which events change. Thus a person's marriage may be said to have the property of futurity, then of presentness, and then of pastness. The tenseless theorist sees this as, at the very least, highly misleading. All this is sketchy and merely preliminary to details in subsequent sections. I shall use the term 'A-theory' to refer to opponents of the tenseless theory, which I shall call the B-theory. This is by analogy with McTaggart's (1927) two ways of ordering events in time, the former in respect of their greater or lesser pastness or futurity, and the latter in respect of being earlier or later than one another. I must add that I do not really believe in the existence of time but only of space-time, unless one gives the name 'time' to a particular 'world line' in space-time. However this will not greatly affect most of the argument.

I hope that this gives the flavor of the difference between those who accept the B-theory and those who accept the A-theory. Perhaps we should use the term 'A-theory' as referring to a syndrome, rather than as having a very tight definition. What, then, are the attractions of the B-theory?

The first thing of consequence to note is that mathematical and physical theories are properly expressed tenselessly. Their truths are, in a sense, eternal truths, not sempiternal ones as the A-theorist will contend. Now if, like me, you want to see the world *sub specie aeternitatis* (to echo Spinoza), or "from the point of view of the universe" (Sidgwick 1981: 382), you should want a tenseless language for metaphysics (Smart 1987). Tenses and other indexicals make us see the world from a particular and egocentric perspective, at least if we take them with ontological significance. Of course we can never see the world other than from the perspective of our place and time, but we should aspire to doing so as approximately as we can. Of course there are other, less metaphysical, reasons for wanting a tenseless theory of time, in that we may think that it would give a better understanding of how tensed language functions, for example by giving the truth conditions for tensed language in a tenseless metalanguage. I appreciate this interest in linguistic theory, but as a metaphysician I see the linguistic theory, though intrinsically interesting, as also a means. I wish to suggest also that plausibility in the light of total science is an important indicator of metaphysical truth.

Biology, in contrast to physics and chemistry, is cosmically parochial. It is concerned with terrestrial organisms and generalizations about them. It uses the laws of physics and chemistry to explain these generalizations of natural history. The natural history may be highly sophisticated, using fairly high technology to make observations, but it issues in mere generalizations, the holding of which, even with exceptions, get explained (we hope) by the physical and chemical laws. A scientist need not be surprised by such anomalies. Organisms are complex mechanisms, and motorcars, even though they obey the laws of mechanics, electromagnetism, and petroleum chemistry, often unsurprisingly break down. Thus we may say that, though there are speculations about exobiology, biology is concerned with terrestrial matters and is cosmically parochial. Metaphysics should not be cosmically parochial. It should eschew tensed language. Tenses in their own way can tempt us to a cosmically parochial, anthropocentric, or even egocentric perspective on the world. Of course, this is not to deny that intelligent beings elsewhere in the universe could have their own cosmically parochial perspectives from tensed language.

This desire for a non-parochial and non-anthropocentric view of the universe provides reasons for liking a tenseless view of time. It must be conceded that some A-theorists try to mitigate cosmic parochialism by (despite the special theory of relativity) holding that at any instant there is a cosmic "now" or simultaneity. I shall indeed shortly make a little bit of an irenic suggestion to the A-theorist on this matter. This,

however, is by the way. As I have said, my motivation is metaphysical, but this does not mean that pure linguistics is not relevant to philosophical concerns. I hold that tenses are indexicals and the semantics of tenses and indexicals generally is important for the ontology of temporal discourse. Compare the case of the word 'I', which in any occasion of normal use refers to the speaker or act of writing. It does not carry any interesting metaphysical baggage. There have indeed been misguided people who talk about the 'I' or who say 'the ego', thus slightly covering up their absurdity with the respectability of a learned language. Some have used the expression 'the Self', though 'self' has its natural habitat in 'myself', 'himself', 'yourself', etc. You kick yourself but it does not make sense to say that you kick your Self (Flew 1949).

2 Two Ways of Treating of Tenses as Indexicals

There are two ways of dealing with tenses and indexicals in general, which I will present as containing no objectionable consequences for the metaphysics of time. These are (1) the token-reflexive approach due to Reichenbach (1947: sects. 50–1), and (2) the approach due to Donald Davidson's "Truth and Meaning" (1984).

Reichenbach called an utterance of a word or phrase a "token" of the word or phrase, whereas a word type is an abstract object. Indeed we can have different senses of 'type word', since if a lad sends 'love and love' to his sweetheart, there is one sense in which he has used three (token) words and another sense in which he has used only two (type) words. If I shout "Fire" I utter a token of the type 'fire'. We can talk in the same way of type and token sentences. In the case of written words these persist but we can identify the token with the act of writing it. After all if we find in an old manuscript letter "Queen Anne is dead," we take the present tense 'is' to refer to the time or the act of writing the letter, and certainly not to the time of our reading it. With this proviso I shall regard inscriptions as momentary events and shall count them as utterances.

According to Reichenbach words such as 'I', 'you', 'here', 'now', and also tense inflections are token reflexive: they refer to their own utterances. An obviously token reflexive expression is 'this utterance'. In theory we could get by with this single token reflexive, though as I shall indicate shortly there could be some difficulty with compound tenses such as pluperfects. Thus 'I' could be replaced by 'the maker of this utterance', 'you' by 'the hearer or reader of this utterance', 'here' by 'near this utterance', 'past' by 'earlier than this utterance', and so on. 'This utterance' does not have as much context dependence as many indexicals, but the extra context dependence of 'here', for example, can be picked up by the context-dependence of 'near' in 'near this utterance'.

Thus we can translate 'The battle of Waterloo is past' by 'The battle of Waterloo *is* earlier than this utterance', and the (nowadays false) statements 'The battle of Waterloo is present' and 'The battle of Waterloo is future' respectively by 'The battle of Waterloo *is* simultaneous with this utterance' and 'The battle of Waterloo *is* later than this utterance'. (Here I indicate tenseless 'is' and other verbs by italics.) Similarly 'was', tensed 'is', and 'will be' can be treated in the same way. 'Joe was a coal miner' can be rendered 'Joe *is* a coal miner earlier than this utterance'. Indeed the difference

between perfect and pluperfect can be accommodated, following Reichenbach, by referring also, definitely or indefinitely, to a contextually agreed reference point. Thus 'Joe will have come before the lecture begins', is to say 'Joe *comes* at some time later than this utterance and before the lecture begins'. With imperfects we need to refer to stretches of time.

So 'past' is just 'earlier than this utterance', 'present' is just 'simultaneous with this utterance', and 'future' is just 'later than this utterance'. There are indeed things that the A-theorist wants to say, such as "The battle is future, will be present and then will be past" and "Thank goodness that's over" (Prior 1959). At first sight, these curious remarks seem to support the A-theorist, who does not think that 'past', 'present', 'future', and in this context perhaps 'over' are indexical, but thinks that they refer to intrinsic properties of events. I shall consider a B-theorist reply when I come to discuss the A-theory.

I now consider the second, also essentially B-theory, way of dealing with tenses and 'past', 'present', 'future', etc., and which I now prefer to the 'token reflexive' way. It is due to Donald Davidson (1984) who gives the semantics for tenses in a tenseless metalanguage. This seems to me to avoid the questionable metaphysics of the A-theory just as well as the token reflexive approach, and I think that it has significant advantages. I shall also consider possible disadvantages noted by Heather Dyke (2002). Dyke usefully refers to the second and metalinguistic approach as "the date theory." Davidson suggests that a semantics for sentences containing tenses or other indexicals should relativize truth of a sentence to a person and a time. Thus, he says, the theory will entail sentences such as '"I am tired" *is* true as (potentially) spoken by person *P* at time *t* if and only if *P is* tired at *t*' and '"I was tired' *is* true as (potentially) spoken by person *P* at time *t* if and only if *P is* tired at a time earlier than *t*' (I have used italics for the relevant occurrences of 'is' and 'was' to emphasize the tenselessness of the metalanguage.) Other tenses can be treated analogously though with obvious complications for compound tenses. This seems to have the advantage over the token reflexive approach in that it deals with sentences, not utterances. There is only a finite number of (say) English sentences that ever get uttered, and yet the language contains an infinite number of sentences as abstract objects. Tarski's semantics for formalized languages with the structure of first-order logic gives a finite axiomatization of the truth conditions for such an infinity of sentences. Davidson's program was to show the underlying structure of natural languages as that of first-order logic. It was an exciting program for whose success I would hope, but we do not need to accept the full program in order to accept the semantics for tenses.

I feel slight unease on account of the word 'potentially' in the suggestion as stated above, and I do not suppose that Davidson really liked the modal word 'potentially' here.[1]

Consider the sentence 'The sun's becoming a supernova is future, will be present and then will be past'. On the token reflexive approach we might try: 'The sun's becoming a supernova *is* later than this utterance, simultaneous with some utterance later than this utterance, and earlier than some utterance later that utterance'. This is at best false, since presumably there are no persons or utterances at the time in question (assuming there are no extraterrestrials and we do not colonize other solar systems). The date theory fares little better, for lack of appropriate utterances at that distant time. We

might take the B-theorist's inability to make much sense of sentences of the form 'Event E is future, will be present and then will be past' as simply the trouble which arises when we treat 'past', 'present', and 'future' as signifying properties in which events change (Smart 1949). We might say that events happen, things and processes change. The B-theorist of course has her own way of dealing with the fact of change. 'The traffic light *changes* from red to green' is just to say that a red temporal stage of the traffic light *is* red and an immediately later temporal stage *is* green.

The A-theorist of course will aver that sentences such as 'E was future, is present and will be past' are perfectly intelligible because 'past', 'present', and 'future' (or rather the corresponding abstract nouns) refer to intrinsic properties of events in respect of which events change and so the (in my view pathological) sort of sentence discussed in the last paragraph is perfectly in order and even platitudinous. Perhaps this is a minor advantage of the A-theory, and I will consider what to say about it in the next section. I now think that in metaphysics we tend to get into a trade-off or comparison of plausibilities, and only in some cases is it a matter of knock-down proof or, as Wittgenstein said, showing the fly the way out of the fly bottle.

3 B-Theorist Critique of the A-Theory

The A-theory is doubtless protean, with various minor differences between different practitioners, but, as I indicated in the last section, I take the essential nature of the A-theory to be the assertion that the words 'past', 'present', and 'future' correspond to intrinsic properties of events. However, I also consider Arthur Prior to be in the A-theorist camp because of his stress on the metaphysical importance of tenses. He had what he called a 'no present' theory, in which the work done by 'past', 'present', and 'future' is done by tense operators. His is not a tenseless theory of time but quite the opposite. Prior was a great man but (influenced by Davidson) I regard him as wrong in his proliferation of sentential operators as in 'Joe believes that', 'Joe desires that', 'It is necessary that', 'Joe says that'. Prior's approach really needs a semantics for 'past', 'present', and 'future', and this would be difficult for him since he holds that the indexicality – or, as he calls it, 'egocentricity' – of these words is spurious ("A Spurious Egocentricity," in Prior 1968). I think that his semantics would be metaphysically in the camp of the A-theorists.

To put it roughly, and acknowledging that there may be need for qualifications, Prior was perhaps the last of important logicians who thought of interesting axiom systems and then fitted interpretations to them (as resulted in his "tense logic"), whereas the semantic approach has been to fit axioms to a model or interpretation. Neither the token-reflexive way of dealing with tenses nor the date theory treats tenses as operators. Prior suggests a "no present" theory analogous to F. P. Ramsey's "no truth" theory that to say that grass is green is true is just to say that grass is green. Similarly to say that something is going on now is just to say that something is going on. However, this is because for Prior verbs are always tensed. Even the tenseless 'is' of mathematics gets thought of as 'always was, is, and always will be', thus sullying the purity of mathematics with temporal reference. Now, if 'is' is tensed, then if something is going on now (or at present), it is going on – and vice versa. To have

both the tensed 'is' and 'now' or 'present' is like wearing both belt and braces. Either keeps one's trousers up, and tensed verbs do the same job as could be done with tenseless verbs and 'past', 'present', or 'future'. Unless one recognizes the indexicality, the operators of Prior's tense logic do not save us from the A-theorist's ontology. At any rate, I shall take it that the A-theorist's assertion that events change in respect of past, present, and future cannot be avoided by representing it in terms of changes of the tenses of verbs we use to describe them. The stronger medicine of the B-theory is needed.

McTaggart claimed that time involves change and that the B-theory denies change. If event E is before event F, then according to him it always was and always will be that it is so. Here he is inappropriately foisting tensed 'is' on the B-theorist. The B-theorist should say that E *is* (tenseless) earlier than F. As I mentioned earlier, the B-theorist does not want to say that instantaneous events change (for example, the beginning of the war does not change unless by 'beginning of' one means 'early part of'). As mentioned above, the B-theorist accommodates the facts of change by tenselessly saying that one temporal stage of a thing or process can differ in certain respects from an adjacent temporal stage. Partly by not recognizing this fact, McTaggart finds a contradiction in both his A-series and his B-series and comes up with a mysterious C-series, but this need not detain us here.

The word 'event' is etymologically cognate to 'outcome' and generally works like 'result' (patently, in its archaic use, as in 'the event of the tournament' in Sir Walter Scott's *Ivanhoe*). Similarly with 'beginning'. Beginnings and endings do not have beginnings and endings, except that I concede that sometimes the words 'beginning' and 'ending' are used with the sense of 'early part' and 'final part', in which case they are process words and not event words. Things and processes can change, events happen. The B-theorist elucidates change as immediately adjacent temporal stages of a thing or process having different properties. McTaggart went the other way, since he held that change, if it exists, pertains to events, not to things and processes. Of course he goes on to argue that there is a contradiction in supposing that events change, by an argument generally held to be fallacious and which I shall not consider here. The matter of interest here is his belief that the B-theory denies change in processes and things and his own locating change wrongly in events. He says that this would be in respect of being past, present, or future. This would be regarded by a B-theorist to be highly misleading to say the least. If 'past', 'present', 'future', and 'now' are indexical, they cannot refer to intrinsic properties. Such intrinsic properties would be 'spooky' and they are not mentioned in physical theory. In physical theory there is no past and future, only earlier and later. Consider the Minkowski space-time of special relativity. It is true that the light cones at a point *O* in Minkowski space-time are sometimes described as 'past' and 'future', but all that is meant is 'earlier than *O*' and 'later than *O*'. Indeed, the mechanics and electromagnetism of special relativity are time-symmetrical and the difference between earlier and later has to be brought in from thermodynamics and cosmology.

Actually physics is not quite time-symmetrical but CPT-symmetrical, where C is charge, P is parity, and T is time. One can think of an anti-particle as the particle lying backwards in time. Time-symmetry can be thought of as reflection in a time mirror and so it seems very natural to reverse parity (reflection in a space mirror). So

one might think of CPT-symmetry as time-symmetry only more so (just as Lord Tweedsmuir, when Governor-General of Canada, said that Canada was like Scotland but more so). It was the great theoretical physicist Richard Feynman who thought of a positron as an electron moving backwards in time, but with philosophical pedantry (necessary for the concerns of this article) I must stress that one cannot move either backwards or forwards through time. Time is already in the Minkowski picture. As a B-theorist I do not really believe in space and time but only in space-time. Of course I do believe in the special relativity distinction between time-like and space-like world lines, and so I am not really being disingenuous in writing this essay on theories of time. This distinction is seen in the minus signs in the expression for the metric of Minkowski space-time. In special relativity there is no absolute space-time and there is no cosmic present. This is a worry to some A-theorists. However, I shall shortly offer a small olive branch to the A-theorist on this matter.

Some A-theorists take a rather pragmatic view of space-time. Thus Peter Geach, in his subtle but I think wrong-headed paper 'Some Problems about Time' (1966), speaks of the four-dimensional and semi-Euclidean space of special relativity as merely "a graph." This strikes me as instrumentalist. I view Minkowski space-time as a real physical entity and the postulation of it, as I think that Minkowski did, as explanatory. Of course in the light of general relativity it is only an approximation, valid only approximately in the absence of very strong gravitational forces. Nor in being realist about space-time do I want to pre-empt the question of whether Minkowski's or Einstein's space-time is to be thought of as absolute or merely a system of relations between physical entities, though there is much to be said in favor of the absolute theory (Nerlich 1994a, 1994b).

Of course it is possible to state the special theory of relativity in commonsense language. Einstein pretty well did it in 1905. There would be a problem, in that commonsense does not recognize that the applicability of the notion of 'now' is local only. For communication with fast (near the speed of light) spaceships, new conventions would be needed. For example, 'now' could refer to simultaneity in the frame of reference in which the message sender was at rest. (The receiver would have to do some very quick calculations!) Minkowski showed the matter in a much clearer and more explanatory light. The Lorentz transformations correspond to a rotation of axes in space-time. The familiar Newtonian transformation amounted to a rotation of time axis *without* a rotation of a space axis. As Minkowski pointed out, this looks arbitrary in a way that the Lorentz transformations do not. Minkowski's way of looking at special relativity helped to pave the way for Einstein's general theory with its space-time of variable curvature. The main insight of Einstein's 1905 paper, which he stated, unfortunately, in rather operationist language, was in connection with the question of how to reconcile Newton's mechanics with Maxwell's electromagnetism. Maxwell's equations are Lorentz invariant, whereas Newton's are not, being the Galilean transformations of commonsense. Should Newton's or Maxwell's equations be modified? Einstein modified Newton's equations that had worked well where velocities that are low compared with the velocity of light are concerned. The modified mechanics has been amply confirmed by observations of fast particles in cyclotrons and indeed in the very design of a cyclotron. Minkowski's geometrical approach makes time-dilation and the supposed twin paradox almost obvious because it is a matter of Pythagoras's

theorem modified by the minus signs which occur in the metric for Minkowski space. Consilience with Minkowski and with Einstein's later general theory is an important motive for liking the B-theory.

I have remarked that special relativity may be felt as a problem for the A-theorist, who believes in an objective and universal present, and even more if she believes in a cosmic advance through time. Here I shall briefly offer a very small olive branch to the A-theorist. Though special relativity does not determine a preferred frame of reference, it does not rule out the possibility of some such preferred frame being determined from outside the theory. We might suppose that we should consider a locally preferred frame in which the cosmic background radiation is equal in all directions. Because of the expansion of the universe, in each cluster of galaxies the preferred time dimension would be at an angle to that of others. This would point to the idea of a cosmic simultaneity given by the surface of a curved hyperspace.

However, though cosmology might give comfort to the A-theorist, it raises other worries for her. There are speculations that universes may be spawned from the backs of black holes, thus arising from new big bangs (Smolin 1997). At any rate it does suggest that the A-theorist's usual idea of a single ordering of past, present, and future may need revising. I surmise that the B-theorist will quite happily allow for a mere partial ordering of earlier and later, even though a very complicated one.

The main objections to the A-theory, as discussed above, are due to the metaphysical mysteriousness of the A-theory ideas of past, present, and future, and also tenses, and to the greater plausibility of analyzing them as indexicals. Tensed discourse also facilitates (though it is not the sole cause of) the supposed intuition of the passage of time in immediate experience. As I mentioned earlier in this chapter, Arthur Prior laid stress on the feeling, after a period of suffering that has come to an end, 'Thank goodness that's over'. The A-theorist thinks that this sort of consideration and an appeal to immediate experience more than compensate for the ontological economy and scientific plausibility of the B-theory. The B-theorist thinks that these considerations do not really support the A-theory.

4 "Thank Goodness That's Over"

Suppose that we interpret your utterance "Thank goodness that's over" as expressing relief that the utterance of it is later and not simultaneous with or earlier than the pain referred to by the 'that'. But are we really rejoicing that the pain is earlier than a certain utterance? As Arthur Prior remarks in his article "Thank Goodness That's Over" (1959), why should anyone thank goodness for *that*? Certainly it is not just a matter of your thanking goodness that something is earlier than your utterance. It is an expression of relief. On the other hand, if you said to a physician "My pain has stopped," your intent might be to give him useful diagnostic information. And though not very idiomatic, "My pain *is* earlier than this utterance" would serve the physician equally well. (As far as avoidance of the unidiomatic is concerned, the date account of tenses and related indexicals may have a small advantage.)

Now why are we pleased that a pain has stopped and not that it is about to begin? This is a question whose answer may seem obvious to commonsense and yet it raises

deep questions about the temporal asymmetry of the universe and about the theory of evolution. We are future oriented because we need to plan or at least take quick action. Why we need to plan for the future and not the past, or why planning for the past does not even seem to have clear sense, is nothing to do with A-theory fantasies, such as that the future is not real or that the supposed passage of time is one way. The question has often been seen as that of the so-called direction of time. I prefer to describe it as the problem of the temporal asymmetry of the universe or at least of our cosmic era. As physicists and philosophers such as Boltzmann, Reichenbach, and Grünbaum have argued, the problem is largely to do with statistical mechanics and cosmic thermodynamics.[2] If, contrary to what is on the whole believed, the universe went after expansion to contraction and big crunch and if the thermodynamic asymmetry was reversed too, then denizens of that era would have their past toward our future – that is, memory traces would be of later events by our reckoning, but they would think of the causes of the traces as earlier. In between the two eras, at a time of heat death, there would be traces in neither direction. Indeed, I doubt if it is possible to imagine a mental state in which we had memories in both directions. I suspect that it is also this thermodynamic (statistical) asymmetry that makes us think of causality as one way (oppositely in the two eras).

It is this asymmetry between earlier and later that makes us care about the future in a way in which we do not care about the past (though we may rejoice in or regret the past). Animals may plan for the future or have instincts that cause them to behave rather as if they had planned. A humanoid ancestor confronted by a tiger knows that he was safe in the previous hour but is not sure whether or not the next hour will contain a tiger with his body dead and perhaps partly in the tiger's stomach. It is no wonder that our anxious worries are future-oriented. (Note that my use of 'past' and 'future' here is not the indexical one I was concerned with in criticizing the A-theory. With a little more attendant verbiage, I could have used 'earlier' and 'later'.) No wonder that we say "Thank goodness that's over" when pain or unpleasantness is no longer something about which we need to plan and make decisions. Evolution by natural selection has seen to it that our minds are turned predominantly to thinking about what will, or will be likely to, happen later (Maclaurin and Dyke 2002). A prisoner who has served nine years of a ten-year sentence is relatively happy that he has only one year left to serve, whereas if he has served one year of a ten-year sentence, even though he is just as temporally near freedom, he will be less happy. The past is not in the time direction in which our planning and emotions are usefully oriented.[3] It comes down in the end to the temporal asymmetry of the universe, not to temporal flow or coming to be. If the prisoner thinks that his release is coming or that his consciousness is advancing toward the time of his release, he is in a perhaps happy state of confusion. We do not need this idea to explain why he feels happier a year before the end of his long sentence than he was a year after its beginning.

5 The Supposed Passage of Time

The myth of passage, as Donald Williams called it in a fine article (1951), the idea that time passes by us, is cognate with what I regard as the equally absurd idea that

we advance through time. A politician will pontificate "as we move into the twenty-first century" and a hymn goes "Time like an ever-rolling stream bears all its sons away." We can feel that we are adrift on a river and being borne inexorably toward the big waterfall that is our death. Or, more pleasurably, that one's wedding day is coming toward one, though all too slowly. I hold that all these ideas and feelings are born of confusion. A first move against this confusion is to ask: 'How fast is this flow of time or our advance through it?' Does a meter bar flow toward the 100-centimeter mark at 1 centimeter per centimeter? In mathematics, of course, we do have $dt/dt = 1$ and $dx/dx = 1$, but neither is informative.

Notice how motion looks if we represent it in Minkowski space-time. To say that two particles are at rest with respect to one another is to say that they (or tangents to them) are parallel, and motion is a matter of them or their tangents being inclined to one another. I am supposing that particles have no dimensions as in Newtonian dynamics, and so in Minkowski space they *lie* along a line, their 'world line'. Even sizable objects are thin space-time worms. Taking the units of space and time such that the velocity of light is unity (thus avoiding an arbitrary-looking constant in the expression for the metric) one second is equivalent to 300 million meters, so that even a star is a very thin space-time worm and approximates to its world line. So in space-time, rest and motion are a matter of parallelism and inclination of world lines. Now if motion is just relative inclination of world lines, there is no room in Minkowski (or Einstein's Riemannian) space-time for us to represent motion of time (flow of time) or motion through time (advance through time). Thus, if we take Minkowski's dictum at the beginning of his famous 1908 paper seriously, that "Henceforth space by itself and time by itself are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality," and still want to talk of the flow of time or of our advance through time, we would need to think of ourselves extending into this hypertime and we would have to have four-dimensional hypertime slices much like our instantaneous three-dimensional time slices of our four-dimensional selves. If we think of Minkowski space as a playing-card, the world of hyperspace would be like a pack of cards. Then if it was felt that there would have to be motion through hyperspace, we would need there to be a hyper-hyperspace –and so on without end. Some philosophers have thought of Minkowski space as "static," but that is a crude mistake. Not all world lines of particles are parallel. The supposedly flowing world of the A-theorist is often described as "dynamic" and the Minkowski world as "static." This is a strange use of the words 'dynamic' and 'static'. In mechanics, 'dynamics' is about forces. Perhaps 'kinetics' would better express what the A-theorist who makes this objection has in mind, but the Minkowski world captures mechanics and a fortiori kinetics. It is not static. Not all tangents to world lines are parallel. Moreover, anyone who thought that time flowed would be likely to call the hyper-hypertimes 'static' too. Confusion proliferates.

If it is said that time flows, it seems, then, that the question "How fast does it flow?" is a devastating one for the A-theorist. However, Ned Markosian (1993) has challenged the rate of passage argument against the notion of time flow or passage argument. Now, I have conceded that the rate of passage argument is not knock-down or apodeictic. For example, it is logically possible that the hypertime is constituted

by a mere ordering of instants, but that (unlike normal time segments) its segments would not constitute magnitudes. As Markosian points out, we define rates of change by comparison of spatial changes, such as the distance walked and the change in the angle of the sun in the sky. A measure of time is better if it keeps the laws of nature simple and not cosmically parochial. So the rate of rotation of the earth will not do because we want to say that, because of tidal friction, the rate of the earth's rotation is decreasing. The best measure of time is the frequency of vibrations of a cesium atom. Nevertheless, the (in my opinion confused) phenomenology that makes us feel that we are aware of a continuous passage of time, analogous to the flow of a river, has done much to make the A-theory seem attractive. To expose the seductiveness of the metaphor is not necessarily to assert that all changes have rates of change. There could be instantaneous changes (though quantum mechanics suggests that the positions of such changes might be indeterminate). There may not be any step functions in fundamental physics, though there are functions that approximate to them. To explain the seductiveness of the phenomenology, I have conjectured that we confuse the flow of information through our short-term memories with a flow of time itself (Smart 1980). I am of course more convinced that the flow of time is a metaphysical illusion than I am of the suggested explanation of it. However, for a plausible explanation of it, see Hartle (2005).

Markosian demands that the B-theorist should be able to analyze tensed sentences in terms of tenseless ones. The B-theorist could follow Reichenbach and Dyke and say that tensed utterances contain a token-reflexive expression. Obviously it is unfair to expect the B-theorist to translate a token reflexive into a non-indexical sentence. If we take the Davidsonian way of giving the truth conditions of indexical sentences in terms of a non-indexical metalanguage, this also does not constitute translation and it is unfair to demand it.

It is often said by A-theorists that the four-dimensional world is "static" where the A-theorist's world is "dynamic." (Of course, dynamics has to do with forces and so perhaps they should say 'kinetic'.) But, of course, relative motion is represented in the Minkowski picture by relative inclinations of world lines and acceleration by curvature of world lines. No fact of motion is lost!

6 Presentism and Fatalism

There is a bizarre form of A-theory called presentism. Of course I reject it. Both past and future are real. It is said that we cannot change the past. Equally we cannot change the future. Suppose that I say to you that I am going to change the future by lifting my left arm or by lifting my right arm. I lift my left arm. Have I changed the future? No, lifting my left arm was the future. The historical past is earlier than us in Minkowski space and the future is up ahead of us. Both are real. Our actions are caused by our beliefs and desires and in part cause future events. There is not room for the silly sort of fatalism that implies that our decisions do not matter.[4] If belief in the reality of the future is fatalism, it is not the silly sort of fatalism.[5]

Notes

1 "'Julius Caesar crossed the Rubicon' is true if it *is* spoken by *P* at *t* and *t is* later than the time at which Caesar *crosses* the Rubicon." Well, lots of people have spoken this particular sentence but what about the sentences that never get uttered? Heather Dyke makes the pertinent objection that by truth functional logic, if the clause after the 'if' is false, then the whole sentence is trivially true and so useless as a statement of truth conditions. She therefore prefers the token-reflexive approach. A semantics for indexicals based on utterances not sentences must give up the idea of a recursive semantics, but as has just been noted, the date approach fares no better. Perhaps the best that we can do for the date approach is to aspire to a recursive semantics for non-indexical sentences and give a non-recursive (except in the trivial sense in which a finite set is recursive) semantics for the set of triples <*S*, *P*, *t*> where *S is* actually uttered by a *P* at a *t*. On this view we might propose a recursive semantics for the non-indexical part of language and no recursive surface rules for the indexical and indeed other contextually dependent sentences. It still remains the case that when we know that a particular tensed sentence *S* has been uttered (or indeed will be uttered) by a particular person *P* at a particular time *t*, we can go on to give its truth conditions non-trivially by a tenseless sentence in the metalanguage. So perhaps I can come to some compromise with Dyke. In any case there is no metaphysical difference between the token-reflexive approach and the date approach. Each, if correct, removes the mystery that arises from the A-theorist's supposed properties of pastness, presentness, and futurity.

2 See Reichenbach (1956) and Grünbaum (1973). For an outstanding recent philosophical treatment of this issue, see Huw Price (1996). For a useful treatise for physics students, see Paul Davies (1974).

3 I hope that this answers the example of the prisoner put up by George Schlesinger (1983: 109–10).

4 See Smart (1981). Peter Geach has called this a laughable argument, which puzzled me until I recollected that he had a strong tensed view of truth.

5 For reasons of space, I omit a comparison of the commonsense language of substance and change with the four-dimensional idiom. (It is my belief that four-dimensionalism together with mereology, the theory of part and whole, makes many philosophical problems as easy as shelling peas. A case in point is the philosophical problem of personal identity, though here there remain psychiatric, juristic, and perhaps theological ones.) On this matter, see Sider's contribution to this volume (chapter 6.1) and Sider (2001).

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CHAPTER SIX