

# Spacetime and becoming

*How to overcome the contradiction  
between special relativity and the passage of time.*

Niels Viggo Hansen, Inst. of Philosophy, Univ. of Aarhus, Denmark.

*For us believing physicists, the distinction between past,  
present and future is only an illusion, even if a stubborn one.<sup>1)</sup>*  
Albert Einstein

## Passage vs. physical extension: a very classical problem.

Apparently modern science has taught us that the passage of time doesn't really fit into physical reality. In the world of our experience, there is an obvious and vast difference between the facts of the past, the acuteness of the present and the possibilities of the future. But in the universe disclosed by modern physics the notion of a "now" seems to be inconsistent, let alone the "passage" of this now through the continuum of time.

Since the time of experience thus seems to be at odds with the scientific concepts of space and time, some have drawn the conclusion that everyday notions of change and becoming are illusory. Others have taken this inconsistency to show that scientific abstraction blocks the understanding of the depth of fundamental questions of existence and temporality. Others again will claim that a coherent understanding of time is a metaphysical chimera which should not be expected or sought after.

This article is an attempt to outline a different kind of response which is, I will suggest, more adequate. It points to a way of overcoming the contradiction by realizing that it depends on certain tacit assumptions in the interpretation of physical continua of space and time and of the temporal aspects of experience. Without these

1) Letter from Albert Einstein to the widow of his friend Michel Besso, cited in Griffin (ed.): *Physics and the ultimate significance of time* (1986), p. ix.

assumptions even strong notions of dynamism and becoming can be reconciled with the special theory of relativity. The suggested solution to the problem is a radically processual and relationist interpretation based on Whitehead's process metaphysics. It involves a reading of special relativity as a source of new and deeper (radicalized rather than weakened) understanding of temporality in technical as well as existential horizons.

The idea that there is some kind of conflict between a systematic understanding of time and the intuitive or experienced sense of change and becoming is not new of course. In fact it has very ancient roots: it can be traced back at least to the origins of Western philosophy, e.g. in Zeno and Parmenides. But in the context of 20<sup>th</sup> century physics there is a specific and acute version of the classical problem which seems more immune to classical solution models. The modern Whitehead-inspired solution suggested in this paper does in fact involve a reconstruction of some ideas central to Western thinking about time. I will even suggest that the reason why the process interpretation has not generally been considered seriously yet, although it offers an attractive solution to a problem much more frequently discussed, has to do with the power still exerted in our secularized culture by a certain theological framework for our ideas of time. In this light I will conclude with a discussion of some relevant aspects of the alternative theological understanding suggested by Whitehead in close connection with his development of process interpretations of experience, science and nature. The suggested solution to the problem of relativity and becoming does not require the assumption of any theological framework. But whether or not the reader will share my sympathy for the Whiteheadian God, I believe the contemplation of this suggested modification of the idea of divinity can be helpful as an illustration of the radical Whiteheadian reinterpretation of temporality.

## Contradiction: special relativity vs. "the myth of passage"

One of the central theories of modern physics has particularly fascinating consequences when compared with concepts of time reflecting ordinary daily life experience: the Special Theory of Relativity (SR). The way SR is at odds with the classical idea of dynamic time or passage of time is not by implying that ideas of change or passage are themselves self-contradictory, as in the classical atemporalist<sup>2)</sup> arguments from Zeno to McTaggart. Rather, SR dissolves a necessary condition for the classical idea of passage: the existence of a unique order of the events of the universe, the allocation of every event to a point or interval on one axis of time over

2) "Temporalism", in the following, is used to denote the notion that time is something more than a kind of extension or a series, whether this something is expressed in terms of passage, ontological or modal difference between past and future, emergence or becoming. Conversely, what "atemporalism" denies is not the existence of a continuum or series but this "something more".

which the passage of the now might take place. (Or, with the equivalent inverted metaphoric of passage preferred by some, what is dissolved is the sequence of 3-dimensional "pictures" constituting a universal movie which might pass across the "projector" point of temporal presence.) In SR's reorganized grammar of spatiotemporal relations, events can no longer be said to be placed in such a 1-dimensional continuum of time and in a separate, independent 3-dimensional continuum of space, rather they are placed in a 4-dimensional continuum of spacetime allowing for a multiplicity of equally valid formulations of timelike and spacelike orderings, relative to velocities. This reorganization seems to complete what Bergson aptly phrased "the spatialization of time" so that the passing of the "now" becomes not only foreign and irrelevant in the physical universe but even cannot be formulated coherently in the context of physical theory. Apparently the result is a direct contradiction between our systematic knowledge of time as part of the structure of the physical universe and our intuitive notions of time, based on whatever unsystematic and perspective-dependent view of a fraction of the physical universe our immediate experience covers.

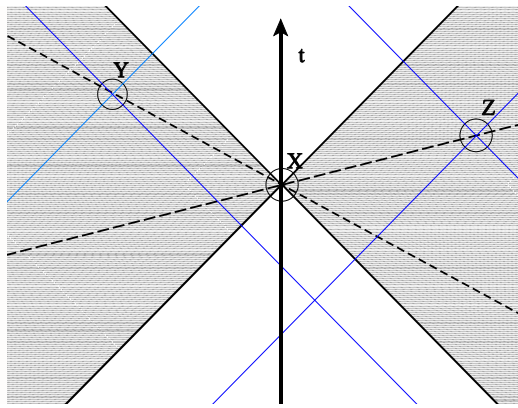
Let me briefly outline the technical structure of the contradiction. The classical idea of dynamic time or passage involves that there is, at each moment, an ontological state of affairs of all events in the universe in which it is the case for each event either that it has already happened, or that it is now happening, or that it has not yet happened. Hence all events, regardless of spatial position, are required to be divided into the basic ontological or modal regions of past, present and future. This implies the existence of a relation of simultaneity determining, for a given present event  $X_{\text{now}}$  and a spatially distant sequence of events  $Y_n \dots Y_m$ , a division of the Y series into a past subsequence followed by a future subsequence, with at most one Y being situated on the border (i.e. co-present and therefore simultaneous with  $X_{\text{now}}$ ). However, in SR, the classical unique relation of simultaneity is replaced by a multiplicity of simultaneity relations depending on the choice of inertial system, i.e. on the arbitrary choice of a viewpoint in which the velocity of a particular group of real or potential objects is zero. Thus there could be many members of the Y series having equally valid claims to simultaneity with  $X_{\text{now}}$ . This implies that a coherent classical division of a set of events into regions of past, present and future is only possible in the degenerate case where the whole set considered is within the limits of the light cones of  $X_{\text{now}}$ . In the general case the attempt to formulate the classical modal state of affairs will be faced with the dilemma of either overriding any reasonable construal of modality by accepting that an event is co-present with events in its own causal past and future, or overriding SR by arbitrarily claiming a fundamental ontological privilege for one of the many inertial systems without any corresponding physical mark of distinction.

The argument is illustrated in fig. 1. Also it is unfolded with slight variations and in greater detail by several authors of a scientific realist bent, including Adolf Grünbaum and the early Hilary Putnam. The variations in technical details and constructions of unacceptable consequences are not essential for our discussion here. It is sufficient to note that due to SR it is no longer possible to assume a natural or unambiguous temporal ordering of events separated by spatial distances.

It should perhaps be noted that the magnitude of the ambiguity of the simultaneity relation happens to be small enough to be negligible in most practical matters, because of the limited distances involved and the limited "clock rates" of the processes involved. Thus, between two persons on the same planet the maximal size of the ambiguity would be a few tens of milliseconds, and a serial ordering of all words spoken and acts performed by human beings on Earth would be almost totally unambiguous in the sense related to SR: If I speak a word NOW, every word spoken and act performed by other human beings can be nicely ordered into the past, present and future of this event, simply because the light cones will contain the entire history of the earth except for an intermediate zone whose temporal thickness, even at the remotest point of the earth, will be small compared to the time it takes to say the word NOW. However there are practical matters related to modern technology in which technicians have to handle the ambiguity: one example would be parallel programming of networked computers. The ambiguity might even be argued to be marginally perceptible in the short time lags experienced when phone calls, tv interviews etc. are transmitted via satellite<sup>3</sup>. Further, the essential nonexistence of a unique temporal order of events entailed by SR implies only an essential *limit* to ordering, not complete arbitrariness. Events capable of being causally connected lie by definition within each other's light cones and hence conserve their sequence under changes of inertial frame of reference, and the essential limitation of sequential ordering is, in most practical cases, insignificant compared with the limits which are anyway imposed by practical problems of delimiting and timing events. In other words, certain groups of events form "island universes" where unique sequential ordering is virtually possible, and the worlds of our sociality, language and practice are such islands because they are relatively slow and local. Generally however, the magnitude of the ambiguity of sequential ordering is enormous; and even if it was not large, its very existence essentially undermines the unique universal time sequence required by "the myth of passage".

<sup>3</sup> The graveness of the problem of ambiguity can be grossly expressed in terms of the relative size of the intermediary zone which is simply proportional to the product of the clock rate of the processes involved and the maximal physical distance involved.

Fig.1: Illustration of the argument in section 1.1. The diagram is a two-dimensional representation of the 4-dimensional spacetime continuum ("Minkowski space") so that the vertical axis is a timelike extension and the horizontal represents 3 spacelike dimensions. Points represent events. Through the event X a time axis  $t$  is drawn, representing one of several possible sequential orderings of events around X. Units are chosen so that a spatial unit is depicted with the same size as a temporal unit times the velocity of light, therefore movement at the speed of light is shown as a 45° slope. The bright area above X is thus the area containing all events which can be reached by light rays from X, X's so-called "future light cone". As the speed of light is the maximal speed of propagation of causal influence, the future light cone is the section of spacetime which can be reached by X's causal influences. Similarly, all events which have been capable of influencing X causally are in the "past light cone", here represented by the bright triangle below X. The events Y and Z are situated in the "intermediary zone" between X's



light cones. Any such event is simultaneous to X according to some choices of inertial system (co-ordinate system with specific definition of "rest") and non-simultaneous to X according to other choices. The dotted lines represent two alternative definitions of simultaneity so that X is simultaneous with Y but before Z in one, and simultaneous with Z but before Y in the other. These dotted lines are a priori equally adequate candidates for the role of the universal ontological borderline between past and future. The only way to choose a particularly "natural" candidate in a given situation is to pick one corresponding to an inertial system in which the centre of gravity of some enduring physical object (or collection of objects, e.g. the solar system or the local supercluster of galaxies) is at rest. But if such a definition of simultaneity is chosen, the "now" time of distant galaxies is changed by millions of years if the velocity of this local object varies a little. This is the first branch of the dilemma. The other one appears if we do not claim any specific inertial system to be privileged but maintain that X is at the ontological border between past and future. In this case the entire (grey) intermediary zone between X's light cones is an ontological no-man's-land so that, at positions far from X, the "ontological present" contains very long sequences — billions of years of consecutive and yet co-present events. If this nonspecific simultaneity relation is further taken to be transitive, as presumably any reasonable simultaneity relation must be, it even follows that if one event X is present, the entire spatiotemporal continuum, including X's own past and future light cones, is present. This is the way Putnam and many others have arrived at the conclusion that every physical event must really have the same ontological status, no matter if it appears from a particular perspective as past, present or future — that assuming SR we cannot coherently uphold the idea that past, present and future events are really different or distinct<sup>4</sup>.

### The anti-metaphysical response.

The traditions of philosophy of science contain several conflicting standard attitudes to this problem. First, some will shrug their mental shoulders at this kind of apparent contradiction. They may claim that commonsense conceptual structures of time and tense<sup>5</sup> work well enough in their practical sphere, and that the terminology of SR works well enough in a completely different set of contexts of very technical character, and that the apparent problem only arises because these concepts are applied and compared beyond their "native" language games. Accordingly they may reassure us that the problem will dissolve through a Wittgenstein-inspired criticism of metaphysics, undermining the idea that there has to be any overarching coherent object, "time", referred to by commonsense notions of time and tense as well as physical theory. Our Wittgensteinian critic may even admit that there are certain "family likenesses" between any two language games using the word "time" and related terms, but maintain that metaphysical problems like the one outlined occur exactly whenever we have gone too far in "metaphysical emphasis" on the likenesses, taking them to commit the concepts to mutually cohere any more than they simply happen to do. From this the antimetaphysician would conclude that any attempt to speculatively construct solutions to such problems is bound to fail, or to produce more metaphysical cramps of language, until we simply realize that the question is meaningless because each of the concepts of time we were trying to compare is meaningful only by virtue of a local context of use.

However, even if we follow the Wittgensteinian realization that concepts and language games are rooted in particular concrete uses, it is hard to see that we could or should avoid the very common tendency of phrases, concepts and specialized languages to extend beyond their native use by metaphors, analogies etc. For example, the Wittgensteinian herself will be using certain terminologies and metaphors — "practice", "use", "language games" — which are extended beyond their native use in order to account for what other sections of language do and mean. Furthermore, questions of time, change and process seem to be particularly difficult to be coherently deconstructivist or antimetaphysical about. Many of those who have expressed a general critical attitude towards overarching metaphysical concepts have in fact been emphatic defenders of particular metaphysical views here, favouring the primacy of either extension or passage as in the two classical responses discussed below. Metaphysics, like ideology, tends to be identified with platforms *different* from one's own.

Even if antimetaphysics is unable to produce the nonmetaphysical platform from which our problem could be dissolved once and for all, the antimetaphysical tradition

<sup>4</sup> Putnam, Hilary (1967) "Time and Physical Geometry" Journal of Philosophy 64:240-247

<sup>5</sup> Verbal tense: the phenomenon that utterances in natural language (at least in the indo-european and several other language groups) generally involve temporal references to past, present and future, even when no explicit mention of time is made, through the inflections of verbs.

contains a very essential insight for efforts to deal with the problem constructively. Whenever particular concepts and language games are taken to be automatically valid and powerful beyond their sphere of concrete use, problematic and useless metaphysics is likely to be produced. But if we avoid fundamentalist assumptions about the simple given and coherent object of all temporal language, we may find humble ways to explicitly participate in the metaphysical attempt of *producing* coherence and relevance, already present in the use of language. We may make accept the inescapable metaphysical activity as the philosophical project rather than the problem.

### Taking sides (1): The scientific atemporalist response.

Among those who have found the passage/relativity contradiction significant and found that some coherent understanding must be produced, there are two classical positions, each of them taking one of the mutually contradictory notions of time for true and concluding that the other must somehow be accounted for as flawed, illusory or only practically and approximately valid. The *scientific* response is the one which insists, explicitly or implicitly, on some kind of strong scientific realism about the most "fundamental" physical theories, including SR, and their representation of time. On this basis the contradiction is taken to imply that the "passage" of time is some kind of illusion, a "myth". This is the view expressed by Einstein in the introductory quote, and it is the conclusion drawn by several philosophers of science, including Grünbaum and the early Putnam, who base their argument on expositions of the contradiction. Scientific atemporalism based solely or partly on this type of argument has also been advocated by more popular science writers such as Davies<sup>6</sup>.

The project of bringing about a coherent understanding now takes the form of the challenge of explaining what Einstein called the "stubborn" appearance of passage and ontological difference, given a spatiotemporal continuum in which all events have the same kind of reality. Various resources of physical, psychological/neurological and linguistic/logical theory have been applied in such reconstructions, in order to show it unnecessary to assume the reality of the apparent dynamism — to assume something the physicalist considers a non-physical happening, 'that there is a mysterious Mr. X out there doing "The Shift"<sup>7</sup>.

Some aspects of the apparent flow or passage of time yield relatively easily to such a program of reconstruction. This is the case with statements containing pure

<sup>6</sup> P. Davies: *God and the New Physics* (1984), P. Davies: *About Time - Einstein's unfinished revolution* (1994). Davies very explicitly proposes a physicalist reconstruction of experienced time, describing the sense of the passage of time as a kind of "dizziness", but in his latest books the tendency is rather that further scientific evidence is needed to tell whether our ideas of ultimate reality should be purged of temporality.

<sup>7</sup> Gale, G: entry on "Time", Audi, R. (ed.): *The Cambridge dictionary of philosophy*, 1995, p804.

temporal references to now, to past and future and to other points of time specified relative to now ("last year" etc.). If any such reference is considered in isolation (from contexts of utterance — social, practical, linguistic) it can be reconstructed in terms of the classical time continuum or SR spacetime as implicit self-reference regarding the (spatio-)temporal position of the utterance — so that "last year" is equivalent to "the year before this utterance is (in a tenseless sense) pronounced or otherwise expressed". This reconstructing move can be formulated as indifferent to the further physical or mathematical elaboration of concepts of (spatio-) temporal position or their semantics, particularly it can be indifferent to the constraints SR may be taken to impose on the semantics of "now"<sup>8</sup>.

Obviously any event — at least any event of a suitable type, say a speech act — regardless of its time and place, may point to itself and claim to be "now" (as well as "here") exactly as you may while reading this. If temporalism is construed as essentially the claim that this particular "now" of yours is privileged over all the other similar nows in the universe, it is easy to dismiss any such attribution of significance to "now" beyond simple indexicality as subjectivism and even solipsism. The atemporalist seems to fulfill the task of reconstructing the sense of *nowness* as an effect of the particular perspectives of certain types of event complexes: those which speak and think of themselves and other events as past, present and future, basically events of consciousness. In Grünbaum's words, the sense of now is "consciousness dependent", not physically real, and consequently the sense of its passage must be an effect of the structure of this particular kind of self-referential events. Davies, for example, identifies the sense of passage with a temporal analogue of "dizziness" — "the 'whirling vortex of self-reference' that produces what we call consciousness and self-awareness, and I strongly believe that it is this very vortex which drives the psychological time-flux". It is hard to escape the conclusion that *nowness*, understood as a mere position of a "present" now-point of time, may be thus reconstructed in terms of self-reference. However, the intuitive notion of passage contains not just the singular moment of pointlike presence but also its *movement*, the passage from *past* to *future*.

<sup>8</sup> The atemporalist reconstruction is simply the claim that in whatever approximate way "now"-references, including references to points of time specified in relation to now, can make sense in physical time, this sense can be reconstructed as a reference to the time of the utterance. The temporalist making the "now" statement can choose whether this is to be understood in a context of classical or relativistic time, in an absolute or relationist account of the continuum, whether the scope of the reference is only in local terms "A before B", "A one day before B" or global in terms of a relationistically constructed clock system or even an absolute (space-) time system. In any case the sense is reconstructed as a reference to the time of the utterance in this sense. It is only that with SR, unfortunately for the temporalist, the now-utterances cannot refer to a cosmic now, but this applies whether the utterances are reconstructed in this way or taken to refer to an ontologically privileged event. The atemporalist reconstruction's indifference or tolerance with regard to the underlying topological and metrical characteristics of time is a main theme in one of the classical formulations of the reconstruction: D.C. Williams: *The Myth of Passage*, *Jour.Phil.* 48 no.15 (1951), pp.457-72.

Thus, we can no longer avoid the difficult question what exactly is the content of the intuitive temporalist notion of becoming, and how much of it the scientific atemporalist should be committed to account for. Clearly atemporalist hardliners will claim that basically no further accounting for is needed since anything beyond indexicality is derivative phenomena which may be analyzed psychologically but have no bearing on fundamental questions of the nature of time. Furthermore since there is no generally agreed explicitation of the intuitive notion of becoming, the atemporalist seems to be justified in focusing his criticism on what seems to be the most minimal equipment for the general use of notions of change and becoming. In fact, in the tradition of analytical philosophy temporalists as well as atemporalists seem to have developed a considerable degree of consensus about analyzing the matter in terms of a particular model, McTaggart's A- and B-series<sup>9)</sup>, which corresponds very closely to the notion of a classical time axis (the B-series) to which a hypothetical now-point (the A-series) may or may not need to be added. Only the McTaggartian model is further minimalized in terms of metaphysical furniture in order to be indifferent to the questions of the construal of physical time as relational or absolute, continuous or quantized. In fact it is obvious that McTaggart developed this canonical minimal model exactly in order for his argument for the untenability of temporalism to be independent of the discussions of such assumptions of a more technical character. However, even McTaggart's minimalized model retains the construal of nowness and passage strictly in terms of position in a sequence, and this amounts to a suppression of certain other aspects of the temporalist intuition of becoming.

In other words, it must be asked whether experience and language of temporality is adequately captured in terms of such pure positional references. There are some very important characteristics of experiences and expressions of temporality which do not fit into the A- / B-series distinction: characteristics which may be summed up in the categories of modality and causation. Time as experienced is characterized (at least outside of the McTaggartian framing of the discussion) not just by *position*, the sense of presence of a particular event and absence and distance of events at other points of time, but also very much by *orientation*, the sense of difference between past events (remembered to some variable extent, traceable through causal effects on later states of affairs, and considered as given, *necessary* facts) and future events (never remembered, not traceable, and considered as open, *possibilities*). Correspondingly, explicit references to time as well as the implicit expression of temporality

<sup>9)</sup> McTaggart gave a classical formulation of the question of passage, in his definition of the two series: The B-series referring to the "content" of time so to speak, the chain of events ordered only relatively (before-after). And the A-series referring to the modalities, to pastness, nowness, futurity, as abstracted from the specific events which happen to be past, present or future. McTaggart's series became a standard framework for the discussion of temporality, particularly in the anglo-saxon tradition. McTaggart's classical definition and argument concerning the two series is presented most systematically in the beginning sections of J.M.E. McTaggart: *The Nature of Existence*, (1927).

omnipresent in tensed language does not merely refer to temporal position but also carries connotations of modality. Now since the atemporalist claims all perspectival "nows" to enjoy the same ontological status clearly he must deny the reality of the modal asymmetry as such, and claim it to be produced, along with the "now"-feeling, by perspectival effects. Apparent modal asymmetry would thus be accounted for in terms of this subjective "now"-feeling combined with a difference in our possibilities of knowing past and present events. But then an account of this apparent difference is required.

At first this may seem as simple as the reduction of the pure A-references: it may seem that all we need is to add an appeal to ordinary causality. A given event is causally influenced by a number of other events situated in its relativistic past (its backward lightcone), and such causal chains leading to a "present" conscious / neurological event from its "past" happen to exist in a number of varieties corresponding to immediate sensation, retention, short term and long term memory. Again, the "present" event can causally affect "future" (forward lightcone) events and some of the ways conscious / neurological events do so involve such patterns as desires, belief systems, decision making and volition. The physicalist atemporalist is justified in leaving the further details of these patterns of perception, memory and decision making to be investigated by psychology and neuroscience *if* he can support the central philosophical point in this account of temporal modality: that the sense of determinedness of the past springs from the causal chains determining (at least partially) the present event. Similarly the sense of openness of the future must be accounted for as springing from the existence of causal chains from the present to the future and the absence of causal chains from the future to the present — a more explicit account should probably invoke some complex of such relations involving remembered experiences of having causally affected what was then future, but no matter the amount and character of details, the essence of the physicalist account of apparent modal asymmetry is that it is rooted in the unidirectionality of causation. However, this raises an interesting problem on the physicalist's own premises, because on the level of physical laws describing the basic forces there is no unidirectionality of causation. It is clear that in a deterministic physical system governed by such fundamental physical laws invariant to time reversal, the "present" state of a system at time  $t_0$  contains all information about the "future" state at  $t_0 + \Delta t$  in exactly the same sense as it contains all information about the "past" state at  $t_0 - \Delta t$ . This symmetry with regard to the preservation of information through causal chains is not affected by the lack of invariance ascribed to the weak nuclear force<sup>10)</sup>,

<sup>10)</sup> The equations describing the fundamental forces of nature are temporally symmetric, just as classical mechanics was — except for the "small" anisotropy ascribed to the weak nuclear force, in the sense that these interactions can only be time reversed if some properties of some particles are reversed. The existence of deterministic trajectories forward as well as backward in time is unaffected by this. See R.G. Sachs: *The Physics of Time Reversal*, Oxford 1980, p.8-12. It is important to note that this idea of a very fundamental status of symmetry in physics is not shared by all of those who are "physicalists"

just as it is not immediately affected by the shift from classical to quantum mechanics<sup>11</sup>). Of course in practical cases where physics is applied the unidirectionality of causation is generally obvious. But such an appeal to obvious facts of the concrete world of applied physics would be very problematic here, as it would be completely analogous to the temporalist's appeal to the obviousness of time's passage in the concrete world, no matter whether it has a correlate in the equations of mathematical physics. Hence, to be consistent, the claim that the past-future difference can be reconstructed on physicalist grounds via unidirectional causation needs to give a physical reason for the asymmetric loss and preservation of informational content in causal connections.

Two aspects of physical theory have been discussed, by Davies, Fraser and many others, as more or less independent candidates for such a reason: thermodynamical entropy increase and quantum mechanical wave function collapse.

A thermodynamical account of experienced temporal modality and apparent unidirectional causality is essentially the claim that they are both effects of a very large entropy gradient rendering very different the practical conditions for prediction and retrodiction — i.e., for making inferences from any particular state of affairs to states at some temporal distance from this state in the two temporal directions. Some information on past states of affairs would then be conserved along causal connections as low-entropy "traces" because a low-entropy state has a very low probability of arising spontaneously, but the same low-entropy state is not a "trace" of its future because it has a high probability of decaying spontaneously. A sand castle very rarely arises spontaneously out of the apparently random movements of sand grains across the beach with wind and waves but very often decays spontaneously — in this sense this kind of recognizable ordered state is said to be a trace conserving information about past recognizable ordered states in the past but not about future

---

in the sense of taking physics seriously as revealing something essential in the nature of things. Joseph Rosen's article in this volume is a fine example of what should be called reflected physicalism (if Rosen will accept the term physicalism at all) arguing that asymmetry is always prior to symmetry in physics because any meaningful utterance of symmetric relations presuppose that the terms related are distinguishable, i.e., that the identity expressed is not complete. I think Rosen is right about this, and also in his corresponding interpretation of the Leibnizian principle of sufficient reason: the process of physical explanation is about finding ever more general differences, as identities alone explain nothing that makes a difference. If this agreement with Rosen seems to contradict my present argument, it is because two very different ways of taking physics as metaphysically significant are at issue. Thus, when I claim that the physicalist cannot derive temporal asymmetry from fundamental physics, this refers to the kind of physicalism that takes fundamental physics to be exhausted by the entities and formulae. Rosen refuses to take these as self-sufficient level of existence in isolation from the fact that they must be workable in a world of distinguishable features. Clearly it is from this that Rosen derives the primacy of asymmetry, not from the formal aspect.

<sup>11</sup> In the sense that the object in quantum mechanical description is a wave function satisfying the Hamilton equation the complete conservation of information in both temporal directions is just as in classical mechanics. In the sense that the object includes the "breakdown" of wave functions into statistical distributions for singular outcomes there is some level of indeterminism in the sense of underdeterminedness of events at times later than a known state, but it is at least not clear that this does not apply in backward direction as well. The possibility of grounding temporal asymmetry on quantum effects is discussed further below.

recognizable ordered states. So the entropic account of unidirectional causation means that although ultimately, at the basic level of the elementary components, causality is symmetrical, in practice the entropy gradient constrains the identification of ordered states and their causal connections in such a way that only causation in one temporal direction can be found.

However, this entropic account of the temporal asymmetry of the well known world of human experience and action leaves two other problems. Firstly, it is not established that the states of affairs we recognize as "traces" of the past are adequately characterized as low entropy states. Denbigh illustrates this with Earman's dramatic example of a bomb crater in a city which is obviously a clear and serious trace of a past event but cannot in any reasonable sense be described as more ordered than its surroundings<sup>12</sup>. He concludes that

"...most records and traces are not distinguished as such in any objective or physical sense, it is rather what we read into them that constitutes them as records or traces. Indeed there are very few physical objects which do not function in this way..."

Thus, a broken window as well as an intact window are traces of certain past events if we know the kinds of projects and contexts they take part in. It is questionable whether one can coherently formulate a theory of traces from the past and not from the future, and of temporally asymmetric information loss, without regress to the kind of project *for which* the states in question are traces or information readable or lost — surely this regress can be expressed in terms minimalized, de-contextualized and objectified in many respects, but hardly without the temporal content of directedness which was exactly what was to be reconstructed.

Secondly, the move of invoking thermodynamics as the basis of a physicalist reconstruction of the experienced difference between past and future also invokes the metaphysical questions regarding the interpretation of the second law of thermodynamics. It is often claimed, particularly by defenders of physicalist atemporalism, that truly basic physical reality contains no "arrow of time" and that the second law's arrow is itself a derivative phenomenon rooted some way or other in subjectivity — either because the definition of entropy expresses ignorance of the precise microphysical states (Gibbs/Einstein) or because some version of the Anthropic Principle is implied in order to account for an extremely abnormal border condition amounting to the entropy slope of an inhabitable universe. I have discussed these and other interpretations of the second law elsewhere<sup>13</sup>. For the present

---

<sup>12</sup> Earman J (1974) *Philos Sci* 41:15, quoted in Denbigh, K: *Three concepts of time*, Springer Verlag 1981, p.127. Denbigh gives an extensive discussion of the relations between a number of "arrows": causality, predictability, memory, cosmology and thermodynamics.

<sup>13</sup> Hansen N.V.: *Process Thought, Teleology and Thermodynamics*. Presented at the conference on *Time, Heat and Order*, Univ. of Aarhus 1997, forthcoming in a publication with the same title.

discussion it is sufficient to note that the main issue in debates over the interpretation of thermodynamics is between

A) moderate or syncretist positions allowing for a realistic interpretation of temporally asymmetric laws as well as branching, stochastic events and commonsense asymmetric causality — in other words, interpretations in which there is no question of reconstructing intuitive temporality as a mind-dependent phenomenon because it is openly assumed as part of the physical world — and

B) more puritan positions reserving realistic interpretation for the fundamental level of theoretical physics — so that large portions of physical reality must be reconstructed as derivative along with mind-dependent phenomena, or even as constituted by mind.

As I have argued elsewhere subjectivist or anthropic accounts are an almost necessary extension of the "purification" separating fundamental physical theory from the world of agencies, projects, conflicts and collectives. The universe available to observations is a temporally asymmetric portion or selection of physical reality because asymmetry is a necessary condition for observation. But the purified anthropos, the pure fact of observation which is here pointed to as the basis of the physicalist reconstruction of the directed (modal and causal) features of lived and experienced dynamic time lies itself in a sphere with "no physical correlate", just like the previously discussed aspects of nowness and passage. It points back to subjectivity as the ultimate source of temporal irreversibility in the physical world. Paradoxically the attempt of deriving the elements of experienced time from fundamental atemporal physics seems to lead to just the reverse: the grounding of large portions of physical reality on the temporal constraints of human subjectivity.

What is interesting about this is not that it may seem to challenge the objectivity or explanatory power of thermodynamics or other physical theories, or seem to support classical idealist notions of observing subjectivity affecting nature. The interesting observation is that when thermodynamics is invoked as an element in the atemporalist reconstruction of temporality, what is depended on is exactly those aspects which presses the theory to limits of the domains of ordinary objective use where discussions of subjectivist interpretation have traditionally been raised by physicalist themselves.

A closely related observation can be made with regard to quantum mechanics (QM), the other branch of physics frequently invoked in attempts of physicalist reconstruction of consciousness and temporality as a possible source of the sense of a modal difference between past and future. The strength and nature of such a support depends very much on the choice of interpretation of QM. A fair discussion of the interesting structures of physical and metaphysical assumptions built by the schools of interpretation is beyond the scope of this article, but for our present

purpose it is sufficient to note one of the central questions regarding the common central issue of events with the nature of a quantum measurement — the kind of events where the complete quantum mechanical description of the state and dynamics of the system in question leads only to a probability distribution over several outcomes (or a continuum of possible outcomes) but where an actual observation yields one particular outcome — events which effect the so-called breakdown of the wave function. One of the questions disputed between the schools of interpretation is what amounts to an act or event capable of effecting such a "breakdown", but we can bracket out that question for now and just accept, for the sake of the argument at least, that it may not strictly require an observing physicist and a laboratory but may happen frequently enough (and in relevant places such as the human brain) to be a plausible candidate for the source of something explaining the ongoing sense of passage and modality. The question we do need to ask is how the temporal aspect of the breakdown itself is understood.

In some interpretations the "breakdown" is taken to happen in time in a commonsense way. This means that the kind of process exemplified in the quantum measurement would be a real change in which outcomes are not fully determined by even a complete description of physical laws and previous states. Obviously when the quantum event is seen as a real addition or emergence of information contained in the state of the system, and when the indeterminacy is understood in a direct, ontological way, as in the Copenhagen interpretation<sup>14</sup>, QM seems to be just what we need in the role of a spring of temporality. Many have argued, on the basis of such a commonsense understanding of quantum indeterminism, that various mechanisms in certain special types of complex systems could amplify the microscopic quantum processes into macroscopic effects of truly unpredictable behaviour and emergence. It has even been argued that such amplified quantum effects could play a major role in the brain processes underlying human consciousness<sup>15</sup>. However, this interpretation obviously involves the reintroduction of temporal modality as an element in basic physics. It involves the requirement that every quantum event in the universe — and every event dependent on a quantum event — must again belong to one or the other of the classical ontological regions of time: either the quantum "breakdown" has happened (past) or it has not (future). The breakdown itself becomes a version of the notion of passage, events really happening

---

<sup>14</sup> Adherents of hidden variable interpretations may be able to show that the existence of "hidden variables" determining the outcome although in practice or in principle unknowable to us could yield indistinguishable observations, but with regard to temporality we would then be in a situation completely analogous to what we would have with classical mechanics if we simply couldn't know the physical state with absolute precision, as in fact we never can. Of course the hidden variable interpretation can allow the assumption of temporal passage, so that quantum effects do in fact change status from future to past, but this assumption would be completely independent of QM, and QM would not itself be the place to look for a source of temporality after all.

<sup>15</sup> A recent authoritative argument of this type is R. Penrose: *Shadows of the mind*, (1994)

as transitions from undetermined future to determined past — but this takes us right back to the problem we started with: how to conceive such temporal becoming under SR's dissolution of the classical unique temporal ordering of events. In fact this difficulty of accommodating the "now" of the quantum wave function "breakdown" into relativistic spacetime is sometimes claimed to be a serious problem for the Copenhagen Interpretation<sup>16</sup>.

It is sometimes claimed that the fascinating "Bell's inequality" type of experimental evidence brought forth by Alain Aspect and others has demonstrated that quantum mechanical phenomena override SR in a sense which implies a supraluminous influence from one act of measurement to another. Comparing certain measurements of pairs of particles which have previously interacted, these experiments have demonstrated correlations which were expected according to Bohrian notions of indivisibility of quantum phenomenon and quantum measurement setup, and which fail to satisfy requirements of "local realism" made notably by Einstein, Podolsky and Rosen. A treatment of the full scope of metaphysical implications of these experiments must be postponed to another paper. However, in the present context a simple observation is essential: that there is no indication of supraluminous or instantaneous influence in these results, and particularly that they carry no evidence of classical, non-relativistic time for such influence to happen in. Take any one of the ingenious experimental setups successful in making measurements on sets<sup>17</sup> of pairs of particles (or whatever previously interacting entities for that matter) exhibit the kind of correlation in question. The "SR overriding" interpretation then goes like this: Since the outcome of one member B of the pair is correlated with conditions involved in the process of measurement of the other member A, B must be influenced by those conditions at A. Therefore, if the setup is constructed in such a way that there is not time enough for a light pulse or anything slower than that to travel from A to B, then they must be connected by some kind of influence transferred at a greater speed or perhaps instantaneously. To show that this is a misinterpretation it is sufficient to consider that the experimental setup could be modified through a series of slight displacements, with event A being placed anywhere, early and late, in the time between B's lightcones. This series of displacements will not reveal a hyperplane of true simultaneity at which the influence from A to B sets in, as of course it should if the idea is that A happens first and then influences B. It makes no difference which one happens first. Hence these phenomena offer no support for the notion that there must be an absolute sequence of events. In fact there is also another important sense in which this type of correlation is not an influence at all: its statistical form is exactly of a nature which

<sup>16</sup>) If my main argument in this article holds, this is not a valid objection to the Copenhagen Interpretation.

<sup>17</sup>) The correlations are not exhibited by any one pair of measurements, the correlation is of a statistical character so that it is only discernible when many pairs are compared.

prohibits its use to transfer a particular message or controlling signal from one end to the other. Whatever these interesting quantum mechanical phenomena are<sup>18</sup>), they have nothing to do with supraluminous or instantaneous influence.

Some of the alternatives to the Copenhagen interpretation seem to avoid the problem of the temporal status of the breakdown, since the "breakdown" is not taken as a real passage from potentiality to reality happening in time. In one school of interpretation the breakdown would be unreal because a complete description would contain additional "hidden variables" selecting one of the multiplicity of apparently possible outcomes as real and rendering the others impossible, so that future events are in fact just as determined as are past ones. This restatement of a more classical picture would relieve us of the problems of the temporal structure of the breakdown, but in the same move it would destroy the possibility of seeing quantum events as the spring of non-classical, temporally asymmetric causality.

In the more metaphysically daring "many worlds" interpretation, the breakdown would be unreal because only the quantum wave functions are real objects, implying that all of the potential future outcomes and the entire branching family of further events dependent on them ("worlds"), and also all of the apparently determinate past events already observed, have equally valid claims to a partial, or perhaps better perspective-dependent, reality. In some popular versions of the many-worlds interpretation the splitting of these branching worlds is understood as producing two or more entire parallel universes in the instant of the quantum event, and such branchings would be understood as happening only in the future direction. Thus the temporal aspect of this popular type of MWI would be very analogous to that of the Copenhagen interpretation<sup>19</sup>). They would share with it the problem of defining a "cosmic instant" to accommodate a quantum ontological change (here, the split) in the face of SR. However a more esoteric and abstract version of MWI escapes this kind of problem created by the apparent need of a meta-time in which splits "happen". Instead, the splits are taken to happen locally and to split faraway regions of the universe only as effects of the splitting event reach them — in effect overcoming the (popular MWI's) need of assuming an ontologically privileged inertial system in spite of SR. Also in the esoteric MWI, the preference of world branching

<sup>18</sup>) I think they are primarily strong manifestations of the Bohrian point that quantum measurements and quantum measurement setups are not ultimately separable. This means that what counts as a particle and a state is dependent on this kind of context. But once there is a context in which states and particles are defined, these are constrained by SR as the grammar of time and space. The shift from one context to another cannot be construed coherently as a process in which specific particles do things prohibited by that grammar. Therefore there is no reason to consider this a reduction of the universal validity of SR, and I am sure Bohr did not.

<sup>19</sup>) The popular version of the many-worlds interpretation is not necessarily committed to temporalism. It would allow an atemporalist interpretation of the entire branching tree of worlds — but then of course the Copenhagen interpretation is not necessarily committed to temporalism either, an atemporalist Copenhagenist could make the completely similar claim that the singular real branch of system states intercepted by stochastic quantum events simply exists atemporally. If branching doesn't require real passing time, neither does the random selection of one branch.



in the future direction is not taken as a metaphysical assumption implying an ontologically privileged *arrow* of time at the fundamental level, defined as the direction of splitting; instead the arrow of splitting is derived from the higher-level arrow of entropy, as a consequence of the required temporal structure of events corresponding to the "quantum decoherence" giving rise to a world split. Since entropy is here taken in the sense of statistical mechanics, world splits in the "backwards" temporal direction are not strictly impossible, the present state of the universe just happens to make them extremely much less probable than "forward" splits. Consequently the ultimate source of temporal asymmetry is, again, assumed to be an extremely special border condition: the contingent existence of a low-entropy "initial" state in one of the temporal directions as viewed from where we are, an entropy slope defining this direction as "past".

It should now be clear that if QM is evoked as a source of the temporal asymmetry needed for a physicalist reconstruction of temporality, the aspects depended on are really on the border of the theory or rather just outside it. They are interpretative additions which fall, for our purpose, in only three categories.. In some interpretations they involve a reintroduction of modality and hence seem to require a unique order of events and thereby reproduce the clash with SR that we started out with. In other interpretations what is relied on is the thermodynamic asymmetry we just discussed. Finally, some interpretations rest directly on the idea of a subjectivity fundamentally involved through "the observer effect" as the source of broken temporal symmetry.

Again my implication is not that quantum mechanics does not meet all reasonable standards of objectivity or that it supports mysterious claims such as the alleged mysterious observer effect, nor is it meant to disqualify the MWI's or the Copenhagen interpretation (which I support). The point is not even a criticism of more or less metaphysical attempts such as Penrose's to extend the theoretical structures of quantum mechanics in order to construct possible connections to neurology and consciousness.

However I have argued that the invocation of thermodynamics or quantum mechanics as resources for a physicalist atemporalist account of temporality either breaks down by simply resting on implicit assumptions of temporalism, or depends on some version of an anthropic or transcendental argument which does not only construe temporal *nowness*, passage and orientation as "mind-dependent" and as having "no physical correlate", but does also throw, along with these aspects of experienced temporality, the larger part of physics' explanatory power into the abyss of "mind-dependence".

In conclusion, it does not seem plausible that a workable model for coherent physicalist atemporalist reconstruction of the structure of apparent temporality has

been found. This by no means proves classical temporalism which is connected with equally serious problems. But it weakens the idea that a coherent understanding can be achieved on the basis of physicalist atemporalism, and it pushes us either back into the antimetaphysical idea that we should renounce on requirements of coherence beyond local language games, or forward to the construction of new models of temporalist accounts.

### Temporalist anti-scientist responses

A third main group of traditional responses to the clash is based on *temporalism*. Explicit temporalism is very often formulated in reaction to scientific atemporalist understandings of time.

On temporalist views, immediate experience and participation in life gives evidence of a fundamental immediately evident fact of temporality. "Change", "becoming" and "passage" express something which is not only immediately evident, but also necessarily involved and presupposed in the experience and understanding of everything else. So if physical concepts of time are in conflict with this fact, this is taken to show an inadequacy or limitation in these physical concepts. Thus we repeat in a certain sense the structure of the atemporalist response: the idea of a fundamental or true time whose nature is adequately expressed in concepts belonging to the one side of our clash between spacetime and becoming — and whose nature is distorted in concepts on the other side. But the roles are now reversed so that it is time as a continuum, as in scientific and technical use, which is diagnosed as the derivative and perspective distorted view of time. It is in this sense that temporalism tends to link with anti-scientism<sup>20</sup>.

### Characterizing "temporality".

Temporalism takes a dynamic concept of temporality to express immediate fact. But what counts as belonging to this fact and its expression? In our discussion so far we have taken temporality loosely to imply a realist interpretation of experienced time, and to include some more or less overlapping commonsense and common language features such as *nowness*, change, passage of time, modal difference between past and future, and unidirectionality — but is this list complete, and does it point to a singular phenomenon or concept at all? We have already seen a certain ambiguity

---

20) I use the term "anti-scientistic" for such a response, not in the sense that the attitude necessarily involves hostility towards the natural sciences — it may and may not — but only in the restricted sense that it rejects the "scientific" idea that the results of natural science provides the answers to fundamental ontological/metaphysical questions. Anti-scientism is the view that science, whatever other virtues it may possess, teaches us nothing about such questions

regarding which aspects of “passage” that the atemporalists should be required to reconstruct as a perspective effect. As we saw, the answer to this question strongly affects the plausibility of the atemporalist argument: if the atemporalist is given the entire benefit of the doubt and is only required to account for “nowness” the argument is much stronger than if the unidirectionality of e.g. memory and causation is included.

So it is part of the philosophical project of a temporalist response to provide a systematic expression of temporality in the first place. Temporalist philosophers may point out that it is exactly because change and becoming have been bracketed out by theoretical thought that we have very explicit concepts of temporal extension but very vague concepts of temporality. But a temporalist response to the clash which does not simply fall back to anti-metaphysical claim of incompatible discourses, must assume a twofold task: first, temporalism must be defined and then the construction of physical time, time as extension, must be accounted for.

### Classical temporalism.

It is probably necessary to first note that some proponents of temporalism in the classical form of “passage” may not agree to be committed to this kind of project at all. They may take temporality to be already explicitly and coherently captured by an unambiguous referent of common speech of past, present and future, identified as the passage of the now as a variable assuming in turn each point through the continuum of extended time as value. Hence they would not criticize concepts of “technical” time as derived or distorted; they would merely claim the need for adding the concept of passage (analogous to McTaggart’s A-series of passage simply being superimposed on the B-series of extended time). In fact classical temporalism expresses temporality in a way completely *dependent* on an underlying concept of extended time. Hence classical temporalism is a compromise response, attempting to give a realist construal to extension, and to passage-through-extension at the same time. However our initial question in this article was just the problems of incompatibility in such a classical compromise<sup>21)</sup>

---

21) Apart from our acute problem arising because SR cannot accommodate classical simultaneity, there is the tradition of arguments for incompatibility of temporal extension and passage, from Zeno to McTaggart. A third problem in this approach is that its metaphysical concepts of present, the now as a point in a mathematical continuum, doesn’t correspond very well with the experienced present held to be its immediate and unquestionable evidence, since the “specious moment” of experience does not have the character of a point of zero extension -- or of an open or closed interval with any other constant extension for that matter -- rather immediate experience contains changes and movements of finite duration, durations of a length varying with the type of experience, and even with apparently varying degrees of acuteness or immediate present-ness. Of course temporalist thinkers have tried to take these problems into account. They might do so by distinguishing sharply between the apparent now of experience and the real physical now -- but this strategy leads back to physicalist “explaining away” of experienced temporality, and hence to giving up the possibility of appealing to the evidence of immediate experience. Or they may do so by moving forward to a more radical and modern version of temporalism in questioning the nature of underlying temporal extension.

### Modern radical temporalism: Bergson and Heidegger

A tradition of much more radical formulations of temporality took shape in the beginning of the 20<sup>th</sup> century, explicitly developing alternative accounts of temporality, not framed by notions of extended time, but based more explicitly and exclusively on the concrete experienced/lived world. Bergson and Heidegger developed particularly explicit and influential suggestions of such a radical temporalism. To radical temporalism, the continuum of time is not an underlying structure which simply needs to be supplemented with temporality in the shape of the now point, it is rather that temporality itself is basic and has a character completely different from extension, so that extended time is an abstraction or construction out of it, useful for particular purposes.

### Bergson’s natural temporality.

In Bergson’s account, temporality is a fundamental common nature of all kinds of existence — mental and biological aspects of human life as well as non-human nature, organic as well as inorganic, subjective as well as objective aspects. The common ground is continuous change. It is essential to Bergson’s point that continuity and change are two aspects of the same phenomenon, that they are ultimately joined just as they are in concrete experience. Bergson’s term for this original phenomenon of temporality is “temps duree”. One might be tempted to translate this into “time of duration”, but “time of ongoing” is probably more precise. In any case it is essential to grasp the sense in which Bergson uses “duration” here: it is definitely not meant to invoke the idea of an interval in a mathematical continuum of time, rather he would have us look at the actual concrete present as experienced and lived. The suggestion is that if we let awareness be with this immediate fact rather than the abstract understanding of it via acquired concepts of extension, it will clearly exhibit Bergsonian “duration”, ongoing continuous change, entire movements rather than abruptly divided sections or unmoving moments..

This Bergsonian original fact of temporality is described as rooted in immediate experience in a very concrete bodily way. Insisting that it is not a phenomenon of disembodied consciousness, Bergson refuses to reserve it for conscious or even living beings, it is essentially a feature common to everything deserving the word concrete. He takes the full consequence of this idea of concreteness: the apparent absence of temporality from any description or understanding of something is considered the archetypical product of abstraction. Continuing a romantic tradition, Bergson considers abstraction as foreign and hostile to the concrete fullness of life which is rather available in intuition and aesthetics. Indeed he proposes an aesthetic

cultivation of sensibilities for concrete fullness, in order to counter the increasing narrowing of intuition through technical project fixation and abstraction<sup>22</sup>).

Yet Bergson is not simply for art and poetry and against science, rather he tries to propose an understanding and ideal of real science as something beyond mere abstraction — again continuing a romantic line of thought strongly reminiscent of Schelling's. This is essential in order to understand Bergson's outspoken interest in scientific developments, particularly those which concern the understanding of time and development, such as biological evolutionary theory and the theories of relativity.

As a consequence of this insistence on omnipresence, in concrete reality, of becoming in a suitably radical sense, and of the insistence on the ontological primacy of concrete life and experience, Bergson arrives at conclusions with very direct bearing on Einstein's SR and its interpretation.

Firstly, Bergson claims that SR does not have to be understood as contradicting the central intuition of temporality if temporality is construed along the lines of Bergson's *temps durée*, and if one drops certain restrictions on the full and radical appropriation of relativity. They are restrictions stemming from the implicit continuation of classical assumptions, restrictions Bergson charges Einstein of not

---

22) According to Bergson, in order to find and express the character of lived time it is not sufficient that we take before us what we have become accustomed to consider to be moments of our immediate experience; we need to "cultivate our sensibility" appropriately. Artists can play the role of developing and communicating such a sensibility, because they are able to step back from the focus of divisions, projects and future hopes and fears — they are depicted as heroes departing from their immediate self-interest in order to return with something much more valuable for humanity: something which can help relieve the painful condition of living in a "dead" world of abrupt moments and immutable structure. Clearly these heroes exhibit a striking similarity to the platonic heroes who ascend from the cave of shadows into the true light. Indeed Bergson compares his procedure with the platonic detachment from immersion in practice. But the cultivation proposed is to go in the exact opposite direction, at least opposite to the standard understanding of platonism which Bergson too identified with the dominant abstracting and theorizing tradition: it is a cultivation away from abstract ideals, into the senses and the immediately experienced phenomena.

There is a further point regarding platonism, pointed out to me by Thomas Schwarz: It may be argued that Plato's intention was in fact not so different from Bergson's, this will depend on the interpretation of the platonic notion of Form, a discussion I will have to bracket out in this article. Bergson clearly expresses a very general trend which could be characterized as an increasingly radical "aesthetic turn" through romanticism, German idealism, phenomenological philosophy, Nietzsche and many others, a reaction to abstraction and a movement towards the concrete, the immediate and the sensual. One significant early result of this reaction is the formation of the concept of aesthetics. In Hegelian dialectics the ascending movement of distinction, understanding and concept formation is systematically interwoven with a descending movement of concretion, expression and embodiment, and it might be argued that Plato's dialectics should be read in a similar manner and not with an isolated emphasis on the ascending move. In the Hegelian picture positive stabilized abstraction is as inadequate as unreflected immediacy, the task is the development of richer concepts able to merge with apparently immediate and non-conceptual actuality. However many of the more radical exponents of the aesthetic turn after Hegel would find too much of a compromise with ascending, "Apollonian" platonism in Hegel, and insist on a pure "Dionysian" descent not forcefully controlled or subtly infiltrated by, and ultimately subsumed under, Hegelian/platonic Reason. Thus, the turn away from a tradition primarily represented by Plato continues to be a common theme in an impressively wide range of philosophies continuing now into its third century the tradition of aesthetic turn against the tradition. Although the descending moment of dialectical movement might be argued to be as important as the ascending in Plato himself, this anti-platonic turn could be argued to be necessary because of the one-sided emphasis on ascending abstraction and changeless form in the neo-platonic stream of influence in the modern sciences or perhaps rather in their dominant philosophical interpretation

being able to overcome. Therefore, according to Bergson, Einstein was unable to grasp the full radicality of his own theory. As you will see I suggest we follow Bergson in all of this.

However Bergson also suggests that the intuition of radical temporality, allied with the core insight of relativity, reestablishes the threatened idea of a cosmic, ontological simultaneity, the common state of affairs of modality. Here unfortunately Bergson has made his case for temporalism inconsistent, easy prey for refutation I will take a closer look at Bergson's most central and technical argument for this. It contains a rather simple error mysteriously overlooked by Bergson, and perhaps even more mysteriously it forces Bergson to embrace a classical McTaggartian picture of the relation between extension and passage.

### Bergson vs. Einstein on duration and simultaneity

Bergson uses one of Einstein's classical examples or thought experiments, used to illustrate the notion of inertial systems and the derivation of the famous relativistic effects including time dilation and relativity of simultaneity relations. In Einstein's example, a train and a railway (and embankment) correspond to two inertial frames of reference, i.e. they are both unaccelerated but there is relative movement at a speed assumed high enough for relativistic effects to be notable. The only further piece of furniture in the Einsteinian example is two strokes of lightning hitting each end of the train. As is well known, Einstein's project is to work out the consequences of assuming that the laws of nature, including the speed of light, are invariant to change of inertial frame of reference. Since this turns out to be in conflict with the classical assumption of an absolute relation of simultaneity, Einstein avoids making that assumption in the first place and ends up disproving it. Retaining the speed of light as an invariant he can introduce standards based on it, for measurement of length and for simultaneity, unambiguous but *relative* to either train or embankment, i.e. to the frame of reference. Basically this is all Einstein needs in order to derive the famous rules of transformation computing measures of time, length, mass etc. in one inertial system from those in another, given their relative velocity.

(What Einstein derived from the assumptions illustrated by the train example is of course, as far as the formal expression is concerned, the Lorentz transformations which were already well known. However Einstein gave them a new radical interpretation as transformation rules between frames equally valid rather than deformations in relation to a fundamental frame. Bergson was eager to embrace this equal status of frames of reference — which was, for Bergson, the core of relativity and a support for the claim of a true immediate time inherent in every concrete phenomenon.)

Bergson complains that Einstein's interpretation of his own procedures takes the computed abstractions for real time and space and forgets the immediate fact of

temporality which is, for Bergson, what relativity should be about. There is a true or proper time for any frame of reference — this of course is in accordance with Einstein's assumptions except that Einstein would object to any ontological significance of "true", it just means the reference system is fixed to the clock(s). For Bergson true time is identified with the immediate time for some concrete dead or living thing, or a group of such things, and this is the only time which could possibly be experienced or observed. The modified times and spaces described in the Lorentz transformations are not real and particularly they are not observable, Bergson claims, they are abstract calculations and constructions for coordination. Thus, the "dilated" time in the train, as calculated by an observer sitting on the embankment using the  $t'$  Lorentz transformation, is not real, it is what would be the case for an impossible "observateur phantasmagorique" experiencing things from a perspective (the train's) moving in respect to its own body at astronomical speeds. The real and observable is what is available to a real observer — who is always a concrete living being in a concrete physical environment, Bergson reminds us — a concrete being in his own real time, the only time real and observable in his body's frame of reference.

This leads Bergson to a frontal attack on Einstein's use of the train example (and the generalized mode of derivation it is meant to represent). The argument is extended and full of brilliant phenomenological arguments concerning the need of understanding abstractions of time in their connection with concrete temporality, but as far as relativity and simultaneity is concerned the hub of the argument against Einstein can be stated as two rather simple points. (And, unfortunately, it is also rather simple to show this technical hub of Bergson's argument to be faulty.) First, Bergson insists that the equal status of all inertial frames of reference means that all relativistic effects, such as "time dilation" are perfectly mutual and symmetrical -- since obviously clocks at rest in one frame of reference move in the other, just as much as the reverse -- and no matter whether we are in the train or on the embankment the time of the other system always *appears, in abstract calculations* to be dilated whereas concrete time is not. Since it cannot possibly be the case that time measured or experienced on the embankment is shorter than that in the train *and* that it is shorter in the train than on the embankment, and since by "complete relativity" the relativistic relation between the two real times is taken to be fully mutual and symmetrical, they cannot really be different. Secondly, Bergson claims, it is not legitimate to analyze events happening within some real rigid object (such as the train) using a frame of reference different from that fixed to the object itself (such as that fixed to the embankment). Thus Einstein's analysis of the train-in-the-thunderstorm example, assumed to demonstrate two lightnings simultaneous in the embankment system are non-simultaneous in the train system, is illegitimate because it tacitly assumes the embankment system to be the true and fundamental framework

for analyzing train happenings, thus overriding the constraints of "complete relativity". Whence its false and contrainuitive conclusion, according to Bergson.

These two main points in the technical aspects of Bergson's argumentation are not just in disagreement with Einstein's theory or its interpretation -- they clearly violate and misrepresent the theoretical structures and procedures they are supposed to show the inconsistency of. Therefore, it is very difficult to construe this part of Bergson's argument as anything but erroneous. Milic Capek has written an insightful exegesis of Bergson's critique of SR, convincingly showing many aspects of it to be "still alive", at the very least in the sense that Bergson's claims are worthy of further discussion. What Capek shows to be alive are those aspects insisting on a concrete temporality underlying the production of abstract time and on the claim that SR and the Lorentz transformations can be seen as respecting rather than violating the constraints imposed by concrete temporality, including the constraints imposed by causality (unique seriality within any chain of causal relations). However, even Capek has difficulties making the most essential distinction between what is living and what is dead in Bergson's critique -- in fact he blurs that distinction by trying to partly defend (even while admitting some moves to belong to the "dead" part) Bergson's failed attempt at showing frame-independent simultaneity to follow from, and to be necessary for, concrete dynamic temporality. By doing so, Capek unfortunately invites the continuation of the idea, held by Bergson, Einstein and almost the entire ensuing discussion, and expressed in the very title of Bergson's book *duree et simultanete*: the idea that the issue of dynamism under SR is the same as the issue of simultaneity. I have separated my treatment of the technical nature of Bergson's erroneous argument from the main text -- the reader who shares my delight in toy trains will find it below ("insert/illustration 2").

It is interesting in this connection to notice that Capek points, as part of his conclusion of his exegesis, to Whitehead's treatment of the problematic as a restatement of the Bergsonian project of a temporalist reinterpretation of SR avoiding some errors of Bergson's argument, and that even Bergson himself, in footnotes added to the second edition of *Duree et Simultanete* refers to Whitehead's sketchy treatment of it in *Science and the Modern World* (1925) as a resource, but obviously Whitehead's separation of the issues of becoming and simultaneity did not even enter Bergson's considerations. As I will argue later Whitehead's solution of the problem was not fully expressed before *Process and Reality* (1929), so Bergson is well excused for not having grasped it. In Capek's reading of Bergson as well as Whitehead it is unclear whether the separation of the two issues is understood as a possibility.

Merleau-Ponty, too, saw something very important — not just philosophically important but culturally — in Bergson's critique of SR. It represents an "offer to Einstein" of re-humanizing physics, of making it possible again to reconcile the

constructed world of physics and technology with the life world — thereby restoring some “classical” trust in reason — reason which is otherwise in a deep crisis because we are increasingly used to scientific or other procedures “reasonable” by accepted standards producing alien, counterintuitive and even threatening to life. The offer consists in the notion that

*“relativity could be reconciled with all men’s reasoning if only we agreed to treat multiple times as mathematical expressions, and to recognize — this or the other side of the physico-mathematical image of the world — a philosophical view of the world which is at the same time the view of existing men.”<sup>23)</sup>*

Merleau-Ponty touches on a very important aspect of Bergson’s project: rather than antirational or antiscientific it attempted to contribute to a more thoroughly rational way of scientific constructing and changing the world we live in. However, even Merleau-Ponty follows Bergson in identifying, without discussion, becoming and simultaneity:

*“this physicist’s reason, invested in this way with a philosophical dignity, abounds in paradoxes and destroys itself, as it does for example when it teaches that my present is simultaneous with the future of a different observer sufficiently distant from me, and thereby destroys the very meaning of future.”<sup>24)</sup>*

Bergson and his two eminent followers insist that classical form of the intuition of temporality must constrain relativity and other scientific constructions. By doing so they all overlook, not just an internal inconsistency in their own position, but also an important possibility of learning something from the development and refinement of scientific construction of the non-human world about that core of the human self, temporality. Even if they all share in an important sense of affirmation of the rationality of the scientific project in their emphasis on building an intelligible connection between scientific world (and time) and lived world (and time), the connection they try to build has the form of a one-way corrective from a lived world, thought to be thoroughly understandable on a priori grounds, to the scientific world. In other words, the scientific process cannot enter constructively the ongoing project of expressing and shaping what it is to be reasonable, natural and human, the project of expressing intuitive tacit rationality, the metaphysical project.

This remark does not represent Bergson’s general intentions. For example, it is very obvious that he took the scientific discovery of the immense history of nature, and especially the enfoldment of the evolution of humanity into that process, as an insight

23) M. Merleau-Ponty: *Einstein and the Crisis of Reason*, *Signs*, (1960/1995), p.196

24) *ibid.*

of great philosophical potential for human self-understanding and self-expression — a potential whose realization he was eager to contribute to. The fact that such a development of metaphysical understanding in concert with the development of scientific constructions has been a major project for Bergson only makes it so much more striking that he and his great followers were unable to see the implications of SR as a potential of developing and refining the notion of temporality, claiming in effect that the intuition of temporality is absolutely and unquestionably dependent on frame-independent simultaneity. As we shall see it is not, but this simple observation is peculiarly absent, not just in Bergson, Merleau-Ponty and possibly Capek. What we are questioning must be an extremely deep-rooted tacit assumption.

#### **Insert / Illustration 2:**

##### **Trains, embankments, clocks and rigid measuring rods**

*I cannot help commenting on a few of the delightful details in the train example and in Bergson’s treatment of it — they can be skipped by readers who don’t share this fascination. The two strokes of lightning are said to be simultaneous in the embankment inertial system. Since laws of nature, particularly the speed of light, are invariant to the choice of coordinate system, they can be simultaneous if and only if the place two light pulses emitted from the two events meet is a position half way between the sites of the two events. The collision of the two light pulses is well defined and its position could be recorded by having an observer sitting there on the right spot to be able to report of the simultaneous reception of the pulses. This procedure of establishing simultaneity is represented in the left half of the figure. The figure is a space-time diagram, units are chosen so that the propagation of the light pulses is shown as a 45° slope (dotted line). As the dotted lines intersect exactly half way between the strokes (along the  $S_e$  axis) the movement of the train, proceeding at a lower velocity, is shown as a steeper slope (vertical line = rest). The right half of the illustration shows the same events as mapped by the train’s inertial system — now the moving object is something fixed to the embankment, say a railway station.*

*The left part of the graph is sufficient to illustrate why, according to Einstein, this carefully constructed simultaneity in the embankment system must imply non-simultaneity of the same two events as observed from within train: the meeting point of the light rays is half way between the two sites of the strokes on the embankment but it is not half way between the two sites in the train — this is seen by noticing that the middle of the train has moved in the meantime, away from that halfway point on the embankment where the rays meet. Bergson complains that this treatment of happenings in the train — the movement of the light and the marking of the meeting point — using the embankment system of reference introduces an asymmetry by assigning a more fundamental status to this system. But Einstein’s procedure is perfectly symmetric, as the right half of the illustration shows. The same structure of events can be mapped using the train’s system. Now the two strokes are not simultaneous, but we can see why they appear to be so from the embankment because the halfway point moves into exactly the right position by the time the rays meet. However, we could find another pair of events*

(represented by the circled  $E$ 's) which now fulfil the criterion of simultaneity — and they will be non-simultaneous in the embankment system for reasons completely symmetrical.

(The same point can be made in a more formal and less graphical way by noticing that the Lorentz transformation which gives us the time difference in the train's system as a function of that of the embankment's system,

$$t_i = \frac{t_e - v s_e}{\sqrt{1 - v^2/c^2}},$$

if solved for  $t_e$ , gives exactly the same expression except that the subscripts are exchanged and the sign of the velocity reversed. Therefore, again, no harm is done to symmetry when we take it for a real observable fact that  $t_e$  is different from zero while  $t_i$  is zero, because the reverse is true as well.)

As even Capek admits, Bergson's claim of the non-observability of relativistic effects such as time dilation is misguided. It is perfectly possible to establish, using Einstein's procedure, a network of timekeeping and measurement in any given inertial system, and then to observe with reference to this network e.g. the ticks of a clock in movement. In this way it is observed that the moving clock's pace is slower than that of perfectly similar clocks fixed to the reference system, and we now have good experimental confirmation of such effects in particle physics. Furthermore, when the speed of light is constant and independent of the choice of inertial frame of reference — and Bergson follows Einstein in making this assumption — it follows that distant clocks fixed to the same inertial frame can be synchronized via light signals (using the fact that a light signal traveling from A to B and back to A again will hit B exactly half way between the time of emission and the time of return). Claiming to accept the special principle of relativity, even in a radicalized form, Bergson must affirm the validity of this procedure as a criterion, if not as a fundamental definition, of simultaneity. But then it follows, as in the train example, that the relations of simultaneity are not conserved between frames of reference.

Bergson's attempt to avoid this conclusion is the claim that the concrete simultaneity perceived by concrete observers can be described reasonably by the physicist only as long as the description is based on the observer's own inertial system. Therefore he starts his analysis of the example with the simple fact of two simultaneous events ("Lançons maintenant nos deux éclairs."). It follows from their simultaneity and from the symmetry between the two inertial systems that the light pulses meet half way between the strokes in the train as well as on the embankment, thus fulfilling the criterion of simultaneity in both systems, Bergson claims, but this will be observable in each case only for observers in that system. This has the incoherent implication that while events like lightnings happen at frame-independent places, as Bergson affirms that they do, the singular event of the meeting of the light rays would be observed to happen in two different places, the two midpoints which are now distant from each other. Bergson would probably claim that this is only an apparent inconsistency, arising because we take the physicist's constructed times and spaces for the concrete ones — but this would leave us completely in the dark as to how to coordinate physical situations where observers, trains, clocks and other receivers and transmitters of impulses do in fact move relative to each other. In fact Bergson himself claims a precise correspondence between concrete and physical time, in his insistence that the meeting of the two light pulses, being "concretely" simultaneous, must be observed in both middle points. But claiming such a correspondence one must accept the commitment to modifying either physical or philosophical time so that physical time can describe events coherently again.

Again, Capek admits that the claim of the unobservable character of relativistic effects (i.e. the modified coordination of events in other frames of reference) cannot be upheld. But as we just saw, this claim is necessary for Bergson to avoid the collapse of his treatment of the train example. However Capek gives a number piecemeal defenses of Bergson's arguments in order to show the viability of Bergson's main intention. Firstly, Capek finds the claim of unobservability of time dilation to be partly justified by the fact that no one will ever observe his **own** time to be dilated. This is tautologically true as dilation is defined as a difference between two measures of time, but it has no bearing on the central issue: the observability of the ticks of a moving clock. Secondly, still within the train example, Capek claims that the idea of an embankment from which one can measure and time events in a train moving close to the speed of light contains the unrealistic

idealization of the existence of a rigid object of the immense length required for it to be used in practice to hold the necessary clocks and marks in place (immense because of the high speed required for relativistic effects to be observable). However, just as the train moving close to the speed of light needs not be implemented by a diesel engine, the solidity and rigidity of the embankment in the example could be exchanged with e.g. a system of equidistant light pulses emitted from several sources, at least if we have a few small rigid rods and reliable clocks somewhere, to start the system of pulses according to Einsteinian procedures. If Capek were to object to this by stressing the difference between real concrete objects and scientifically constructed ones, reserving relativistic effects for the latter, he would be abandoning the entire Bergsonian project of interpreting the Lorentz transformations as valid in a temporal world. Finally, Capek claims that Bergson should not be construed as reverting to a non-relativistic notion of absolutely simultaneous events. This is not so, Capek says, because Bergson urges us to give up the notion of a punctiform moment and replace it with durations, so that there is simultaneity of durations and processes, not of events. In the concrete world, what is happening presently and simultaneously has a finite temporal "thickness", in other words. I think this is a deep and important aspect of Bergson's account of temporality, but in respect to SR it makes simultaneous temporality no less absolute and non-relativistic as long as the thickness of this durational present is, at some distance, thinner than the span between the light cones of any given punctiform event or extended process (see fig. 1) — that is, as long as the thickness of the present does not pass to infinity destroying again, paradoxically, the central idea of difference between past and future. Thickness may be a very good point about temporality but it doesn't defend the insistence on frame-independent simultaneity — this is still incompatible with SR.

In the discussion of the train example I have touched several times on an aspect of relativistic time it brings to light: the active maintenance and construction required for temporal coordination. In the Newtonian picture, simultaneity and lengths of time are unquestioned, they inhere in the simply given conditions; in the Einsteinian picture they are incarnated in meticulously organized activities of moving clocks, aligning measuring rods and transmitting signals. Or, at least the constructivist picture of them as incarnated in such activities emerges in Einstein's presentation of the derivation of SR, and particularly in his early writings on the subject, whereas the later Einstein appears to have developed a more thoroughly absolutist or realist attitude in which Minkowskian space-time simply replaces Newtonian space and time in the role of given conditions. Clearly, with the atemporalist attitude Einstein expresses in the famous letter quoted at the beginning of this article, he could not regard the activity of constructing as really making a difference; and hence his generalized prescriptions for the procedures would be interpreted, by himself, as the temporal tool for reaching atemporal insight, something akin to the ladder in the end remark of Wittgenstein's *Tractatus*, to be thrown away after it has been climbed. Bruno Latour has given a beautiful exposition of the central role played by timekeeping and coordination of time systems in Einstein's presentation of SR — Latour's focus is on the underlying social agenda of representation, delegation, mobilization and dissolution of privileges, an aspect of relativity apparently far removed from the metaphysical issues treated in this article — but they are connected as we shall see. Latour also suggests that the choice of a train for the example is not arbitrary, that in fact Einstein's work is largely shaped by a (particularly Swiss) preoccupation with vehicles, precision, clocks and timetables. Another great resource discussing the role of the train in the modern construction of time and space is Schivelbusch's "The railway journey" — note especially the work of producing "railway time" necessitated for coordinating traffic in early railway companies as they transcended local communities and their simply coordinated clocks. No image expresses the work of simultaneity production more vividly and concretely than that of the railway officer with the solemn task of traveling back and forth every day carrying a clock<sup>25</sup>. In spite of his insistence on concreteness and becoming, Bergson was never able to consider simultaneity as something which had to become through such concrete measures.

### Heidegger's temporality without nature

25) Wolfgang Schivelbusch: *The Railway Journey*, 1979, p. 43

Heidegger was very much aware of the fundamental difference between his radical notion of existential temporality and the extended time of physics, measurement and chronology. In sharp contrast to Bergson he made no attempt of building compromises but rather emphasized the need of keeping them apart, not “falling” prey to the tendency of understanding temporality and existence in the light of nature. For Heidegger this tendency is a constant pull towards inauthentic understandings of temporality, not just inauthentic in the sense of a misrepresentation but in the more radical sense that it leads us to *live* inauthentically, in the impossible attempt of escaping the openness and responsibility inherent in true temporality which is basically *situated agency*. Furthermore this tendency always provides us with the most immediate, available and well-known grasp of time — the time as available within our projects rather than the temporality unfolding them — so that a determined, authentic attitude is required in order to stay clear of it. Thus, in Heidegger’s version of radical temporalism, the contrast to notions of extended time is seen as a virtue, something to be insisted upon rather than overcome.

Also in contrast to Bergson and Merleau-Ponty, common sense is taken as mostly an expression of the inauthentic and fallen understanding of time, rather than a major resource supporting the expression of more adequate concepts of time. However, this immediate “fallen” character of commonsense understandings is not their exhaustive characterization according to Heidegger — if we were in such as state of complete illusion, Heidegger’s hermeneutic-phenomenological project, aiming at digging out the more fundamental and authentic sense of things by attentively starting from what and where we are, i.e. from the practices and understandings we are already involved in, could not even get started. So that probably a more precise rendering of Heidegger’s view is that common sense is ambiguous, that it is some kind of mixture of authentic and inauthentic understanding of temporality, but a mixture which generally leads us to insert a few patches or echoes of genuine temporality as subordinate features in a picture dominated by inauthentic, “vulgar” time. In this way, a first attempt of giving a Heideggerian account of the commonsense notion of passage might find in it an echo of authentic temporality, vaguely represented into quantitative time through reduction to a point, the now, placed in the continuum. In the adequate and authentic understanding Heidegger wants to further by philosophical means, the roles are reversed so that it is extended time which is enfolded in temporality as a particular “derivative mode” in a way we shall return to shortly. Heidegger does not accept such a pointlike commonsense notion of presence as an adequate representative of true temporality — as most thinkers in the temporalist camp have done. In fact there is an important sense in which Heidegger does just the reverse, focusing on agency in combined terms of future (possibility) and past (situatedness) rather than presence (facts, states and things). This is significant. It means that Heidegger’s account can be taken to imply

that presence, and hence co-presence, is not a fundamental and universal feature of strong temporality, but a derivative and local one. As we shall see, this implied insight is really the core of the Whiteheadian reconciliation between relativity and temporality I am suggesting, but Heidegger did not explicitly work out the implication that co-presence is a derivative, local and mediated pattern of relational time, and furthermore he emphatically avoided the connection between temporality and nature, particularly nature as channeled through science and technology.

Indeed it seems that Heidegger was aware that SR posed particular problems for notions of temporality. In a footnote [henv] in *Sein und Zeit* (the only reference in the entire book to any details of modern science and technology except for one remark on the signaling devices on automobiles) Heidegger insists that the implications of SR for the understanding of time can only be discussed and understood once we have found and explicated the existential sense of time and take it as the basis. Heidegger may very well have written this with Bergson’s hopeless struggle against Einstein in mind, wishing to stay clear of any such commitment towards any one notion of physical time rather than another. On Heidegger’s view it is rather that any construction of physical time is bound to be so much of an externalization and hypostatization of a certain aspect of the temporality of practice that contradiction should be expected rather than avoided. Hence a genuine coherent understanding of the relation would only be possible by reducing any physical notion of time to the role of a practical bookkeeping device, so derivative as to have no ontological significance beyond that opened by a hermeneutics of its underlying practice entirely independent of its technical details. On the face of it, this denial is all that Heidegger has to offer us as an answer to the contradiction.

The denial is closely related to a fundamental split in Heidegger’s account of the way “vulgar” extended time gets constructed. The basis is the project character of human existence, which interprets itself inauthentically into the three temporal modalities (“extatic modes” as Heidegger calls them, i.e. temporality projected “out of itself”). This accounts for the structure of the notions of past, future and present, and Heidegger points out, in close accordance with Prior’s idea of a temporal logic, that all other temporal notions can be constructed out of these. But of course this cannot possibly account for the actual content, the events placed in these “regions”, or the regularity in these events allowing for a sequentiality of an appropriately rhythmical character to allow for the properties of real chronologies, calendars and clocks. Therefore, in order to account for these, Heidegger makes a reference to *something* completely different confronting existential temporality as a background of its projects. This something is the rhythmical sequence of day and night, the movement of the sun making the frame for the workday and the “antique peasants’ clock” allowing project-involved existing beings, e.g., to meet at a previously agreed time. This reference to nature constitutes a peculiar break in *Sein und Zeit*’s developments

which have, up till this point towards the very end of the work, been programmatically in non-natural, existential terms. Just because existence is considered so perfectly transcendental, the metrical and topological properties of “vulgar time” have to be of a completely different origin, the realm of pure unmediated nature. But this implies that existential temporality has no bearing whatsoever on the question whether or not the rhythms of nature allow for an unambiguous definition of simultaneity.

[The problem is that the two moments are held so utterly separate, so that existential time is supposed to be already completely and unambiguously available at any meeting between existence and nature — so that the classical modalities, and particularly the present, still function as a transcendental condition for the encounter. From this follows the traditional requirement that all events be ordered in a unique sequence, allowing at any time and place the allocation of any event, causally connected with the actual existential subject or not, to one definite temporal region: past, future or present.]

Heidegger had the profound insight that presence is a particularly derivative mode of temporality rather than the paradigmatic mode of being. But he avoids making the kind of connection between natural and human temporality which could allow this insight to solve the puzzle of simultaneity and becoming. Instead, he amplifies the contradiction by claiming that nature is at the same time the unmediated background of rhythm for practice and irrelevant for temporality of practice itself.

Bergson’s explicit attempt to handle the tension between SR and becoming failed because the notion of dynamic time he claimed “complete relativity” to be consistent with was, in the end, loaded with a classical metaphysics of presence undermining the relativity. Heidegger, although he went very far in overcoming this metaphysics, claimed his further radicalized temporality to be so much devoid of nature, and particularly so much in contrast with the constructions of natural science, that nobody, and least of all Heidegger, may have noticed the constructive solution to the paradox it makes possible. Very generally, radical temporalist responses to the clash have tended to fail in this respect because of anti-scientistic reservations, and moderate temporalism because of its reliance on the classical notion of simultaneity.

### Whitehead’s “new” solution: radical but local temporality

None of the accounts discussed so far have dissolved the contradiction between special relativity and temporality by taking both seriously. They have taken either SR, becoming, or both, to be without ontological import, to carry no specifications on what is actually or could possibly be the case in the world.

Of course it may well be too naive to imagine that the two kinds of language, the everyday talk about “today”, “tomorrow”, “a minute ago” etc., and the physical calculations involving (space/) time systems  $t$ ,  $t'$ , etc., are fully accountable for as simply representations of context-independent facts. There are many good reasons why both of these language complexes are incurably something richer and more interesting than just representations of the same pool of context-independent facts, with a difference only consisting, e.g. in the selection of different subsets of this pool and some different procedures of projection and representation. They are something richer and more interesting because they are also aspects of collectives and practices involved in the making of facts and perhaps even the making of conditions for something to be a fact in the first place. I am not going to discuss in this context the various modes and models of constructedness and historicity of facts; I have done so in a previous article on the historicity of scientific objects<sup>26</sup> — for further reference to the very extensive current debates on modes of scientific realism and constructivism see e.g. the most recent works of Andy Pickering or Bruno Latour and their many further references<sup>27</sup>.

Still, the conflict we have been discussing about temporality is really so basic that it is very hard to see how it can be dissolved through the reference to involvement, contextuality, historicity and constructedness, unless these are taken in a sense of a very extreme kind of skepticism.

If there is any such thing as a fact and not just a collection of incoherent states of mind and discourse, then either there are temporal facts (e.g. that you have *already* read the previous sentence) or there are only atemporal facts (e.g. that you have read it before November the 30th, 2097). And if there are temporal facts, then either they have the universal character generally assumed in Western metaphysics before Einstein, or they do not.

In other words, Bergson was right that no matter how much contextuality is involved, we cannot seriously hold at the same time that there are concrete facts involving distant simultaneity and that such facts cannot exist in the physical universe. Surely one could claim that they don't enter physical descriptions — if “description” is taken at a sufficiently theoretical level this is undoubtedly true — but clearly if such immediate facts of concrete temporality are there before clocks and measuring rods are used they will still be there when these things are employed. But if that is the case, then there will be an ontologically privileged system of reference, a set of events concretely simultaneous. But SR reveals that this will be a very strange sense of

<sup>26</sup> N.V. Hansen: *Interpretations of the historicity of objects*, *Philosophia* 25, 3-4 (1996), p.83-113 (Danish translation -- contact the author at filvig@hum.aau.dk for a preprint of the English version).

<sup>27</sup> Bruno Latour: *We Have Never Been Modern*, 1993. Andy Pickering: *The Mangle of Practice*, 1995, Andy Pickering: *Science as Practice and Culture*, 1992.



concreteness, since it will not be physically discoverable in any way. It will be one of a multitude of inertial frames of reference which will be, in any observable sense, equally valid. Unless Bergson or others will claim to have intuitive, non-physical access to knowledge about what happens on Mars or in Andromeda right now, the “concrete fact” would be entirely devoid of anything really happening in the world or really observed by anybody or anything. I should add that the way distant simultaneity has difficulty being concrete is another and much stronger sense than the one in which atemporalists claim passage and presence to be unreal — because clearly the present situation is very concrete, detectable and real if anything is, as long as we consider it apart from the question of what may be the case at the same time at very distant places.

This is the turning point of Whitehead's radical suggestion of a solution of the paradox. Whitehead shows that the problem is due to a traditional unreflected metaphysical prejudice about the form of a temporal fact — or more precisely, Whitehead gives an explicit account of a more general, concrete and flexible way of conceiving the form of a temporal fact. The idea is simply that a *concrete temporal fact is not global but local*.

I suppose I do not need to say much to show that such a notion of local temporalism would be a very satisfactory solution the paradox of SR and becoming, if the notion is thinkable at all. As we have seen, what creates the contradiction we have been discussing is that SR replaces the absolute relation of simultaneity and the equivalent unique sequence of events by a weaker constraint on the spatiotemporal order of events. But if real and concrete temporality can be conceived without dependence on the stronger constraint, then clearly the contradiction vanishes. In fact, Whitehead showed that the weaker constraint contained in SR is exactly what is needed.

This idea is so terrifyingly simple and solves the paradox so beautifully and completely that it is a very strange phenomenon in the history of ideas that it has hardly been considered by any other contributor to the rather extensive discussion of the contrast between relativity and becoming — not even after Whitehead proposed it.

Why not? When there is such a simple and complete solution why is its possibility not even known? I can think of two kinds of reason for this.

The first kind of reason is the way Whitehead presented it. He developed it as an integral moment in his general metaphysics of concrete Processuality, in his notoriously difficult main opus *Process and Reality*. This major work of 20<sup>th</sup> century philosophy is sadly neglected, but it must be admitted that Whitehead did not succeed in making it a user friendly introduction to his philosophy. Rather it is as dense and rich as, e.g., the works of Heidegger or Hegel, and unfortunately there are very few who read relativity as well as Hegel etc. Furthermore, the hermeneutic work of gaining access to a philosophical work of that kind of density is rarely undertaken unless one has the impression that it will be “deep”, usually because of its reputation

— which Hegel and Heidegger have much more of than Whitehead. A further complication is that Whitehead wrote another book entitled *The Principle of Relativity*, presenting an alternative formulation of the *General Theory of Relativity* but not the point about Special Relativity which is our focus here. This book is not nearly as dense as *Process and Reality*, and the result is that the rare occasions when Whitehead's contributions to the interpretation of the theories of relativity are discussed, the main contribution is almost always overlooked.

The second kind of reason is more philosophically interesting. Why does the appropriation of this simple philosophical point depend on the readability of Whitehead's *Process and Reality*, why did nobody else discover and present it? It is just very hard to grasp the idea because of an implicit metaphysics, probably one which carries on a particular theological content into a tradition which is no longer aware of being theological — a connection I will explore below. But for now, let me make the personal confession that grasping the Whiteheadian alternative was almost like a religious conversion — unfathomable before but simple and almost self-evident afterwards.

Therefore, just in case I am not the only one who is a bit slow in grasping it, in order to flesh out the suggestion of the Whiteheadian alternative I have already given, I think it will be expedient to first ask how it is that the traditional notion gets to seem so obviously true — the traditional metaphysical notion that a temporal fact must be global? In other words, why is the question of becoming always posed, by its friends as well as its enemies, as if either there are global temporal facts or there are none? It seems to be so deeply enfolded into our notion of time that it is usually taken to go without saying. Very few have given any kind of argument for it. But I did find, in two of the most reflected 20<sup>th</sup> century proponents of temporalism, some vague or partial arguments for continuing this traditional metaphysics into their formulation of temporalism.

The first one is Bergson who seems to seek support for the notion by an appeal to his very sympathetic idea of solidarity between human, organic and inorganic existence. They all share in immediate temporality he says (rightly, I believe), and he draws the conclusion that therefore they all share one temporal fact. But as soon as we ask if this really follows it becomes clear that it does not. The stars in the sky can have their own local temporal facts even if they are just as temporal as ours.

The other one is Prior<sup>28</sup>. He explicitly asks if it is possible, since SR seems to imply it, to entertain the notion that there are no global temporal facts. He rejects it with an appeal to our way of conceiving and expressing concrete temporal facts. We sometimes say, e.g., “Thank God, that's all over now”, and clearly refer to a very real and significant state of affairs. What we refer to, Prior claims emphatically, is

---

28) A. Prior: *Some free thinking about time*, Prior, In Copeland, B.J. (ed.) 1996. *Logic and Reality: Essays on the Legacy of Arthur Prior*. Oxford: Clarendon Press.

definitely something different from “Thank God, the end of that event is [atemporally] earlier than my utterance of this sentence” — in other words, we refer to what is in McTaggartian terms A-type facts rather than B-type facts. Prior takes this to demonstrate that there are facts of temporal modality — some things are now, some things are past, and then still other things have not happened yet but *may* come to be in the future (Prior, like other temporalists, would not talk of the future as having actual content). But I would like to point out that even if this kind of phenomenological evidence of temporality is basically valid, which I will not challenge, it goes just exactly as far as to demonstrating the existence of *local* temporal facts, and no further. The description of relief fueling Prior’s argument makes sense exactly when the past events in question are in the speaker’s local past, meaning the concrete past which is able to affect him, that which makes out his situation, that which is potentially knowable. The abstract idea of a non-local past provides no such fuel. There is no reasonable “Thank God, that’s all over now” about events which have happened on Mars during the last minute or in Andromeda during the last million years — events which are not yet part of the speaker’s causal past. Of course Prior may say that it is possible to think or even know some scheduled event — say, a friend’s exam — to be over at a distant place — say, on Mars. But then we will have to remind Prior that the problem posed by SR is just that there is no physically privileged time system to synchronize Prior’s clock with the one in the Martian University. Hence even if Prior will claim the existence of a metaphysically privileged time system, he will have no way of determining which one it is. He will either have to make an arbitrary guess of when to initiate his relief, or else kind of fade it in gradually over the approximately 10 minutes duration (depending on the variable distance of the planets) of the relativistic ambiguity of simultaneity — or finally he could postpone his relief till the event is definitely and unquestionably over, that is, till it is part of Prior’s causal past. I trust you will join me in recommending the third option to him, the only one which has anything to do with the way relief works in real life. And of course, what this demonstrates is exactly a local temporal fact, no more than that. Now, I can already hear half of my readers objecting to this mistreatment of Prior’s nice example. Why did we have to bring Mars into the story, when Prior was just making a point about ordinary solid temporality with an ordinary solid earthly example? Yes, I too am sorry to depart from the solidity of Earth and practice, but it is exactly what we need to do in order to find the kind of thing Prior’s earthly example *does not* imply, although he claims it to: global temporal fact. Prior’s example functions nicely locally and practically, and the kind of temporal fact it demonstrates is exactly as nicely local and practical.

Whitehead’s reformulation of what a temporal fact is should not be read as something far-fetched but rather as a (re-) naturalization: it is taken back into the concrete relations between real processes as they actually happen, and saved from the burden of carrying an instantaneous cosmic state of affairs — an ideal of global

simultaneous presence corresponding to the idea of the “God’s eye perspective”. But in this naturalization it is important to see that Whitehead preserves, even in a very radical form, the central insight of temporality: the ontological difference between past, present and future. But locally. (Also to some readers it will be important that the dissolution of the idea of a “God’s eye perspective” of classical and particular modern metaphysics does not have to imply the denial of God or Her involvement with the world — in fact, for Whitehead himself, a welcome consequence was a new possibility of conceiving such an involvement in more locally active terms, different from global omnipotence and omniscience.)

The point of departure is a simple concept of process which is made more and more explicit in a series of respects — expressed as 54 “categories” in the first chapter of *Process and Reality* — in order to avoid that traditional metaphysical notions of substance and time would reinstall themselves as implicit background, for example via an idea of a time and space that processes *happen in*. Instead, Whitehead gives a relational account of time and space as a system of certain kinds of relations between processes<sup>29</sup>.

This relational interpretation of time is of course a proposal well known at least since Leibniz argued it against Newton’s absolute view of time. It is also well known that Einstein, too, was influenced by this relationist tradition<sup>30</sup>. But just because Einstein and others have combined a relational view of time with an atemporal view — that is, a view of time as constructed out of before-after relations, with no need or place

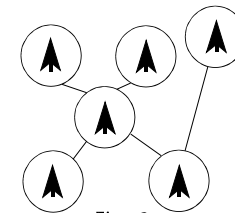


Fig. 3

for the “now” or “past” or “present” type of fact — it is important to stress that the relational account of time and space is not just able to accommodate truly temporal facts, but that it allows the expression of a more radical notion of temporality than the traditional one based on absolute time. This radicalized notion is change happening in an active, immanent sense rather than events situated in a continuum traversed by

a now-pointer ultimately external to the events.

So, one very central point in Whitehead’s system is that processes are themselves active — that the temporal modalities are a question of the happening of processes themselves — or, in other words, that the basic realities in the world pass,

<sup>29</sup> In fact the relational web constituting time and space also involves relations between more or less virtual subprocesses — I leave out this and many other interesting details in Whitehead’s account, as they are not essential to the treatment of time and simultaneity — just as we have discussed traditional interpretations without taking into account the fine grained structure of the substances involved. See Whitehead’s notes on “Coordinate Division”, *Process and Reality*, p.283ff, or my summary of Whitehead’s method in *Process Thought, Teleology and Thermodynamics* (see note 18)

<sup>30</sup> see e.g. Einstein’s introduction to Max Jammer’s *The concept of space*, 1954

themselves, from potentiality through actuality to pastness. Each process is a unit of becoming, and according to Whitehead it “becomes in solido”, which is exactly to say that it is not some temporally extended entity placed on an axis of time along which it could be played, like an audiotape, one stage or movement after the other. The idea is not that it is of zero extension like a point, it is the more radical idea that it is something different from extension — something out of which extension is *constructed*. Within this relational system, according to its properties, it may then become meaningful to ascribe to the process a zero or finite extension. I have represented this idea of integral becoming in fig. 3 by taking the arrowhead signifying dynamism inside each process unit rather than putting it on the traditional axis of “underlying” time. However, this account of modality should not be taken as only monadic, the other equally important element in Whitehead’s processual and relational account of time is the relations to other processes. They are deeply involved in the very sense of the modalities. One may think of the relations represented in fig. 3 as a kind of family tree. They are relations between “parent” and “child” processes, causal relations in which the outcome of a parent process adds to the beginning conditions of each of its child processes. Each child process can have many parent processes and vice versa, Whitehead’s picture implies that such branching and rejoining is generally the case. What it means for something to have already happened, Whitehead says, is that it has produced a determinate result — to terminate is to be determinate — but this result should not be understood substantially. What “result” means is exactly that it is available as part of the initial conditions for new processes. Or perhaps better, it is *taken in* by these processes — the terminated parent processes are indeed said to be there, in some sense and to some degree “repeated” within the activity new process. It is really all that the new process can “be”, apart from its core of creativity (and then possibly what may enter from a realm of potential forms, whose nature is one of many interesting aspects we will have to bracket out in this context).

Thus, a process is something happening in a particular determinate *situation* in the sense that it is causally influenced by a certain set of terminated parent processes; and in turn the process is something which produces some determinate *result* in the sense that it produces, more or less deterministically and more or less creatively, some coherent and determinate (and in this sense “unified”) expression out of its multiplicity of a situation. Expression understood, again, simply in the sense that it can be ingressed by some other, new processes.

This “categorical” account of the simple concept of process is not supposed to be very novel or surprising, it is mostly a description of well known aspects of what it means for something to *happen* in the concrete world. What may be controversial is the linking of it with a relationist account of time and space, which is not itself a very novel idea and presumably not even very controversial anymore — but Whitehead

is particularly explicit about the idea that the concrete dynamism of processes can be understood as the ground of extension rather than the reverse. This is the first element of the Whiteheadian solution to the tension between extension and becoming: The modalities are not really situated in space and time at all, but in the concrete processes whose web of relations gives rise to space and time.

But there is more; this is not sufficient. If we would attempt to “save” temporality through appeal to relationism and internal processual temporality alone, and then identify the relational web with the time of physics, we would end up with a strangely dualistic picture [reminiscent of the one I argued that Heidegger ends up with for the dynamic units he reserved for a particular kind of being, human existence]. Modality would be an inner state completely out of joint with the world. Temporal facts would not only be local, they would be completely private — and what is more, the content of these private facts would not really have three options, it would always be “present” at the only relevant time, the time of the utterance. Hence it would be tautological. It would be true after all, as Grünbaum claims, that becoming is an irrelevant subjectivistic addition to a world whose content is completely indifferent to it.

The other essential element in the Whiteheadian account is the explicitation of a strongly dynamic character of the relations in question. That is to say, dynamism in Whitehead’s account is not just in the “inside” of the processes, it is also in their “outside”, i.e. in their relations. Or better, the ways of being related to other processes is an integral part of being a process. Therefore, many of the specifications of processuality in Whitehead’s categorical scheme have the form of explanations of and constraints on the ways processes relate. Of the features of processual relatedness Whitehead describes the ones particularly important to our purpose are the causal, asymmetrically internal character of the relations and the notion of a causal universe. Causal relations are the primary kind of temporal relations, and they are all that need concern us in the present discussion of temporality. (Of course there are many interesting things to say about more complex relation types and the mode and measure of their dependence on causal relations, and Whitehead did say much about it)<sup>31</sup>.

Causality is asymmetric in a way which is deeply involved in the nature of a process because, as stated above, the process is a transition from the possibilities opened by

---

31) There is no reason to claim that Prior and his friend on Mars are not related. Prior may not yet have a direct causal link from the friend’s exam. But of course there are all kinds of interesting complex links involving, but not necessarily reducible to, common origins, common projects, participation in common ways of structuring things. But for the present discussion this can be bracketed out if we just agree on the commonsense constraint that causality is primary in the following sense: no other relations transfer actual content or influence where there is no causal connection. If one likes, it can be stated instead as a definition of causality: any relation that does transfer influence is or involves causality. Thus future events do not influence us although we may relate to them in many more complex senses.

a specific situation into a determinate outcome, and the determinacy of an outcome is nothing different from its availability as part of the situation for new processes. Causality is this one way transfer from the terminated to the actual process, and it means for the parent process not just to give something to the child process but in an important sense, as the great Whitehead scholar Charles Hartshorne has pointed out, to give itself: it is *in* the new process, repeated in it. In this sense the relation is so strongly asymmetric that it can be characterized, as Hartshorne did, as internal from one side and external from the other.

[In close parallel to Schelling's statement that the past is *aufgehoben* in the present. One may also note the striking structural resemblance with Russell & Whitehead's set theoretical reconstruction of the sequence of numbers]

Closely related to this idea of dynamic causality is the notion that each process adds something, leaves its mark on all of its entire branching tree of child processes. As a

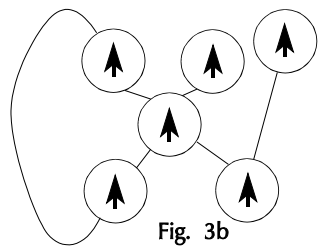


Fig. 3b

corollary, there is no completely identical repetition of any process, or in Whiteheadian terms, any process "leaves its mark" on the subsequent branching chains of processes. In other words it is not allowed to draw cyclic configurations like fig. 3b. This condition expresses the absence of backwards causality and a universal condition of irreversibility. It also means that no character of an enduring object can be absolutely changeless, and that

no change can be completely undone. Of course trust may be regained and damages repaired etc., but not without some other aspects of the situation changing. Elsewhere I have attempted to show how this in conjunction with some of the other conditions in Whitehead's categories implies a dialectic of order and disorder which can be employed in the interpretation of the second law of thermodynamics<sup>32</sup>.

Another Whiteheadian "categorical" constraint on causal relations essential to our discussion here is that "no two processes can have the same universe" or the same past. This "universe" of any process is its family tree of parent, grandparent etc. processes: everything which can affect it and be available to it. It typically consist of a few terminated processes which affect the actual process strongly and a larger number of processes with a more marginal influence. The

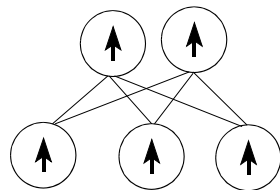


Fig. 3c

configuration which is ruled out is the kind represented in Fig. 3c: two separate processes with exactly the same "universe" — they would not be two but only one process, Whitehead says. Two separate processes may share all kinds of subsets of universes, and typically do, but not the entire universe.

It is in this notion of the unique universe of each process that Whitehead's categorical scheme explicitly states the nonexistence of global temporal facts. Whitehead even uses the term "the principle of relativity" for the principle that it belongs to the "being" of terminated entities to be a potentiality for the becoming of new process entities — to be part of their specific universes. The terminology seems to imply that Whitehead was aware that this shift in the notion of what it is for the past to "be" solves the puzzle of relativity and becoming, by including relativity into a new and more coherent grammar of becoming. A fact, on this account, is truly, as the etymology suggests, something which is "done", it is a certain set of terminated processes available to a new actual process. Such a fact is strongly temporal: it involves the pastness of the terminated processes in this universe, and nothing in the future of this actual process. Also such a fact is not "private" at all, in the sense of just being on the inside of the process unit. On the contrary, the pastness of everything in the universe is "public" in the sense that each of its elements is available to "everybody" in some appropriate causal neighbourhood. Each becomes objective by being available as object to new processes. And finally such a fact is *local* in the sense that nothing secures its instantaneous transmission into objectivity for the entire cosmos. Thus, the process ontology suggested by Whitehead enables us to formulate a coherent concept of local temporal facts, and hence an idea of becoming with no dependence on simultaneity. This solves our problem in principle: there is no contradiction anymore. But a few final qualifications may be called for.

#### Some further qualifications and ramifications of the Whiteheadian solution

First, you may want to raise an objection to the previous move. I went directly from Whitehead's categorical "principle of relativity" to the nonexistence of global temporal facts, which does not follow in a strict sense. What does follow is that there are local temporal facts and not necessarily global ones. As I said, this particular principle in Whitehead's categorical scheme only states that no two processes can have the same universe, that is, the same family tree of predecessors. However, this of course doesn't rule out the special "degenerate" case of a singular thread of events, as in fig. 4. In such a case, there would still be a different temporal fact for each of the processes —

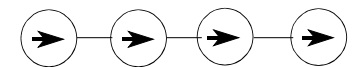


Fig. 4

32) Chap. 4 of this collection.

namely everything which is past when it is actual — and this fact can be said to be “global” in the sense that this fact is then valid for the entire cosmos. However, it is obvious that such a single causal chain does not represent something physically

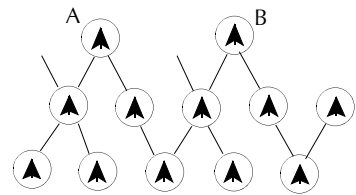


Fig. 5

interesting or otherwise useful — except in the construction of very minimalized models (e.g. Markov chains). The constraint involved in this minimalization, that there be no splitting causal trees, corresponds to an absolutely isolated system of zero spatial extension. However, in the general case involving branchings and joinings of causal chains, the Whiteheadian category implies exactly that

there are only local temporal facts: the different temporal facts of different processes, analogous to the content of “backward light cones” of different events according to SR. A’s universe can be included in B’s or vice versa, in the special case that one is a child process to the other, but in the general case (fig. 5) their universes overlap partially. In this general case there is no ultimate fact as to which one is first, or that they are simultaneous. Whitehead clearly advocates the same metaphysical relaxation in a beautifully simple form he repeats several times in *PR*: “there is no unique seriality of events”<sup>33</sup>.

I should say a bit more about the sense of the graphs I have used. It may seem problematic to represent something temporal in a graph. It amounts to a “spatialization of time” — or, in this case, a spatialization of temporality which is supposed to underlie time, which is of course no less problematic. The problem is that different processes and different temporal facts look as if they are there together, one beside the other, equally actual, available in the same sense — whereas the point of temporality is just that they are not, or at least that any two processes can only “exist together” in the sense and under the condition that they are both past to some actual process. One could read such graphs as confirming the traditional view that processes and relations are all there in an ultimate atemporal reality, through which the ghostly “now” may or may not be held to pass. But they need not be read that way, just as little as your use of a planning calendar containing entries for both 1<sup>st</sup> Jan. and 31<sup>st</sup> Dec. of the current year commits you to think that your acts and experiences of both of these days exist in an ultimate atemporal reality. The graphs represent, just as words could do it, some structures of processual relationships which can be discussed without deciding on the modalities. But this question has a further interesting ramification. As long as we discuss a singular serial chain of events, as in

fig. 4, it would be possible to make a drawing representing the temporal fact of the matter of the entire system — we could draw all the past events in one color, say black to suggest solidity and ground — draw the one present event in another, say green to suggest growth — and for the future events we could either skip them altogether or draw them with some airy color, say light blue, to suggest that they are only there as potentialities. For a Whiteheadian, branching system, as in fig. 5, temporal modality will no longer fit into one spatial picture. It would only be possible to map the modality corresponding to one actual process, and its past and future ramifications. (Notice that this dependence on one particular event would in fact not be different from what is the case in the more traditional modality map you may draw on fig. 4. But drawing such a trivially consistent map of modalities in the chain of events in that monolithic world you would not be bothered by the question of “modalities elsewhere” as there is no elsewhere. In the general case involving an elsewhere, there is no modal question of what is present elsewhere “at the same time” as the actual event, because there is no system of time and space at this basic level of modality and causality. Time is constructed out of these relations and depends on more special constraints, regularities and contexts than discussed so far. If conditions are met for the possibility of constructing space and time, not just one but many time systems can be constructed. Modality is not not in time.

There is an interesting similarity between the notion of local temporal fact, which reduces *presence* to a very modest place and role, and Heidegger’s *Zeitlichkeit*. Here too, temporality is more strongly tied to past and future, and clearly in the *local* sense of situatedness and potentiality. The modal reality behind presence is local actuality, the acting of the local process in question; but presence gets hypostatized into a much larger region and even a paradigm of being, while Dasein’s own temporality forgets itself in the background. For Heidegger too, this huge region of presence is a construction carried by projects. But Whitehead takes this kind of account for presence much further in two respects: firstly, temporality is not taken to be exclusively or even primarily situated in conscious or practice-involved processes of human existence, and secondly the construction of time systems and regions of presence is well grounded in regularities and procedures Whitehead undertakes to account for with mathematical rigidity<sup>34</sup>.

I argued above that the notion of local rather than global temporal facts is a consequence Whitehead’s categorical characterization of the process as ontologically primary. Of course someone will object that we are not obliged to accept a metaphysical principle because it follows from some particular speculative construction. This is obviously true as long as the system has not been established from first principles, or empirically, or however one might imagine that a metaphysics

33) Of course there may be the kind of practical procedures of coordinated timing instantiated in SR by the choice of an inertial system, but no context-independent ontologically warranted sequence.

34) Whitehead’s “method of extensive abstraction”, *Process and Reality*, p294ff

could be grounded. In any case Whitehead's process metaphysical scheme is not intended as something which is established, or which ought to get established, once and for all. Rather, it is an attempt at contributing to an ongoing process of constructing and refining concepts and grammars, seeking to integrate as many aspects as possible of evidence, experience and practices in a coherent conceptual structure. Such an attempt should not to exclude any practical, scientific or experiential background as "overseen halves of the evidence", and at the same time it should not just aim at superimpositions of unconnected ideas but at the production of richer and deeper concepts to make meaningful and relevant contrasts out of what appears at first to be contradictory, irrelevant and/or useless. So this is the gentle tone of voice which should be heard in the process metaphysical suggestion: it is proposed as a conceptual structure which may make coherent sense of vastly different and apparently contradicting fields of language and practice, which is exactly what experienced temporality and scientific time are. And it seeks legitimacy not by pointing to aprioristic authority from some unquestionable fundamentals somewhere else, but rather from turning out to be richer and more useful than other schemes in this kind of situation. So in looking to Whitehead's systematic development of the concept of process what we can draw in is not so much authority as it is a particularly rich, radical and flexible structure to try out<sup>35</sup>.

But shouldn't the metaphysical project, then, be committed to affirming exactly such experiences and notions as presence, co-presence and simultaneity which are such a dominant feature in language and experience and also in most physical descriptions except for the anomalous SR? Yes, it must be committed to showing how and when these structures work, but it is not committed to take them as fundamental if that creates conceptual stiffness and closedness. And indeed it can be argued, as I did above when we discussed Prior's "Thank God it's over", that the notion of local temporal fact covers our concrete experience and language at least as well as the classical notion of global temporal fact. Furthermore, as I mentioned, Whitehead has given a detailed account of the way time systems can be constructed given certain kinds of regularities in processual relations, so that a common time system can be well established in practice, accommodating all the well known uses of chronology and chronologically determined simultaneity<sup>36</sup>. Also, Whitehead argues that this construction of simultaneity is not just a scientific procedure. We have a very vivid immediate impression of being in a space of presence, Whitehead argues, because such construction — ongoing and spontaneous — is always involved in human and probably many other complex processes. What happens, he argues, is that systems

35) See Whitehead's opening chapter on "Speculative Philosophy", *Process and Reality*, p.3-18, for a programmatic presentation of philosophy's role and aim as one of ongoing development of deeper (more coherent) and wider (more relevant and inclusive) conceptual structures.

36) Whitehead's "method of extensive abstraction" in *Process and Reality*.

with a sufficiently "complex" mode of experience will take reliable processual regularities into account and thus project influences and impressions into a scheme of the kind of extension — e.g. the dimensionality — supported by all processes in a sufficiently large region ("cosmic epoch"). We are participants in a rhythm of the epoch, and through this rhythm Whitehead accounts for the complex fact that we continuously sense ourselves and everything else in a very real and unlimited space of co-presence, even while everything sensed is causal past. So in the end, on the process account too, we are well justified in finding our friends and all kinds of other things in the present, but this is a practical presence which need not and cannot be supported by global temporal facts in the fundamental modal/causal sense. Practical simultaneity is of course not just a question of sensation, it is very much a question of coordination between organisms and other processes sharing partial pasts and futures — a question of what Whitehead termed "unison". Unison and rhythm, two musical metaphors, have the advantage of showing this kind of accordance to be something to be produced by participants.

The speed of light is very high compared with all of the processes and movements relevant for our projects. Therefore, in practical earthly engineering, the zone of "elsewhere" which is completely out of reach of the causal trees of any given event is temporally very thin, and a very precise practical synchronisation can be achieved without even worrying about the choice of inertial system — any choice will do, the difference will be microscopic. But as we saw, the speed of light is not even part of the Whitehead's incorporation of "relativity" into the metaphysics of process. Whitehead implies that there is a difference between physical and metaphysical relativity: besides being interesting and important as a physical theory, even as one deeply involved in the constructive grammar of physical time and space, SR became a provocation — providing both a possibility and a necessity of making implicit a principle of even greater generality: a basic feature of temporality and causality altogether. Physical relativity is much more specific and detailed, but it includes and implies the metaphysical principle Whitehead explicated as something significant in understanding things also in fields with little relation to geometry and electromagnetic radiation. If Whitehead is right about this, it will be because local processuality is a useful grammar also in understanding e.g. history, thought, music...

In contemporary discussions of the issue of simultaneity and relativity it is frequently argued that relativity's challenge to classical temporalism has vanished because the cosmological solutions to the equations of Einstein's *general* theory of relativity currently favored imply that the existence of an inertial system with a uniquely simple relation to the overall cosmological evolution and objectively definable, e.g., by the isotropy of the 3°K background radiation. It may or may not be true that a more or less context-independent chronology can be defined thus, but I think the challenge of SR is of a deeper character than what can be handled with this response. Firstly

because the conditions expressed in the equations of the theories of relativity have to be of a more fundamental nature than the features of the cosmological models *satisfying* GR, whether or not it is true that all reasonable solutions — i.e., all solutions corresponding to an inhabitable cosmos or a cosmos in other respects similar to what we observe — possess the appropriate kind of symmetry. And, more generally, this is not a satisfactory way of handling metaphysical problems. True, the history of metaphysical questions and answers has always been deeply involved with scientific developments, and if Whitehead is right this must be so, because the metaphysical project is really a necessary ongoing improvement of concepts and grammars to take into account new elements of practice, culture and science. But metaphysical development requires the production of deeper coherence, not just the concatenation of results. Therefore, if one fundamental theory of science is in conceptual conflict with what we take to be fundamental to everyday time, this is a serious metaphysical problem even if another scientific theory gives some hope that the conceptual conflict will not turn into a direct empirical conflict. In other words, adopting this response as a defense of classical temporalism is accepting that the question of passage and becoming is simply a yes-no question depending on findings of physical cosmology. But I suspect most adherents of classical temporalism would not accept a negative conclusion from physical cosmology regarding the existence of a privileged time system as evidence simply dismissing temporality, just as Prior — rightly — would not accept such a consequence to follow from SR.

Finally, proponents of the quantum mechanical accounts of experienced time, as well as proponents of a Bergson or Heidegger inspired radical temporalist interpretation of scientific facts, may claim that the kind of solution I have proposed, based on the notion of local temporal facts, is just as available within their theories. Hopefully so, and I will have no objection as long as they actually do employ a notion of natural local temporality without reducing it to either atemporality or human subjectivity.

#### **Theological end note: where does God stand on the simultaneity issue?**

There are many traditional connections between theology and concepts of time. Very generally there are two main trends in Western thought: one complex of connections between hellenistic philosophy and religion, pantheism, mysticism and atemporalism, and another complex of connections between Judeo-Christian theology, ideas of God in history and temporalism. These two main complexes are also frequently connected with cyclic and linear time, respectively. For example, St. Augustine is frequently cited as the first to formulate the prototype of linear dynamic time, and he did so with a clearly theological agenda, defending the view of a God actively involved in creating and transforming creation, and of a human soul making irreversible decisions

and acts. Also, modern defenders of atemporalism are not all of a mainly scientific orientation, references to mystical insights of Being beyond time are not infrequent<sup>37</sup>.

Whitehead suggested that the metaphysical development of adequate concepts of process would also have interesting implications for religious interpretations of life. In the “Final Religious Interpretation” chapter of PR<sup>38</sup>, he develops a vision of a God truly participating in the creative processes in the world, with “Galilean humility” rather than occupying an “Imperial ruler” position beyond it. A God affecting worldly processes, human and organic as well as inorganic, through a kind of gentle inspiration into the moment of striving which is, according to Whitehead inherent in all processes to some degree. Thus God would influence things locally, with a kind of “lure” towards good life, understood in terms such as realization of a richness of form, complexity, realizing order in conflicting situations so that “nothing is lost”, etc. I should probably stress that the idea is not that of God guiding things into streamlined progress towards a prefigured end state of goodness known by Her in advance, but rather that of Her participation in the development of aims, sensibilities and ideals made possible by the situation, so that God would not only be experiencing an unforeseen history, She would even essentially be learning with it. She is also characterized as “the fellow sufferer who understands”. (The reference to God as a female is my own addition, I think it helps shift the imagery in the intended direction of immanence and participation rather than transcendence and control.)

Whitehead’s suggestions of religious interpretation of process thought have given inspiration to a more or less well defined school of “process theological” thought with Charles Hartshorne, John Cobb and David Griffin as some of the prominent figures. They have done admirable work in fleshing out process thought in terms of theoretical and practical theology. However, their use of the concept of process within the theological tradition has led to a peculiar attempt at attenuating the full radicality of Whitehead’s concept of process. This is of particular interest for our discussion in this article, as it is expressed just in a discussion of the implications of the special theory of relativity for God’s interaction with the world. In this discussion, Hartshorne, Griffin and others have suggested models for such an interaction of a process God with a process universe. Some of these models picture God as a “society of divine occasions”, others as one ongoing divine process, but what creates the problem is that they all hold on to some version of the idea that God prehends the temporal fact of the present state of the entire universe and, on that basis of that, acts on the world, typically through local persuasive influence as sketched. However, Hartshorne discovered, correctly, that this idea of the interaction is in conflict with SR because it requires cosmic instants. A number of suggestions for saving process

37) e.g., J.M.E. McTaggart: *The Nature of Existence*, 1927.

38) A.N. Whitehead: *Process and Reality* (1929/1978), p.512/337ff

theism were brought up in an ensuing debate. According to some of them, divine occasions should be imagined in terms of more or less “thick” timeslices through the events of the universe. However, clearly this does not really help, as we saw already in the discussion with Bergson, because the ambiguity of simultaneity introduced by SR will be larger than any thickness. Another suggestion, due to Griffin, repeats Prior’s idea that SR holds for physical time but is somehow not valid for real, concrete time, which would also be the time of God’s prehensions and actions — the idea that SR is physically but not metaphysically valid. Hartshorne, Griffin and others are well aware that Whitehead had explicitly dropped the assumption of a unique seriality of events in his process scheme, but they tend to conclude that Whitehead must have overlooked something here. Like Prior, they do not find the limitation to local temporal fact acceptable as a framework for the interactions they want to talk about, but now it is not human but divine interactions which are in question.

Hartshorne has even embraced a version of the argument that quantum mechanics supplies global temporality beyond the constraints of SR. After wrestling with the difficulties SR implies for his idea of a serial “society” of divine interactions with the entire cosmos, Hartshorne found new hope in the news of some of the celebrated experiments of the Bell’s Inequality type which began to come forth in the 1980’ies — taken in some QM interpretations to display mystical supraluminous influences. Particularly, Hartshorne refers to such an interpretation due to Henry Stapp. I think Hartshorne is quite right in considering these experiments as metaphysically significant, particularly from a process metaphysical point of view, since they suggest quantum phenomena to be emerging in a strongly relational way. However, as I noted above, whatever the nature of these phenomena is, they carry no support for limitations of the scope of SR, or for the reintroduction of classical notions of cosmic instants or global temporal facts.

In the project of formulating theological notions in concepts which are coherent with fundamental conceptual structures of science, Hartshorne clearly continues a main trend in Whitehead’s work, the ongoing commitment to the widening and deepening of metaphysical coherence. However, Hartshorne does not pursue this aim with Whitehead’s radical willingness to accept contradictions as stepping stones to creative improvement, and in relying on support from a very questionable interpretation of certain quantum mechanical experiments as a shield against a challenge stemming from the basic structure of organizing physical time and space, Hartshorne makes his theological model at the same time weaker and more conventional than Whitehead’s sketches of religious interpretation. It is probably in realization of the dubious character of this shield that Griffin suggests the even more conventionally theological move of denying the metaphysical relevance of scientific theories, in effect reinvoking the gulf, between the human and concrete world on the one hand and the scientific

and technical on the other, that Whitehead had attempted, quite successfully, to bridge in metaphysical understanding.

I think this has significance far beyond the internal process theological discussion. Why is it that God is taken to require a cosmos-wide instant toprehend and act?

Process theology has proposed some very interesting shifts in the traditional concept of God. One very central shift is the dropping of the traditional notion of omnipotence. In this respect, the process theologians have followed and unfolded Whitehead’s idea of a participating God, gently persuading and luring rather than ruling. But in another important respect, omniscience, they have only gone half the way. They have gone as far as to strongly affirm what should already follow from traditional temporalist theism if it is taken seriously (but apparently it isn’t always), namely, that God does not know the future. She does not because there is nothing definite to know. It cannot be held to exist as anything but potentialities when acts to come, including God’s own acts, are taken to involve real creativity. Having already gone this far in admitting limits to the notion of omniscience it would seem natural to follow Whitehead one step further towards a processual and participatory God: namely, to take omniscience to be limited by what is part of the past universe of any concrete process. Clearly that would correspond to a dissolution of the idea of God knowing “everything” in a supernatural sense overriding forms and regularities of all other existence, but doesn’t this supernatural ability seem to be very much of the same sort as the omnipotence and the future-knowing which are already dropped? And also, isn’t there a much more interesting sense in which God could be knowledgeable, namely wisdom, *sophia*, something like insights into the potentials of goodness and truth and beauty in the local situation? For that, She needs no miraculous access to global temporal facts.

In other words, why not follow the Whiteheadian shift from global to local temporal facts with regard to God as well? I believe the reason why this seems unacceptable even to process theologians is because our traditional Western notion of God is so strongly involved with transcendence and control. There is no doubt that this traditional notion of a ruler God relating to all of creation at once, if not atemporally then at least in one cosmic moment, has played a strong role in the formation of our modern concept of time, and I wish to end this meditation with the suggestion that the reason that local temporal fact is such a difficult concept for us to grasp is that the “imperial ruler”<sup>39)</sup> kind of God is still strongly alive in our thinking of time, and apparently no less so in secularized modern thinking of time.

---

39) *ibid.*



I suggest an interpretation of this phenomenon strongly inspired by the writings of Bruno Latour<sup>40</sup>. An imperial ruler is a very different kind of authority than, say, a local chief. Imperial rule implies the establishment of a kind of transported presence, mediated through “representatives and delegates” (borrowing Bruno Latour’s terminology developed for the context of science studies but clearly and intendedly full of political connotations) throughout the empire — e.g. in the form of uniforms, coins, rituals, statues, procedures. When this mediation is efficient, it has no significance that the emperor’s presence is mediated, or better, in fact this political efficiency of empire goes along with the invention of a kind of power relation which is only stronger and seems more universal for containing that distant, transcendental quality. The never-ending activity of transporting the emperor becomes first implicit and then alienated as the power gets established as a stable fact, even rooted in the divine. At the present late stage of modern critical thinking it is hardly a controversial statement that the Judeo-Christian-Islamic God was shaped by the structures of transported legitimacy and presence in imperial rulership that He was first a rival to and later took over. Also it is presumably clear that He was involved in the invention of dynamic, global, linear time — cf. St. Augustine. But what is very often overlooked is that the global presence implied in notions of universal time — whether imagined in the form of Newtonian cosmic moment or Minkowskian timeless spacetime — is still just as dependent on an incarnation in transporting and mediating agencies. The ideal, positive and unmediated existence of a universal present is the apotheosis of *somebody’s* or *something’s* omnipresence, the ideal of a rulership so absolute that its transportation is immediate, seamless and absolutely reliable. This combined dependence on and forgetfulness about transportation seems to be a very general trend in Western thinking of time. It still makes it so very difficult for us to imagine processuality as concrete and local — so that SR’s contradiction of global time is taken as a contradiction of dynamism.

SR produces a challenge for this deeply rooted metaphysical idealization and prompts the development of richer metaphysical notions allowing a grasp of concrete conditions of processes of *presenting* and *timing*. In this way, SR can be viewed as indeed enabling a new metaphysical understanding of the close relation between becoming and (space-)time — in a very different way than Einstein thought<sup>41</sup>.

---

<sup>40</sup>) B. Latour: *We Have Never Been Modern*, 1993, and other recent writings.

<sup>41</sup>) cf. the introductory quote on this paper’s first page.