Four-Dimensionalism

An Ontology of Persistence and Time

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and how an object is moving at a time is a fact about what that object is like *then*.

On this view velocity is independent in some sense of successive spatial position; but if the anti-Russellian introduces a quantity that is *entirely* unrelated to position it is hard to see what this quantity would have to do with *velocity*. This view's leading contemporary defender, Michael Tooley, therefore holds that velocities are irreducible 'first-order' properties that are *picked out* as those properties that are, in fact, nomically correlated with the first derivative of the position function. According to Tooley (1988, sect. 3), the term 'velocity' is to be given a theoretical definition of the Ramsey–Lewis style[28] in which the reference-fixing postulates are the laws of motion. Thus, Tooley picks out velocity as the property, *v*, that actually satisfies the following equation, among others:

$$T_1 : s(x,t_2) = s(x,t_1) + t_1 \int_{t_1}^{t2} v(x,t)dt$$

I myself prefer the Russellian theory because of its simplicity and reductive nature. If it is true, no spatiotemporal facts beyond those of spatial and temporal distance need be postulated. It seems to me there are no good reasons to introduce Tooley's complications into the theory of space and time, and in the absence of such reasons the simpler Russellian theory is preferable. But even if I am wrong about the virtues of Tooley's theory, it is of no help to the presentist in solving the problem under discussion. According to Tooley we are to pick out velocity by its role in the laws of nature. This role concerns the relation between velocity and spatial position over time. But the latter is precisely what I have been arguing the presentist cannot capture in his tensed language. The presentist, therefore, has no way to pick out Tooley's non-Russellian velocities.

3. The Truth-Maker Objection

A second argument against presentism addresses the legitimacy of taking the tense operators as primitive.[29] The presentist claims that 'WAS

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[28]   See Lewis (1970).

[29]   Another objection to primitive tense operators is McTaggart's (1908) infamous argument for the incoherence of the A-theory. It amazes me that this argument is still advanced. I sympathize with Broad (1938 : 309–17) when he calls it a 'howler'; see also Prior (1967 : 4–7).

(there exist some dinosaurs)' is true. But if there do not exist any past dinosaurs, what *grounds* the truth of this sentence?

The vague assumption that truths must be 'grounded' can be made precise in a couple of ways. One is the *truth-maker principle*: for every truth, T, there exists an entity—a 'truth-maker'—whose existence suffices for the truth of T.[30] These truth-makers are often called states of affairs or facts, and are thought of as concrete constituents of the world in the tradition of Russell (1918) and Wittgenstein (1961).

Many have objected to the requirement that negative existential sentences like 'there are no unicorns' must have truth-makers. It is comparatively easy to see how there could be an entity that necessitates the truth of 'there exists a cat'—for any cat, c, the fact of c's existence seems like the kind of entity one can bump up against and kick around. In contrast we never bump up against any fact whose existence entails that there are no unicorns. It is only the positive states of affairs whose inclusion in the concrete world seems unproblematic. And even very large positive states of affairs are not truth-makers for 'there are no unicorns', for given any such state of affairs, S, it would be possible for there to exist a unicorn *in addition to S*.

To avoid this sort of difficulty John Bigelow (1988: 130–3) and David Lewis (1992: 215–19) formulate the grounding principle instead as the claim that *truth is supervenient on being*: what is true supervenes on what objects exist, what properties those objects have, and what relations they stand in. This principle does not require the existence of a fact that there are no unicorns; it merely requires that since 'there are no unicorns' is true in the actual world, it must also be true in any world in which the same objects exist, those objects instantiate the same properties, and those objects stand in the same relations as they do in the actual world.

Either way the grounding principle is cashed out, the point is to rule out dubious ontologies that posit 'ungrounded' truths, for example 'brute counterfactuals' with no basis in the way things actually are. The thought is that it is illegitimate to postulate truths that 'float free' of the world. At first glance it would appear that the presentist's tensed truths float free of the world—they seem not to have truth-makers and not to supervene on being. For the presentist, all states of affairs are *currently* existing states of affairs, and the properties and relations of objects are

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[30]   See Armstrong (1997, esp. ch. 8); Martin (1996); and Mulligan *et al.* (1984).

confined to those of *currently* existing objects. But surely the truth about the past is not fixed by such facts about the present.

Lewis invokes the principle that truth is supervenient on being in a discussion of something entirely different, but mentions in passing that presentism seems to be inconsistent with that principle (1992: 219). Bigelow, on the other hand, is himself a presentist, but wishes to uphold the principle that truth is supervenient on being. What he claims is that the world—the sum total of everything—instantiates properties like *previously containing dinosaurs*. Tensed truths then supervene on the instantiation of these properties (Bigelow 1996). The defender of the truth-maker principle could, in a similar vein, postulate tensed states of affairs such as *there once existing dinosaurs* as truth-makers. Clearly, the success of the truth-maker argument against presentism depends crucially on whether such moves are legitimate or whether they 'cheat'. In fact I think they do cheat, and I will say below in what sense I think they cheat. But first it must be argued that the presentist must indeed cheat in this way; it must be argued that no other truth-makers or supervenience base for tensed truths can be found in the present.

The presentist might try to ground tensed truths in facts about current objects and the laws of nature. On this approach, 'there once existed dinosaurs' is true because its truth is allegedly entailed by the laws of nature and the properties and relations instantiated at the present time by currently existing objects.

Note that no regularity theory of laws of nature could then be accepted. In its simplest form, a regularity theory says that a law of nature is simply a true statement of the form 'All *F*s are *G*s'—a 'regularity'. (Much modification is needed for this simple statement to approach adequacy; see Armstrong 1983, part I.) If tensed facts are to be grounded in the laws, the laws could not themselves be grounded in the tensed facts. The only regularities available for securing the laws would therefore be *current* regularities, and regularity theories are only plausible if the regularities are drawn from all of time. Some more robust account of laws of nature would appear to be required, some account allowing the presentist to say that what counts as a law of nature does not supervene on the distribution of non-nomic properties over currently existing objects.

The Armstrong (1983)/Tooley (1987)/Dretske (1977) view that laws of nature are relations between universals, for example, would better

suit the presentist. On this view, nomic facts are facts over and above the totality of non-nomic facts. A law that all Fs are Gs involves the holding of a higher-order relation, the nomic necessitation relation, N, between the universals *F-ness* and *G-ness*. Whenever N holds between *F-ness* and *G-ness* then there is a regularity that all Fs are Gs, but the converse does not hold—it is possible for there to be a regularity without a corresponding law. Thus, two possible worlds alike in what regularities hold, and thus alike in the instantiation of first-order universals like *F-ness* and *G-ness*, might yet differ in how the higher-order relation N is instantiated, and thus might contain different laws of nature.

Appealing to this theory to reply to the truth-maker argument would represent an added commitment associated with presentism. Moreover, David Lewis (1986*b*, p. xii) and Bas van Fraassen (1989, ch. 5) have argued powerfully that Armstrong, Tooley, and Dretske cannot explain how N's holding between *F-ness* and *G-ness* could possibly entail the regularity that all Fs are Gs.

More importantly, grounding the tenses in the present plus the laws of nature threatens to imply that the past is 'open', just as some have claimed that the future is open. If the laws of nature are present-to-past indeterministic, current facts plus the laws do not imply all the facts about the past; given presentism and either the truth-maker principle or the principle that truth supervenes on being, for many statements, ɸ, neither ⌜ it was the case that ɸ⌝ nor ⌜ it was the case that not-ɸ⌝ will be true. Jan Lukasiewicz (1967: 38–9) was one philosopher who was willing to accept the openness of the past, and in fact pointed out a welcome feature of this doctrine: 'There are hard moments of suffering and still harder ones of guilt in everyone's life. We should be glad to be able to erase them not only from our memory but also from existence.' But few, I suspect, would be willing to follow Lukasiewicz in this belief, however comforting it may be. (And of course it may well not be comforting, given that the good in the past would be erased along with the bad.) Perhaps we will never *know* what caused the dinosaurs to become extinct, but very few of us are so verificationist as to doubt there is a fact of the matter![31]

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[31]   The class of philosophers, as always, provides exceptions. Michael Dummett (1969) expresses sympathy for the verificationist position; see also Crispin Wright (1987, essays 3 and 5).

Even if the laws are deterministic, the problem of the open past still arises if the presentist accepts the Russellian theory of motion discussed in the previous section. If velocity is a matter of one's location in the past and future, fixing the properties and relations of present objects will not fix their velocities (I continue to set aside 'cheating' by allowing tensed properties or relations). And there is no hope whatsoever that the laws of nature plus *non-dynamical* properties of present objects will entail anything interesting at all about the past.

As before there is the possibility of rejecting Russell's theory of motion in favor of Tooley's. I continue to think this would detract from presentism's attraction since the Russellian theory is intrinsically preferable. But this issue need not be joined, for as in the previous section the presentist cannot make use of Tooley's theoretical definition of velocity as the property, v, that actually satisfies the following equation, among others:

$$T_1 : s(x, t_2) = s(x, t_1) + t_1 \int^{t2} v(x, t) dt$$

T_1 is a law stated from an eternalist's point of view; the presentist's version must involve tensed properties of location. But now the velocities are being grounded in the tensed properties (via the Tooleyan theoretical definition that utilizes T_1), while the tensed properties are being grounded in the velocities (to answer the challenge to presentism from the principle that truth supervenes on being or the truth-maker principle.) The worry can be brought out more carefully, as follows. Unless we 'cheat', the truth-maker principle or the principle that truth supervenes on being require truths to supervene on, or be made true by, facts about which non-tensed properties and relations are instantiated by which objects. A law of dynamics, for example T_1, must then hold in virtue of these facts. But it can't, for once the tensed facts of location are left out, the law T_1 can only involve the necessitation relation (remember that we are assuming the Armstrong/Dretske/Tooley view) and the primitive velocity properties, and thus cannot relate velocity to location.

I conclude, then, that if the presentist is to continue to uphold the principle that truth supervenes on being, or the truth-maker principle, she must 'cheat' by somehow incorporating tense into the properties or relations of present objects. She must stubbornly insist that, for example, it is a 'rock-bottom fact about the world' that the world has the property of *previously containing dinosaurs*. What should we make of this?

The point of the truth-maker principle and the principle that truth supervenes on being is to rule out dubious ontologies. Let us consider some. First, brute dispositions. Many would insist that the fragility of a wine glass—its disposition to shatter if dropped—must be grounded in the non-dispositional properties of the glass, plus perhaps the laws of nature. It would be illegitimate to claim that the glass's disposition to shatter is completely brute or ungrounded. Second example: brute counterfactuals. Most would say that when a counterfactual conditional is true, for example 'this match would light if struck', its truth must be grounded in the actual, occurrent properties of the match and its surroundings. Someone who postulates counterfactuals *not* grounded in this way is Alvin Plantinga (1974: 180). Imagine God deliberating whether to create a certain free creature, *C*. According to Plantinga this amounts to deciding whether to cause a certain individual essence to be instantiated; the essence exists whether or not instantiated. God must take into account certain true counterfactual conditionals specifying what free choices *C* would make if placed in certain circumstances. These counterfactuals hold even if God decides not to create *C*, and therefore seem objectionably ungrounded, since they depend in no way on what existing things are like. Third example: the theory that there is a law of nature that *F*s are *G*s iff each object in the world has a certain 'brute' property *being such that all* F *s lawfully must be* G *s*. Fourth example: imagine someone who believes in only one point in space, but introduces irreducible 'spatial tense operators', for example NORTH (ɸ), much like Prior's temporal tense operators. Final example: Prior himself (1968*b*) once investigated the possibility of introducing 'personal tense operators', which would be formally analogous to temporal tense operators. Instead of writing 'everyone taller than me is sitting', one would replace the quantifier over persons with an operator ALL-TALL, resulting in the sentence 'ALL-TALL (Sitting)'. Now imagine a solipsist claiming that the operators are primitive (Prior himself advocated no such thing). The solipsist claims to reject the existence of other people but reconstructs what the rest of us regard as talk of other persons using these personal tense operators.[32]

The argument against allowing the presentist to 'cheat' by invoking primitive properties like *previously containing dinosaurs*, or by invoking

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[32]   I thank Roy Sorensen for this example.

the tenses themselves as primitive, is that this cheat seems of a kind with the dubious ontological cheats of the previous paragraph. In each case the cheater is unwilling to accept an ontology robust enough to bear the weight of the truths he feels free to invoke.

What seems common to all the cheats is that irreducibly *hypothetical* properties are postulated, whereas a proper ontology should invoke only *categorical*, or occurrent, properties and relations. Categorical properties involve what objects are actually like, whereas hypothetical properties 'point beyond' their instances. The presentist's primitive tensed properties (or operators, or whatever) would be hypothetical. Whether the world has the property *previously containing dinosaurs* is not a matter of what the world itself is like, but points beyond itself, to the past. The distinction between categorical and hypothetical is admittedly elusive, though it seems to get at the core of what is wrong with the dubious ontologies. But note that the argument against presentism is not strictly tied to the hypothesis that non-categoricity is to blame. The argument without this claim would simply be that the presentist's primitive tenses share some unspecified negative feature with the rejected ontologies.

This argument against primitive tense would work just as well against taking modal operators as primitive, for modal notions are paradigmatically hypothetical. Here the argument hits close to home, since many philosophers do precisely this. I have been urging that we reject the presentist's primitive tense operators and instead accept the B-theoretic reduction of tense, which reduction requires postulating past objects. But only David Lewis pursues the analogous strategy in the philosophy of modality. In his infamous *On the Plurality of Worlds* (1986*a*), Lewis gives a reduction of modality analogous to the B-theoretic reduction of tense by interpreting modal operators as quantifiers over non-actual but existent possible worlds and individuals. Most philosophers, myself included, are unwilling to accept Lewis's modal realism, and instead are actualists. The question, then, is whether we actualists can consistently uphold the ban on primitive non-categorical notions.[33]

In fact we can, by reducing modality to categorical notions without invoking Lewisian possible worlds. Though this is not the place to pursue

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[33]   I thank Trenton Merricks for persistently pressing me on this issue.

this reduction in detail,[34] this is the place to show why one cannot equally well reduce the presentist's tenses. The crucial difference is that there is a hope for reducing modality to notions like logical consistency, analyticity, and so on, which (hopefully!) are themselves categorical notions, or at least reduce to categorical notions. Though the project faces obstacles, I believe they are surmountable. But there is no chance whatsoever of reducing the tense operators to anything like logical or analytical consistency. Beef up the notion of consistency any way you like; there will still remain consistent things that never happened. Thus, the symmetry between time and modality is broken. An actualist can object to the presentist's primitive tenses provided she is willing to forgo primitive modal operators.

4. Presentism and Special Relativity

I turn finally to what is often (justifiably, I think) considered to be the fatal blow to presentism: that it is inconsistent with special relativity. The notion of the *present* time that is so crucial to presentism is meaningless within Minkowski spacetime, in which there is no distinguished partition of spacetime into space and time, and no observer-independent notion of simultaneity.[35]

Some presentists have said: so much the worse for special relativity, at least in its Minkowskian formulation.[36] Perhaps future empirical research will bear out this position, but in cases of science versus metaphysics, historically the smart money has been on science.[37] At any rate, the present discussion will assume that consistency with something fairly close to current physics is a constraint that must be met by any adequate theory of time.

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[34]   For recent reductive theories of modality see Armstrong (1989), Peacocke (1999, ch. 4, 1997), and my unpublished 'Reducing Modality' (Sider 2000*a*).

[35]   The literature on presentism and special relativity includes: Godfrey-Smith (1979); Hinchliff (1996); Prior (1970, 1996); Putnam (1967); Rietdijk (1966, 1976); Savitt (1994, 2000); Sklar (1981); Stein (1968, 1970); Weingard (1972).
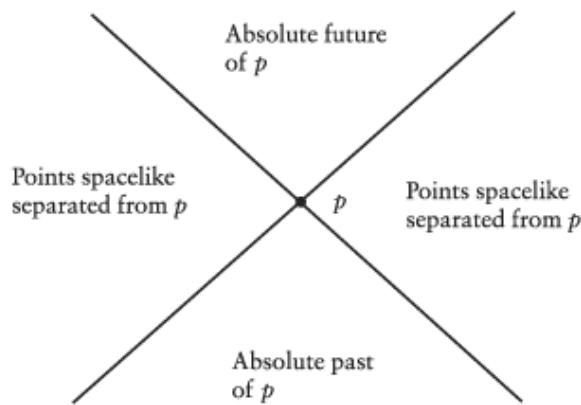
[36]   Prior (1970 : 248): 'all physics has shown to be true or likely is that in some cases we can never *know* , we can never *physically find out* , whether something is actually happening or merely has happened or will happen'; see also Prior (1996).

[37]   Note, however, that some recent work within physics has suggested a need for a distinguished simultaneity relation; see the end of Balashov (2000), who cites Cushing (1994, sect. 10.4.2).

I begin by describing informally the important differences between classical and Minkowski spacetime. Classical spacetime, whether in a Newtonian form that includes absolute rest or a neo-Newtonian form that does not, may be based on a four-dimensional manifold of spacetime points that includes all that happens in the past, present, and future. In this spacetime, simultaneity is a well-defined, absolute concept. For any given point, p, the set of points simultaneous with p is called a hyperplane of simultaneity. Since classical simultaneity is an equivalence relation, the set of hyperplanes of simultaneity is a partition of classical spacetime. Think of any one of these hyperplanes as the 'present' and the rest of the spacetime divides into those points that are temporally after all the points in the hyperplane (the *future*), and all the points temporally before the points in the hyperplane (the *past*). These temporal relations of *simultaneity*, *before*, and *after*, are absolute, in the sense that they are intrinsic to the geometry of classical spacetime, and do not depend in any way on observers.

Minkowski spacetime also consists of a four-dimensional manifold of spacetime points that contains all of what happens in what we normally call the past, present, and future. But Minkowski spacetime does not include the classical notion of simultaneity. Just as the notion of absolute rest is not well defined in neo-Newtonian spacetime, the notion of simultaneity is not well defined in Minkowski spacetime. Thus, Minkowski spacetime is not partitioned into ordered hyperplanes of simultaneity. With any given point in spacetime, there cannot be associated a set of those points simultaneous with the given point. There are, however, three well-defined sets worth mentioning, relative to any given point p: (1) the *absolute future* of p: the set of points that could be reached from p by a signal traveling at or below the speed of light; (2) the *absolute past* of p: the set of points from which p may be reached by a signal traveling at or below the speed of light; and (3) the set of points *spacelike* separated from p: those points that cannot be connected to p by any signal traveling at or below the speed of light (see Fig. 2.1). These sets are well defined: although simultaneity is not well defined it is well defined which points can be reached from which by a signal traveling below the speed of light. The relation between points p_1 and p_2 when p_2 can be reached by a sub-luminal signal originating at p_1 is an intrinsic feature of the spacetime. Note that the relation of spacelike separation is intransitive, and therefore cannot be

Fig. 2.1. Regions of Minkowski spacetime

used to partition Minkowski spacetime into anything like hyperplanes of simultaneity.

I have said that simultaneity is not well defined in Minkowski spacetime, but what is strictly speaking true is that absolute simultaneity is not well defined. A *relative* notion of simultaneity can be defined via the Einsteinian 'radar' definition of simultaneity for a given observer. Imagine an observer moving on some inertial (unaccelerated) path, F. Such a path is called a *frame of reference*. At a certain point, p_1, along path F, the observer sends out a light signal, which bounces off some other point, p, and intersects F at another point p_2. On the radar definition of simultaneity, point p is regarded as being *simultaneous relative to the observer's state of motion along path* F with the midpoint, m, between p_1 and p_2 on F. Simultaneity thus defined varies depending on the state of motion of the observer; points other than p will be regarded as simultaneous with m if the observer's path through m is something other than F. Given this definition of simultaneity relative to a frame of reference, one can also introduce frame-relative notions of past and future. Relative to any frame of reference F through point p, another point q may be defined as being in the past of p relative to F iff q is in the absolute past of some point simultaneous with p relative to F; q may be defined as future to p relative to F iff q is in the absolute future of some point simultaneous with p relative to F.

In what sense is Minkowski spacetime inconsistent with presentism? There is a superficial inconsistency right at the surface since Minkowski spacetime includes all of history's events in a single existent manifold.

But by this measure presentism is already inconsistent with classical spacetime, which also consists of a four-dimensional manifold. This is not surprising: scientific spatiotemporal theories are typically formulated under eternalist assumptions since the formulation is much easier, and since scientists do not typically share philosophers' scruples about the ontology of past and future objects.

The more interesting question is whether, despite the superficial inconsistency, there might yet be a consistent hybrid theory that departs in letter from presentism or special relativity (or both), but in some sense preserves the essential spirit of each. To give the idea of what is sought, return to classical spacetime. The presentist could replace the four-dimensional classical spacetime with a single hyperplane of simultaneity, the present. Assertions about other points in the spacetime would then be translated into tensed claims in which all quantifiers over non-present points or events or objects are inside the scope of tense operators. This is, in effect, what presentists who are not thinking about relativity usually do. This seems like a coherent view (although there are of course philosophical objections, for example those discussed above). The question is whether one can formulate this sort of presentism/ Minkowskian hybrid.

My argument from relativity against presentism will be that no plausible presentism/Minkowskian hybrid exists. I will survey various possibilities for constructing a hybrid theory and raise objections in each case.

What would the hybrid look like? The presentist wants to deny existence to some of the events and objects accepted by the eternalist. The classical presentist wanted to banish *past* and *future* events and objects, but the notions of present, past, and future look very different in Minkowski spacetime. Each hybrid theory I will examine will be a claim that only a certain proper subset of the eternalist's Minkowski spacetime is real. Talk of the rest of spacetime must be captured in some way by primitive tense operators. The hybrids differ by selecting different portions of spacetime as the real portions.

Hybrid 1: here-now-ism. First, the presentist might banish all of spacetime other than a single point.[38] (A related proposal would be to banish

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[38]   See Hinchliff (1996),   Savitt (2000),   Sklar (1981),   and Stein (1968 : 15).

all of spacetime other than a single point plus its past light cone.)[39] Thus construed, presentism is more rightly called 'here-now-ism'. Note that the right way to assert here-now-ism is to say that only a single point of spacetime is real, that there exist no spatiotemporally distant events. The wrong way is to say that *at any point in spacetime, only a single point of spacetime is real*. This suggests a misleading picture, that there *are* multiple points in spacetime, but somehow, from the perspective of one of them, the others are not real. Unless the presentist is indulging in a Meinongian distinction between being and existence, this can only be a confusion.

The first problem for here-now-ism involves the tense operators that must be postulated. The here-now-ist cannot simply take over the classical presentist's WAS and WILL, since those presuppose that there are absolute facts about what is before, simultaneous, or after a given point-event. What WAS the case or what WILL be the case should depend on the states of motion of observers. The natural way to incorporate this in a relativistic context would be to relativize the tense operators to frames of reference. The sentence 'WAS (*F*, There exist dinosaurs)' might be thought of as expressing a relation between a frame of reference, *F*, and the proposition that there exist dinosaurs. The eternalist would say that this sentence, as uttered at point *p*, is true iff there exists some dinosaur located in the past of *p* relative to frame of reference *F*, though of course the presentist takes the tense operator as primitive. But the problem for the here-now-ist is that the tense operators cannot be relations to frames of reference, since the here-now-ist's ontology contains no frames of reference. A frame of reference is a path extending through spacetime, whereas the here-now-ist's ontology consists only of a point.

Secondly, the truth-maker objection to presentism becomes more acute than ever. Reality has shrunk to a single point, and seems to contain few truth-makers and little Being on which Truth might supervene.

Finally, here-now-ism is solipsistic in a way that presentism was not. While the presentist denied reality to all times other than a single one, multiple objects within the present time were equally real. Not so for the here-now-ist. ('Solipsistic' is in fact a bit of a misnomer, for there may be no person located at the sole point that is real. One might worry that persons and other macro-objects would *never* exist given here-now-ism

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[39]   See Godfrey-Smith (1979)   and Hinchliff (1996).

since no macroscopic object could fit into a single point. But the here-now-ist might claim that a person can exist without *fitting into* reality, just as the standard non-relativistic presentist claims that I exist despite not temporally fitting into the present moment.)

Hybrid 2: retain an arbitrary 'hyperplane'. A second possibility would be to banish all of Minkowski spacetime save a single 'hyperplane' of simultaneity relative to some frame of reference. From the eternalist's point of view the idea can be put as follows: for some frame of reference, F, and some point, *p*, the presentist accepts the reality of all and only points simultaneous with *p* relative to F. I call this accepting an 'arbitrary' hyperplane because, from the eternalist's point of view, the presentist's selection of the frame of reference, F, which is used to pick out the set of points deemed real, is arbitrary—no suitable frame of reference is distinguished by the intrinsic geometry of Minkowski spacetime.

Hybrid 2 improves on here-now-ism by eliminating the solipsistic element—spatially distant planets, for example, become real. In this way it is closer to the spirit of traditional presentism. Being, moreover, includes a bit more on which Truth might be thought to supervene. The tenses must still presumably be taken as primitive, but at least *some* statements, for example present-tense statements about Mars, may be grounded in Being.

The main problem with Hybrid 2 is that it is scientifically revisionary, for it in essence recognizes a distinguished relation of distant simultaneity. According to the eternalist Minkowskian, if I snap my finger there are events such that there is no fact of the matter whether they are simultaneous with the snapping. But according to Hybrid 2 this is not the case, for one may define simultaneity with the snap as *coexistence*. If you snap your finger across the room and your snap and my snap equally exist, there surely is an affirmative answer to the question whether they occur at the same time. No such answer can be given by the eternalist Minkowskian.
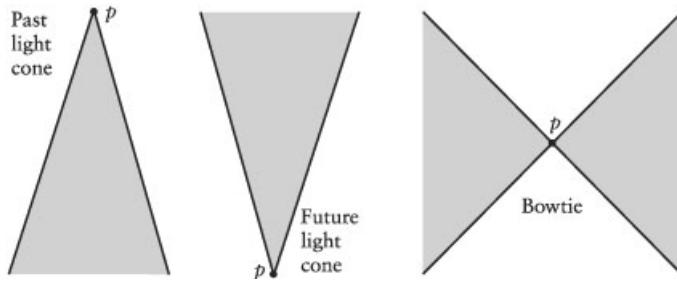
So, the defender of Hybrid 2 must admit the existence of an absolute simultaneity relation. It would be natural to be even more scientifically revisionary and admit all the other spatiotemporal comparisons of classical (or at least neo-Newtonian) spacetime, including absolute comparisons of temporal and spatial distance. From the eternalist's point of view, admitting absolute simultaneity is in effect choosing an arbitrary

frame of reference, *F*, to pick out a distinguished relation of simultaneity. The admission of absolute comparisons of temporal and spatial distance in addition seems to be of a piece with the admission of absolute simultaneity: absolute spatial and temporal comparisons would be, from the eternalist's point of view, temporal and spatial distance comparisons relative to this same frame *F*. Moreover, suppose the defender of Hybrid 2 resisted admitting absolute comparisons of spatial and temporal distance. She would then need to relativize the metrical tense operators ⌜ WAS *n* units ago⌝ and ⌜ WILL *n* units hence⌝ to frames of reference. But since reality according to Hybrid 2 consists only of a plane, frames of reference do not exist.

Hybrids 3 to 5: retaining four-dimensional regions. A different reaction to special relativity would be to retain a four-dimensional region rather than merely a point (or hypersurface), of Minkowski spacetime. Three possibilities present themselves (see Fig. 2.2.): (1) retain a past light cone—a point *p* plus every point in *p*'s absolute past; (2) retain a future light cone—a point *p* plus every point in *p*'s absolute future; (3) retain some point, *p*, plus every point spacelike separated from *p*—a 'bowtie'. The ontology of each of Hybrids 3 to 5 is a four-dimensional region, and hence includes inertial paths through spacetime—frames of reference—to which tense operators may be relativized. This is a great improvement on Hybrids 1 and 2. Another improvement is that reality contains more truth-makers and more Being; fewer truths must float on nothing. None of Hybrids 3 to 5 is scientifically revisionary in the way Hybrid 2 is. Each of the three sorts of region (a past light cone, a future light cone, and a bowtie) are regions definable within Minkowski spacetime, once point *p* is chosen. None of these hybrids resurrects absolute simultaneity. Of course, the eternalist will deny that any point *p* within Minkowski spacetime is distinguished in the way required by these hybrids. But this just represents the core disagreement between presentists and eternalists. Even in classical or neo-Newtonian spacetime the presentist chooses a single hyperplane of simultaneity as the solely existing present; the choice of *p* is analogous.

However, new difficulties emerge. A serious problem with Hybrids 3 and 4 is that they are quite distant from the intuitive picture with which presentists began. Reality contains dinosaurs according to the first, and (perhaps) Martian outposts according to the second. Gone is the intuition
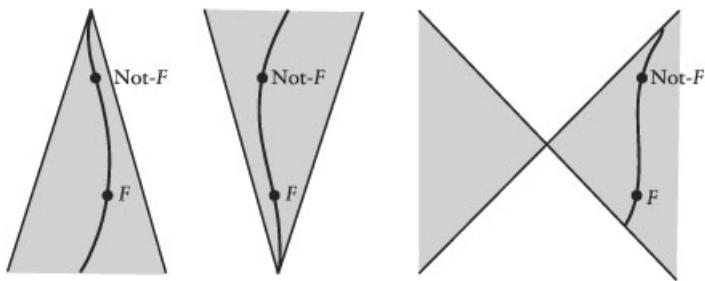
Fig. 2.2. Hybrids 3 to 5

that the past is no more, and the future is yet to be. These were the intuitions motivating the presentist to adopt his theory in the first place. If they must be sacrificed, why be a presentist? (As Steven Savitt (2000) points out, similar remarks apply to the view mentioned parenthetically above, that reality consists of a point plus all the points on the surface of its past light cone.)

Moreover, all three hybrids lack certain theoretical features that have been claimed to be distinctive of presentism. First, it has been argued (Hinchliff 1996; Merricks 1994*a*) that presentism is to be accepted because only the presentist can acceptably account for the phenomenon of change without relativizing property instantiation. This argument will be discussed fully in Chapter 4, Section 6, but the quick version runs as follows. A changing thing apparently exemplifies contradictory properties F and not-F. Any adequate theory of change must resolve the apparent contradiction. One way is to relativize property instantiation to times: a changing thing is F relative to one time but not relative to another. This is argued by some to be objectionable, since it makes all properties relational. But Merricks and Hinchliff argue that the presentist can account for change without relativizing property instantiation. Suppose x used to be F but is not any longer. Reality consists only of the present, and so we can say that x lacks F *simpliciter*, and capture the fact that x changed by saying that it WAS the case that x instantiated F (*simpliciter*). This is a nice solution, but it is ruined by the acceptance of any of Hybrids 3 to 5. On any of these views, if x is appropriately situated, reality contains multiple points along x's worldline (see Fig. 2.3). To avoid contradiction, instantiation will need to be relativized to points in spacetime—x is F *at* certain points of spacetime but not others.

Fig. 2.3. Change for hybrid presentists

The presentist's distinctive solution to the problem of change would thereby vanish.

Other common arguments for presentism are similarly undermined. The 'thank goodness that's over' argument for presentism is clearly undermined by the past-light-cone formulation (Hybrid 3), since for any point q on any worldline, any earlier point on that worldline is equally part of reality—pains never 'go away'. As can be seen from the diagram, it is also true on the other two formulations that reality contains both pains (F) and subsequent painless states (not-F) as equally existing events along a single worldline. However, it is hard to say whether this undermines the argument in those cases. As with Broad's growing-block-universe view, on any of these three versions of 'presentism' we must distinguish two senses of the tenses (now relativized to frames of reference), one given by an eternalist style analysis in terms of four-dimensional reality, the other irreducible sense describing the change in that reality.[40] On the second sense, it WILL be the case (with respect to some chosen frame of reference) that the relief exists but the pain does not (on either Hybrid 4 or Hybrid 5). What is unclear is whether this supplies the explanation of relief that the argument requires, for despite

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[40]   This second sense of the tenses is of course primitive, but it may help to give the picture by seeing how an eternalist would view this sense (just as the gloss 'WILL (ϕ) is true iff ϕ is true at some future time' clarifies, though does not provide an analysis, the non-relativistic presentist's tense operator). Let p be the 'generator point' of reality, in the sense discussed in the text below. A truth, ϕ, about changing four-dimensional reality WILL be, relative to F, iff there is (in the eternalist's spacetime) another point p', such that (1) relative to F, p' is in the future of p, and (2) ϕ is true of the segment of spacetime 'generated by' p'.

the truth of this tensed claim the relief and the past pain are equally parts of reality.

There is also the argument that the reality of the future must be denied to make room for free will (this argument of course does not favor presentism over Broad's growing-block-universe view). Like the thank-goodness-that's-over argument, this argument is clearly undermined by one of our three formulations, and has an unclear status on the other two. On the future-light-cone formulation, from any point q in reality all points in the absolute future of q are themselves parts of reality; thus, if the existence of the future undermines free will, the defender of this formulation is in no better shape than the eternalist. As for the other two formulations, suppose reality contains a case of agent S deliberating whether to do a certain action, as well as containing the commission of this action A. When S deliberated whether to do A, was S free? Using the tense operator 'WAS' in its irreducible sense, the defender of Hybrids 3 and 5 can say truly that it WAS the case (relative to some frame of reference) that the deliberation existed but act A itself did not. Nevertheless, the deliberation and action are equally part of reality, which (according to the defender of the argument) undermines S's freedom while deliberating.

A final critical problem is that each of Hybrids 3 to 5 grants a special privilege to a single point in reality. On each view there exists a 'generator point', a point p such that all other points in reality are: (1) in the absolute past of p (Hybrid 3); (2) in the absolute future of p (Hybrid 4); or (3) spacelike separated from p (Hybrid 5). The rest of the points in spacetime are equally part of reality, but are not generator points. According to non-relativistic presentism, no particular point (or event, or object) is granted any such status—given that classical simultaneity is an equivalence relation, each point (or event, or object) is a generator point of reality (in the sense that all other points are simultaneous with it). Nor does Hybrid 2 postulate any such privileged point; and even here-now-ism grants no point any special status at the expense of others (since only one point is real).

Notice that in Broad's (non-relativistic) growing-block universe there is a privileged *class* of points. The points on the crest of the wave generate reality (in the sense that spacetime consists of the class of points before the members of this class), whereas other points in spacetime are not generators in this sense. This inegalitarianism is related to the (not unintuitive) conviction on the part of the view's defenders that time and space are

importantly disanalogous. While it *would* be implausible to say that one region of space is ontologically privileged, it is not implausible, Broad could claim, to say that one region of time is ontologically privileged. This defense of inegalitarianism could perhaps be extended to Hybrids 3 and 4, since the generator point in each case enjoys a purely temporal distinction: it is time-like related to all other points. But the defense utterly fails for Hybrid 5, the bowtie view, since on that view the generator point is simultaneous, relative to suitably chosen frames of reference, with other points in reality. This asymmetry is important. As noted above, Hybrids 3 and 4 do not retain much of the original spirit of presentism, since reality contains dinosaurs on Hybrid 3 and Martian outposts on Hybrid 4, but Hybrid 5 seems closer to the original spirit of presentism. The additional argument against it is therefore welcome: Hybrid 5 implies the existence of an implausibly distinguished point. Located at the generator point, I could say truly that reality consists of all points with spacelike separation from me. An utterance by you, located across the room, would be wrong.[41]

We have considered five hybrid theories combining elements of presentism and special relativity. None avoids being scientifically revisionary or otherwise unbelievable while retaining the alleged virtues of traditional presentism. Only Hybrid 2 really preserved the spirit of traditional presentism, but it was Hybrid 2 that was the most scientifically revisionary. I conclude that presentism can be upheld only by those willing to revise their science because of their metaphysical views on the nature of time. A physical theory of time other than special relativity must be constructed which is statable using the usual (classical) presentist's tense operators, but which is consistent with the observed experimental data that has led scientists to special relativity.[42] For all I know this may be possible. And I do not say that philosophical argumentation can never push us to revise science. Berkeley's objections to infinitesimals were a valuable gadfly prodding mathematicians to develop foundations for the calculus, to which Prior (1996) compares his defense of presentism. But given the other arguments of this chapter, presentism is in independent philosophical trouble. Moreover, there is an alternative theory, the B-theory, which is consistent 'as-is' with contemporary science and suffers no apparent philosophical defects. At the least, tentative rejection of presentism seems in order.

[41]   Compare Putnam's rejection of 'Privileged Observers' (1967: 241).

[42]   See Tooley (1997,   ch. 11).

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