# 6 In Search of Passing Time

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**Abstract** I have defended the idea that the passage of time can be thought of as a local phenomenon, as the succession of causal diamonds along timelike curves, in relativistic spacetimes. This idea has been criticized by Craig Callender and Oliver Pooley. In this paper, I articulate my view in more detail than I have hitherto and defend it from their criticisms.

## 6.1 Introduction

It is a fortunate philosopher who has a good critic, someone who forces them to articulate tacit assumptions or to refine or even alter their views. I am a very fortunate philosopher, then, for I have two good critics, Oliver Pooley (2013) and Craig Callender (2017). What I will try to do in this paper is to respond as fully and cogently as I can to their criticism.

Let me add immediately that I agree with much that each of them has to say about time. I am here only trying to convince readers that there is more merit to the views I have espoused concerning the passage of time and the nature of the present than they might suppose, given the criticism of these views in Pooley's paper and Callender's book.

## 6.2 The Boring Bit

I begin from the fact that, broadly speaking, there are two views of time that vie for allegiance[1]. The first is manifest time, the time of our ordinary world view. We are intimately familiar with it, yet find it hard to describe. One feature nearly universally ascribed to manifest time is that it has a kind of dynamic quality that space lacks. I

[1] As does Sellars (1963) and Callender (2017, chapter 1).

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acknowledge this feature by saying that time passes. Some say that time flows, but I think this is an unfortunate choice of words. Water flows, as in the age-old comparison of time to a river, but the water in a river flows by changing its spatial position with respect to time. Time cannot flow in this sense, since it cannot change its temporal position with respect to itself, and usually no other sense is offered.

The second feature of manifest time is that it contains a present or now, and it is perfectly clear what this present is. It is a universe-wide (or global) hyperplane of simultaneous events, all the events that are happening now everywhere. The simultaneity relation uniquely divides or partitions the universe of events into these hyperplanes, as far as common sense is concerned[2].

These two features combine into a straightforward account of the nature of manifest passage: the passage of time is the successive occurrence of sets of simultaneous events. I argued in Savitt(2002) for this account by noting that both Broad(1938), (his third and best account of time) and Williams(1951), in his classic critique of passage, both agreed that passage in this sense existed. I think that Henri Bergson(2002) also held this view. He wrote, quite pithily, that "time is succession". I think he felt that there was no need to state the (to him) obvious—that it is global nows that succeed one another[3].

There are two useful clarifications that I should make straightway. First of all, I want to remain neutral regarding the topology of time. I use the word 'successive' because I do not have a better one, but I do not wish to imply that a given now has an immediate successor or predecessor. Time might have a discrete topology, like the integers, but it might have a dense topology, like the real numbers. Discrete vs. dense is a broadly empirical matter on which I take no stand.

Secondly, I do not wish my account of passage to commit me to a side in the venerable spacetime substantialism vs relationism dispute. My characterization of passage above has a relationist flavour, but I would be equally willing, if pressed, to state the view in a less catchy but more substantivalist way: the passage of time is that which makes possible the successive occurrence of sets of simultaneous events. For what it's worth, I was raised in the substantivalist church, but I intend my remarks here to be neutral, even if some subconscious bias shows up in the phrasing.

Let me now turn to the criticism of these ideas in Pooley(2013). Pooley (quite correctly) lumps my view in with that of Dennis Dieks and Mauro Dorato[4] and says :

> their claim to have successfully identified temporal passage in the block universe risks diverting attention from the key challenge that the B theory faces, namely, that of providing a B-theoretic explanation of why we are inclined to take the 'becoming more past' of events as an objective feature of reality. (326)

[2]A third basic feature of manifest time is that there is a radical difference between the past and the future. I will have little to say about this feature in this paper. I will throughout suppose that spacetime is represented by an orientable manifold and that this manifold has, somehow, acquired an orientation.

[3]I soften this claim considerably in my paper "What Bergson Should Have Said to Einstein," forthcoming in issue 1 of volume I of Bergsonia.

[4]And he could have added Richard Arthur(1982) as well.

There are, it seems to me, two ways to understand this sentence. First, Pooley may think that events do not objectively become more past. What is needed, then, is an account within the confines of the B-theory (as he understands it) of why we are inclined to fall into the error of thinking that they do. But why should our view of passage, amongst all the various claims made in philosophy of time, or philosophy in general, or in any field in general, uniquely suffer from the "risk" of diverting attention from the (alleged) problem of providing an error theory for our inclination to believe that events become more past? No explanation is given.

Alternatively, Pooley may think that events do objectively become more past and so we are correctly inclined to think that they do, but the Arthur-Dieks-Dorato-Savitt account of passage is unable to underwrite a good explanation of this phenomenon. With that latter thought I straightforwardly disagree. Some events are past; and with the passage of time in our sense, they become more past. The event of Shania Twain's birth, for instance, happened over fifty-two years ago[5]. If sets of simultaneous events continue to occur successively, then in a few months, on August 28th, her birth will have occurred fifty-three years ago. It will have become more past, and we all understand why. More time has passed since it occurred.

Furthermore, this account is entirely compatible with Pooley's own views. On his view (a view that I share with him and with Callender, I believe) indexicals do not describe, they locate. (Pooley 2013, 324) 'Here' locates one in space, and 'now' locates one in time. So now (spring, 2018) Twain is at a certain temporal distance from her birth. I say: "Now Shania Twain is fifty-two. The event of her birth is past." Later, after more sets of simultaneous events have occurred[6], she will be located temporally further from that event. I can say then: "Now Shania Twain is fifty-three. The event of her birth is more past than it was when she was fifty-two." All this seems perfectly objective (that is, not mind-dependent or subjective), though of course the exact nature of my statements and their truth conditions do depend on the existence of languages and systems of timekeeping and dating[7].

Pooley, like John Earman(2008), thinks this is all pretty boring—"thin and yawninducing" (Pooley 2013, 326) is their precise phrase. Let me say in response that if Pooley or Earman had said that my view was "contradiction-inducing" or "infinite-regress-inducing" or "circularity-inducing" or "the-end-of-physics-inducing"[8] (as has been said of most, if not all, of the other, "thicker" accounts of passage on offer), I would be

[5]This paper was written in the spring of 2018

[6]Ignoring, for the moment, relativistic complications. We will get to them soon enough.

[7]In relativistic spacetimes the proper time interval between two events is path-dependent, so I and a space-traveller may disagree as to the time interval between now and Twain's next birthday. But once path is taken into account, objectivity is restored. There are further relativistic corrections that could be invoked, but they would leave the argument for objectivity unchanged.

[8]With this last phrase I have in mind the critique of branching spacetimes in Earman (2008). In particular, as Figure 10.2 in that essay was supposed to make clear, a branching point creates a spacetime that is either not locally Euclidean (and so not apt for General Relativity, Earman's Escape 5) or not Hausdorff (Earman's Escape 6), with the attendant problems described in §3.4 of his paper. Unfortunately, Figure 10.2 is misprinted, obscuring the dilemma that threatens to undermine physics as we know it. In the (b) section of that Figure, the square and the round brackets should be interchanged and their directions adjusted accordingly.

distraught. But "yawn-inducing" I can live with[9], and even in part agree with. What I have said so far is a bit boring, but I ask you to be patient. What I have said is only the first chapter in a story that eventually becomes head-scratch-inducing and amazement-inducing, not yawn-inducing, as you will see.

Let me end this section by quoting what seems to be a grudging admission by Pooley. *"If,"* he writes, "one wishes to label the successive occurrence of events 'temporal passage' then, yes, time passes according to the B theory."(326) But why not call the successive occurrence of events temporal passage? Anything less surely would not be passage, while anything more, as just noted, lands one in either logical, physical or metaphysical hot water. Perhaps the safe but dull path is the right one.

## 6.3 Passage Found

I began this paper by saying that there are two views of time that vie for our allegiance, but so far I have talked only about one of them, the manifest or commonsense view. As an alternative to the manifest view, the scientific view of time[10] began to take shape in 1905 with Einstein's special theory of relativity. It has grown and become strikingly more complex with the advent of the general theory of relativity, quantum theory and the various attempts to unite them into one picture in a quantum theory of gravitation. One can find a lot of this detail in the first half of Callender's new book, but for my purpose it suffices to focus on one feature of the very first step into post-1905 time.

Einstein (1949, 61) wrote:

> We now shall inquire into the insights of definite nature which physics owes to the special theory of relativity.
> (1) There is no such thing as simultaneity of distant events ...[11]

A chain of disastrous conclusions seems to follow from Einstein's observation. If there is no such thing as the simultaneity of distant events, then there are no global hyperplanes of simultaneous events. If global hyperplanes of simultaneous events are nows, then there are no nows. If passage is the successive occurrence of such nows, then there is no passage. Time in the post-1905 universe seems to be inert. The universe, it is said, is a "block universe". Pre-1905 time has been shown to be, in Callender's piquant expression, "rubbish" (Callender 2017, 22). But these conclusions, as straightforward as they are, contradict all our experience, not to mention clichés in every culture. What to do?

Callender, as did Sellars a generation ago, thinks that a reconciliation between these two competing views is necessary, and I agree. But a reconciliation between two parties

[9] Perhaps Huggett (2014, 12) expresses a similar attitude when he writes: "Almost everything that we take for granted in formulating physical theories is at stake in a thickening of passage."

[10] For good reasons not to talk of "the" scientific view of time, see Rovelli (1995). I think that I can safely ignore in this paper the excellent distinctions amongst scientific views of time that he makes there.

[11] Or consider Mermin(2005 xii): "That no inherent meaning can be assigned to the simultaneity of distant events is the single most important lesson to be learned from relativity."

requires an accurate understanding of each position. Part of the point of the boring stuff in section I is that manifest time has not been properly understood. If that's true, then attempts at reconciliation will not lead to true reconciliation but to misbegotten ideas like "the block universe". Let's start afresh.

I suggest that we start from Bergson's (2002) aphorism "Time is succession," but in a post-1905 world we ask ourselves "Succession of what?" Some still want to give the same answer that Bergson would have given, a succession of global simultaneity slices. The search for these slices has not worked out well in post-1905 spacetimes[12]. In their absence one can embrace a block universe (whatever that might be) or take an instrumentalist or constructive empiricist approach to modern spacetime physics. One can do this, but is it not extremely puzzling, really, why the GPS works so well with relativistic corrections (and so how the Uber car manages to show up in response to a call)?

I believe that in each of us (me too!) there is a deeply embedded picture of ourselves in a world (a whole or total world, a universe) unfolding in time moment by moment. In this picture all events (everywhere, anywhere) are totally ordered by a before (or after) relation. It is this cherished picture that Einstein requires that we give up, but giving it up, difficult as that might be, has some upside; it opens a path to reconciliation. For if we focus on succession rather than on the global slices, we find that there is succession in relativistic spacetimes. It exists (or happens, or occurs) along timelike world lines. If we think locally (along timelike curves) rather than globally (across global hyperplanes), we can find in post-1905 spacetimes a successor to pre-1905 passage. The project of fashioning a coherent picture of time based on local passage to replace the familiar one based on global passage that we must abandon is, if it is a valid project at all, a far from trivial one.

But having identified a reasonable successor concept for the passage of time, we must ask whether we can find a viable successor concept to the pre-1905 now or present? From one point of view, the answer is that it is surprisingly easy to find one. I noted in section I that Pooley and I (and Callender too) think of 'now' as an indexical that is used to locate the speaker (or writer) temporally. As long as there is time in post-1905 spacetimes, 'now' will continue to have the same use.

A reasonable philosopher might maintain that simply indicating the indexical use of 'now' is all that one can or should say about the now, but a different reasonable philosopher might find this simple stance a cop out. In our pre-1905 way of thinking, the now is a region of spacetime—the hyperplane of events simultaneous with the utterance or inscription. Is there any any region of spacetime that can play a similar role in post-1905 spacetimes?

As I have said, 'now' is used to locate one temporally, but "locating something temporally" is a vague or amorphous enterprise. If I say "I used to be able to swim a mile, but now I can't," that 'now' indicates a period of fifteen years or perhaps even two

[12]See Callender (2017, chapters 2 and 3) for a catalog of failures. See Dieks (2006) for arguments that such searches must fail in most spacetimes and that, even in the rare spacetimes in which they succeed, these global hypersurfaces have an arbitrary element and are irrelevant to our experience of time.

decades, just as when I use 'here' I might mean this room or this city or this country or this planet or... One has to acknowledge that there is an elastic or accordion-like quality to these two indexical expressions.

But one has also to acknowledge that there is in addition a "core" or very common use, at least, of 'now'. It's that core use that made it plausible to identify the now as a particular set of simultaneous point events central to pre-1905 time and beloved of presentists. So our question becomes: Is there any similar way to identify a region of a relativistic spacetime as a region indicated or singled out by a "core" use of 'now'?

One straightforward, natural, and even elegant suggestion along these lines is that of Stein, and Dieks (1998, 2006). The present is just the spacetime point at which the utterance "It is now..." is made. The passage of time would then be a succession of points (or point events) along a timelike curve through that point. Ideal clocks measure proper time along timelike curves. Real clocks approximate the behaviour of ideal clocks. From this perspective it is natural to think of passage, if that is what is measured by ideal or real clocks, as a succession of points on such curves. These points can be completely ordered by the before relation.[13]

An unnatural or unintuitive feature of this proposal, if taken literally, is that none of us would share a now or present. The timelike curve representing your life is entirely distinct from the timelike curve representing my life. This observation prompts a question: Is there a way that one might add (without going global again) a region, a hump or bump or limited lump of some kind, to a timelike curve to represent a region of spacetime that might be a reasonable location picked out by a core use of 'now'?

In doing this one has to be a little careful. Pooley says that he seeks an A-theoretic view that "fully respects the symmetries of relativistic space-time." (Pooley 2013, 322) Stein (1968, 5) requires that structures in relativistic spacetimes be defined in terms of intrinsic features of the spacetime rather than "more or less arbitrary auxiliary constructs". This is not the occasion on which to determine precisely what these restrictions come to,[14] but I do take them seriously. No arbitrary selection of a global hypersurface from amongst the usual infinity of global hypersurfaces, for instance, will do by the Stein standard. No arbitrarily shaped bump on a worldline will do either.

But perhaps a bump defined in terms of causal or light-cone structure, in addition (of course) to the timelike worldline on which it is a bump, will do. That is a suggestion that I have made (Savitt, 2009)[15] and that I still believe merits consideration.

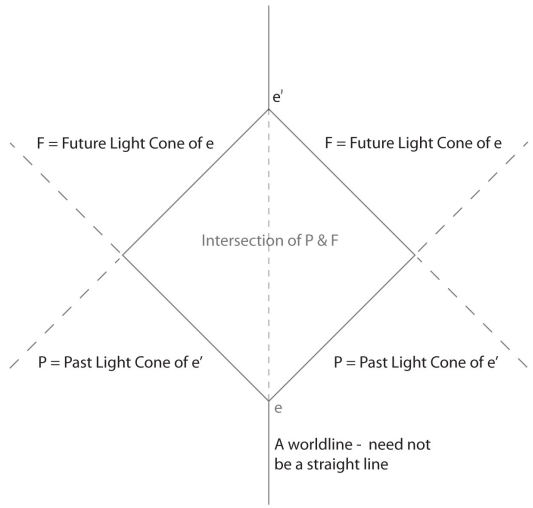
Think of the present not as an instant but as a "specious" present, a short time period in which we regard a set of events that happen sequentially (like the notes of a musical phrase) as happening now. The specious present varies in length from individual to individual and, for a given an individual, from time to time. Typical estimates of the length of specious presents range from .5 seconds to 3 seconds. Trying to take account fully of this variability would be very difficult and, I think, not very illuminating. So let me idealize a bit and assign to specious presents some arbitrary fixed duration of T seconds within the range of standard estimates. Then consider two

[13] Points not on a timelike line can at best be only partially ordered.

[14] See Clifton and Hogarth(1995) for a discussion.

[15] Along with Arthur (1982), both of us inspired by Stein (1968).

points on a timelike curve that are T seconds of proper time apart. Call them e and $e'$, with e the earlier of the pair. In any relativistic spacetime that is strongly causal there is a region defined as the intersection of the interior of the future light cone of $e$ with the interior of the past light cone of $e'$ called a causal diamond[16]. See figure 1.




My proposal is that properly scaled causal diamonds, those with proper time T from initial point to end point along a timelike curve, are regions of spacetime that can serve as nows—that are regions of spacetime that can be thought of as the locations indicated by core uses of the indexical 'now'. The passage of time is a succession of such causal diamonds (along a timelike curve)[17]. Time passes, of course, along every timelike curve[18].

Craig Callender argues that attempts to find relativistic counterparts of manifest nows must fail. The more like the manifest now a proposal is, he says, the less relativistic it must be. The more relativistic it is, the less like the manifest now it must be. (Callender, 2017, 31) While I admit that this dilemma has bite—and it does indeed bite several proposals that Callender reviews in chapters 2 and 3 of What Makes

[16]See theorem 3.27 in Minguzzi and Sánchez (2008). In spacetimes that are not strongly causal one must be doubly local. Each point in a relativistic spacetime is contained in an open set that, if taken as a spacetime in its own right, is globally hyperbolic (Wald, 1984, 263). The point is proved in Proposition 14 in Krasnikov (2002), as John Manchak pointed out to me. In spacetimes that are not strongly causal, confine the discussion to the neighbourhoods U of that Proposition. See also Krasnikov's Proposition 17, and for further philosophical discussion of causal diamonds, see Savitt (2015).

[17]If the length of proper time T between the initial and final points of causal diamonds is allowed to vary, then it is by no means easy to say what the succession of such diamonds would be.

[18]And would continue to pass even if, through some mischance, all sentient life on Earth were annihilated in the next few years. This passage is not mind-dependent, and so is in that sense objective, as I insisted above.

Time Special?— I'd like to try to defend my own proposal against his arguments. This defence may also help to clarify it.

Let me begin with a criticism of his that I think misses the mark just a bit. He says that "Savitt wishes to explain why human beings might come up with manifest time" and he rightly points out that causal diamonds play no causal role in explaining this peculiar bit of human conceptual development. But let me re-emphasize that what I wish to do is find a region of a relativistic spacetime that can play a role in our thinking about time that is something like, has some recognizable connection to, the late, lamented manifest global now.

I'm afraid I muddied the waters a bit when I made the following methodological point about causal diamonds: "One reasonable demand on a scientific successor concept to a previous scientific concept or even to a folk concept is that it explains why the earlier concept is as useful or salient as it is." (2009, 357) One reason Minkowski spacetime was readily accepted is that, at normal human speeds and scales, the region of points spacelike separated from a given point (a "doughnut" in Callender's terms) looks like (or reduces to in the limit as velocity becomes infinite) a flat Newtonian hyperplane. Similarly, a causal diamond that is, say, one second of proper time in temporal length is 300,000 km wide at its waist. A causal diamond that is two seconds of proper time in temporal length is 600,000 km wide at its waist. Throughout history (until recently) such distances would be vast, and it would not be surprising if one thought them universewide or global. It would be very hard to make the same case for points, or pointevents, by the way, a proposal of Howard Stein and Dennis Dieks (as noted above) that has influenced me greatly. I intended to make no proposal about human psychology or conceptual development beyond highlighting this particular advantage of diamonds over points.

Let's look at some further complaints.

> By themselves, diamonds aren't very promising manifest presents. They are local, [not] achronal, fail to bisect the world, and typically aren't shared. One doesn't find the global tripartite division of reality that is so central to the manifest image of time here (Callender(2017, 65).

At least, I think these were intended as complaints, but really they are just descriptions of my position. Three of them have the same content. Causal diamonds are local, and so they fail to bisect (into future and past regions) the world in the way a global hypersurface would, and so they do not provide a "tripartite division of reality" into past, future and present. And that's all true. Causal diamonds are local structures, tied to timelike curves. They can't divide all "reality" into past, present and future. The best they can provide is a partial ordering of events, but it seems to me that that is the most one can reasonably hope for (or demand) in relativistic spacetimes.

Callender also points out that causal diamonds are not achronal. To say that a set of points is achronal is to say that no two points in the set are pairwise timelike separated. The set may form a wavy surface, but there is a limit to the waviness, and the set is thin. In a paper I wrote long ago (Savitt 2000) I took it as a condition of adequacy for any region of a relativistic spacetime to be a successor present that it be

achronal, like the manifest present. And then I proved to my satisfaction, and perhaps to the satisfaction of some others, that no achronal region could be a decent successor to the manifest now.

But after a few years I began to feel I had been a bit cavalier. I don't understand it and I may not know how to describe it exactly, but experience persistently tells me that there is such a thing as the specious present, a period of time in which successive events all seem present or to be happening now (but not simultaneously). Such a thick set of events cannot be achronal. The set of events on some timelike curve (like my worldline) are by definition timelike related. So odd as it may seem, it looks as though two events e and $e'$ can both be happening now (in the sense of being in the same specious present) even if $e'$ happens after e (where this is not a frame-dependent but an invariant relation). If specious presents can be presents though achronal, then being achronal can't be a necessary condition for being a present. I concluded that my old argument had been good as far as it went, but that it did not go far enough because it restricted without sufficient warrant the set of possible presents to thin surfaces, as opposed to thick ones[19].

It is true that failing to be achronal is a way that causal diamonds differ from manifest presents. I can no longer argue, as I was once inclined to, that failing to be achronal disqualifies causal diamonds from being possible successor relativistic presents. I hope no one else can make that argument now either.

Callender also says that causal diamonds fall short as presents because they are not shared. In this charge I think he holds me to a stricter standard than he holds himself. It is true that diamonds anchored on two different world lines, even if they are of the same proper time T in temporal length, will not completely overlap. In that sense, they will not be "shared."

But they can overlap, sometimes almost completely (if the world lines to which the diamonds are attached and the beginning and end points of the diamonds are close). It seems fair to say that for all practical purposes they do sometimes overlap, and in most ordinary circumstances when we use temporal language they nearly coincide. In that satisficing sense two diamonds can be and are sometimes shared.

This satisficing sense, moreover, is one that Callender avails himself of in a discussion of "now patches". A now patch is "a spatiotemporal region over which typical observers in a typical environment do not require a time stamp in order to reliably navigate their environments" (Callender, 2017, 216). If we are not far apart and we speak of similar times, then your now patch and mine are likely to be extremely similar, though not strictly identical. These now patches are then "sewn together" into a global common now. "If I snap my fingers and say 'right now!' this picks out the same coarsegrained moment for everyone in the room." But if Callender snaps his fingers and says 'right now!', he is saying it right now as far as both his and my diamond presents are concerned too. Why can't I take advantage of a similar coarse-graining and say that our causal diamond present is shared 'right now'?

[19]Reminder: this current use of 'thin' versus 'thick' contrasts achronal with non-achronal sets. My contrast of 'thin' versus 'thick' earlier contrasted my deflated or minimalist account of passage as succession with other allegedly "richer" (or "thicker") accounts.

Callender also writes that diamond presents are not good candidates for the kind of "ontological priority" required of the present (Callender, 2017, 66). I am not quite certain what he means by this, since I am not sure what 'ontologically prior' means in this context aside from temporally immediate—that is, present as opposed to past or future. In that trivial sense, the present is of course ontologically prior.

But if the present needs to be ontologically prior or ontologically distinguished in any stronger sense, then that stronger sense needs to be spelled out clearly. Savitt (2006) can be read as arguing that there is no non-trivial sense in which the manifest present is "ontologically prior". I am therefore, untroubled by the claim that my relativistic successor presents, causal diamonds, are not good candidates for ontological priority either. If others think I should be troubled, I invite them to spell out what the trouble is.

In addition to all these supposed problems with my proposal noted above Callender thinks that the motivation for it is confused. "Diamond presents seem to be a kind of unstable attempt to satisfy two masters, relativity and psychology" (Callender, 2007, 65). Leaving aside stability for the moment, I want to plead guilty to, and even to double down on, this charge. Not only do I see myself as serving two masters, but as serving two pairs of two masters!

The first pair I have already discussed at length—the manifest and the relativistic views of time. I have argued that what is viable in the manifest view, what can survive the relativistic revolution in time, is local succession, and I have proposed causal diamonds as clean relativistic local structures that can be arranged successively along timelike curves. To reconcile the competing claims of these two conceptions of time, a goal that Callender, like me, professes to be pursuing, is to serve two masters.

The other pair of masters is the one that Callender indicates, relativity and psychology. Many years ago I was asked to contribute an essay on Abner Shimony's (1993) view of time for a Festschrift in his honour. (Savitt 2009) In his famous paper on time called 'The Transient now' Shimony proposed a goal for a naturalist realist metaphysics, the goal of "closing the circle."

> The program [of closing the circle] envisages the identification of the knowing subject (or, more generally, the experiencing subject) with a natural system that interacts with other natural systems. In other words, the program regards the first person and an appropriate third person as the same entity. From the subjective standpoint the knowing subject is at the center of the cognitive universe, and from the objective standpoint it is an unimportant system in a corner of the universe. (Shimony, 1993, 40)

In trying to capture the import of this program for understanding time, I devised the following slogan:

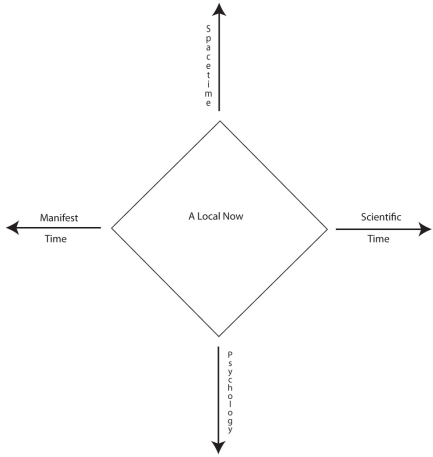
> Philosophy of time should aim at an integrated picture of the experiencing subject with its felt time in an experienced universe with its spatiotemporal structure (2009, 351).

Callender fulfills part of this program by carefully reviewing the current literature on our construction, mostly via unconscious processes, of the subjective present from

the mass of sensory inputs. These signals come from different directions, affect different sensory systems, take different times to arrive at the central nervous system and to process, yet somehow out of these messy materials we construct a unified subjective present. If I understand Callender's notion of present patch correctly, they are regions of spacetime that more-or-less correspond to the content of these subjective presents. So Callender moves along the circumference of the circle (if I may continue Shimony's image) from the subjective to the spatiotemporal, although present patches—the objective correlates of the constructed, felt present—seem bound to be messy and shifting regions of spacetime.

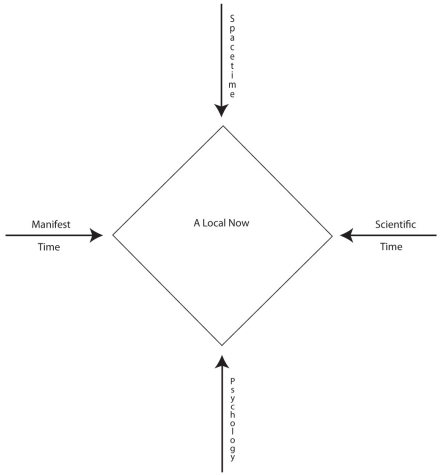
My suggestion, then, amounts to the proposal that we move just a little bit further along the circle—that we make present patches relativistically acceptable by smoothing them into diamonds. We know that diamonds, in strongly causal spacetimes, can form a topology for the whole spacetime. Of course, this comes nowhere near closing the circle. It's just a tiny step. We are just beginning to explore the global structure of spacetime. And locally we need a much fuller picture of the interaction of the environment (the ambient bit of spacetime and matter) with our sensory systems, the functioning of the sensory systems and central nervous system, and the mysterious gap between neural activity and consciousness. But every little connection, if it's a step in the right direction, helps.

Is my proposal unstable? I think not, but I have no more proof of this than Callender has of the opposite. I think he sees two pairs of vectors representing conceptual "forces", each pair pointed in opposite directions, pointing away from causal diamonds, tugging them in different directions. Hence instability. See figure 2.




I see the same two pairs of vectors but both pairs pointed towards the one point, the one way to balance all these conceptual forces, the stable causal diamond present.

Let me add that, while I propose and defend them, I cannot prove that causal diamonds provide the unique best solution to the problem of finding a present in




relativistic spacetimes, if there is indeed a present to be found there at all. There may be other ways of looking at passage and, just as there are those who prefer moissanite to diamond, other kinds of present might seem attractive to others. The one thing I do feel confident about is that, after Einstein, the resulting present will be local.

## 6.4 Conclusion

As Bergson said: Time is succession. I suspect that Bergson felt able to express this thought so succinctly because he had no doubt about what succeeded what. Global simultaneity slices. Many still think that way. But this view is difficult, and perhaps impossible, to maintain post-1905.

There is no need to maintain it. Drop globality, I say, but retain succession. One then has passage, but as a local phenomenon along timelike curves, where proper time and the clocks that measure it live. Trying to form a picture of time this way is not at all a yawn-inducing exercise. It is puzzling and difficult when one tries to picture a world of local times, but it is well worth a try[20].

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