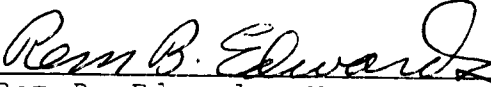
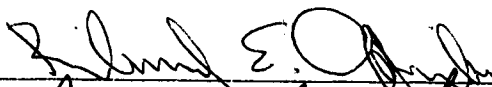
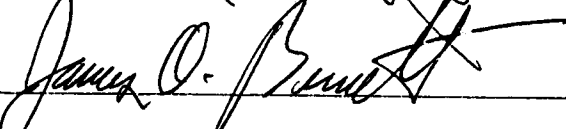
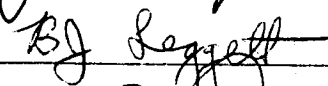
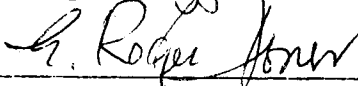


To the Graduate Council:

I am submitting herewith a dissertation written by Villard Alan White entitled "An Examination of Whitehead's Epochal Theory of Time." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Philosophy.


Rem B. Edwards, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:


Vice Chancellor
Graduate Studies and Research

AN EXAMINATION OF WHITEHEAD'S
EPOCHAL THEORY OF TIME

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Villard Alan White

August 1982

3063234

ABSTRACT

This thesis is an examination of Alfred North Whitehead's epochal theory of time. Two necessary conditions for Whitehead's epochal theory are analyzed. First, Whitehead's requirement that events "become" is examined, with the result that becoming is found not to be an objective, physical feature of events in Whitehead's theory as is commonly thought. Second, the requirement that events be discrete is examined, with the result that this requirement is found to be incompatible with contemporary quantum theory, contrary to Whitehead's claim that it is compatible.

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INTRODUCTION

Traditionally there have been two conditions that have been viewed as ones necessary to Alfred North Whitehead's view of time. The first condition is that the entities which make up time "become" in some sense of that term. The second condition is that the entities which make up time be discrete; that is, they have an extension or duration that is indivisible or irreducible. There may be other conditions which are also necessary to an epochal theory of time, but Whitehead alludes to no others than the two above. However, allowing for this possibility that there are others, I do not claim that my analysis attempts to examine all the conditions sufficient for holding to an epochal theory of time, but only these two. However, if either of these two conditions is lacking in a theory of time proclaiming itself to be an epochal theory, that theory would be hard-pressed to lay claim to that title.

My first task will be to find out what becoming is. I think that the vast majority of Whitehead's students have assumed that becoming is for Whitehead as real an aspect of time as the more established physical relations of simultaneity and precedence. "Becoming" is thus taken to mean something like "transition" in this interpretation. Adolf Grunbaum, a longtime opponent of Whitehead's view of time, likewise construes Whiteheadian becoming as a sort of physical transition, and protests against such a view. My

examination of this issue, and the furor that has arisen over it, will therefore first entail a hard look at the debate over temporal becoming. Only after the terms of the debate are established can I hope to find Whitehead's and Grunbaum's positions in that exchange.

My next task will be an examination of the epochality of Whiteheadian time. At the outset I confess a certain trepidation about this venture, for its intricacies and implications are so many and varied as to be overwhelming. To focus my task and give it some hope of success I therefore make the following qualifications of my study. For one, I intend to discover the reason why Whitehead embraced an epochal theory, and then to evaluate critically the strength of that reason. Another goal is to determine if Whitehead's principal opponent, Grunbaum, has an adequate basis for his own view that time is dense rather than discrete. Finally, I wish to discover if the discreteness of epochal time is itself intelligible. Above all, however, I wish to stress that I believe this to be an issue heavily weighted with scientific overtones, and that my conclusions are expressed with the recognition that they may be deficient in the respect that my scientific credentials are not the best. It is unsurprising then that my final attitude in regard to the discreteness of time is one of informed agnosticism.

I. THE STATUS OF TEMPORAL BECOMING:

THE DEBATE

For more than a decade a sporadic but vigorous debate concerning the status of temporal becoming has wandered from journal to journal, the latest installment of which appeared not long ago.¹ On the one side of the issue stand Adolf Grunbaum and his defender, Lynne Rudder Baker, who argue that temporal becoming is a mind-dependent property and hence has no place objectively in the physical universe.² Opposing views have been forwarded by H. A. C. Dobbs and Frederick Ferre, who have insisted either that temporal becoming has a ground in the physical universe or that arguments offered by Grunbaum and Baker are not adequate to demonstrate their contrary opinion that becoming is mind-dependent.³ Yet a critical review of the progress of the

¹ Frederick Ferre, "The Self and Physical Transiency," The Southern Journal of Philosophy, Vol. 18 (1980), pp. 107-112.

² Adolf Grunbaum, Modern Science and Zeno's Paradoxes (London: George Allen and Unwin, Ltd., 1968); "The Meaning of Time," Basic Issues in the Philosophy of Time, eds. Eugene Freeman and Wilfred Sellars (La Salle, Ill.: The Open Court Publishing Company, 1971), pp. 195-228. Lynne Rudder Baker, "Temporal Becoming: The Argument from Physics," The Philosophical Forum, Vol. 6 (1974-1975), pp. 218-236; "On the Mind-Dependence of Temporal Becoming," Philosophy and Phenomenological Research, Vol. 39 (1979), pp. 341-357.

³ H. A. C. Dobbs, "The Present in Physics," British Journal for the Philosophy of Science, Vol. 19 (1969), pp. 316-324. Frederick Ferre, "Grunbaum vs. Dobbs: The Need

debate only yields the unsettling notion that very little if any headway has been made toward resolving the issue, and moreover, that some significant concepts have been even more obscured by the process of argument. In sum, it is my view that the debate over temporal becoming is at a deadlock, and if it continues on the course it has traversed for so long, it is likely to remain deadlocked.

Thus, the intent of this section is to serve as something of a critical arbiter. In such a role it should be clear that what follows is not meant to resolve the issue at hand, nor even to indicate what position is a favorable one, but only to clarify certain muddles that have arisen in the debate and to point out some consequences of the positions that have been espoused. To the extent that I can accomplish this task, perhaps then the argument can continue more profitably, arrive at some sort of compromise, or be abandoned altogether as an argument that is essentially wrong-minded.

The Argument Against Temporal Becoming

Since the debate concerning temporal becoming arose primarily out of reactions to certain publications by Adolf

for Physical Transiency," British Journal for the Philosophy of Science, Vol. 21 (1970), pp. 278-280; "Grunbaum on Temporal Becoming: A Critique," International Philosophical Quarterly, Vol. XII, No. 3, (September, 1972), pp. 426-445; "Transiency, Fate, and the Future," The Philosophical Forum, Vol. II, No. 3, (New Series, Spring, 1971), pp. 384-395.

Grunbaum,⁴ and in view of Baker's admissions that her work is only meant as an exposition and defense of Grunbaum's mind-dependence thesis,⁵ then Grunbaum's word must be taken as authoritative on the matter of the mind-dependence of temporal becoming. In fact, as I will attempt to show, a close scrutiny of Grunbaum's and Baker's remarks on the nature of temporal becoming will disclose that Baker misconstrues Grunbaum on an important point which leads her in turn to append a requirement to Grunbaum's thesis that is neither desirable nor necessary.

Grunbaum's thesis about the mind-dependence of temporal becoming states that although the temporal relations of "earlier-than," "later-than," and "simultaneous-with" can obtain between physical events in a manner that requires no consideration or account of consciousness, the relation or property of "being now" or "nowness" is essentially mind-dependent. Grunbaum's condition for the mind-dependence of temporal becoming is captured in this oft-quoted passage:

. . . what qualifies a physical event at a time t as belonging to the present or as now is not some physical attribute of the event or some relation it sustains to other purely physical events. Instead what is necessary so to qualify the event is that at the time t at least one human or other mind-possessing organism M is conceptually aware

⁴ Ibid.

⁵ Baker, "On the Mind-Dependence," p. 341.

of experiencing at that time either the event itself or another event simultaneous with it in M's reference frame.⁶

Clearly Grunbaum asserts only a necessary condition here. Further, Grunbaum goes on to characterize what he means by the necessary conceptual awareness:

What then is the content of M's conceptual awareness at time t that he is experiencing a certain event at that time? M's experience of the event at time t is coupled with an awareness of the event with a state of knowing that he has had that experience at all. In other words, M experiences the event at t and knows that he is experiencing it.⁷

From these passages it is evident that Grunbaum's account of the mind-dependence of becoming supposes that two distinct kinds of events occur in the world--mental and physical--and further, that events of one kind may possess properties or relations that are not shared by events of the other kind. For the moment I shall defer critical comment on these suppositions, for they are best discussed in light of rejoinders made by critics of Grunbaum that bear more directly on them.

Granting then this distinction between mental and physical events, it must be seen what the terms are under which Grunbaum's necessary condition applies. Concerning the class of mental events, if a mental event M which occurs at a time t also possesses at t the requisite awareness of some of the content of M, then M may be said to occur now at t (from M's perspective). I stress that at least some of the content of

⁶ Grunbaum, "Meaning of Time," pp. 206-207.

⁷ Ibid.

M must be present as part of M's awareness because there seems to be no necessity that the requisite awareness concern the entire content of M. Thus if M is partly comprised of a pain and M occurs at $\underline{t}$ and at $\underline{t}$ M also knows that a pain is occurring, then M occurs now at $\underline{t}$. Note also that nowness can only be predicated of a mental event at the time of its occurrence, and thus a remembered event cannot occur now at the time of its remembrance, although the remembrance itself can so qualify.⁸ In sum, mental events qualify as occurring now at the time of their occurrence on the basis of awareness characteristics that they have concerning some portion of their contents. Moreover, as Grunbaum admits, since a qualified mental event can have nowness predicated of it on the basis of the fulfillment of the necessary condition, fulfillment of that condition also constitutes a fulfillment of a sufficient condition.

Though the above explains how Grunbaum's necessary condition applies to immediate experiences of nowness, it does very little to explain Grunbaum's thesis of mind-dependence except in a very trivial way. For a more meaningful description of the thesis, it must be shown how the necessary condition above applies to physical events.

Grunbaum requires that what confers nowness upon a physical event is that there is some mental event M which occurs

⁸Ibid., p. 210.

at $\underline{t}$ such that at $\underline{t}$ M is aware that the physical event is occurring. The awareness requirement for M at $\underline{t}$ remains the same as above except that the relevant content of M which the conceptual awareness concerns must contain at least in part an experience of the physical event to which nowness is attributed. Further, if the physical event itself is not directly experienced, then that event may nevertheless be held to occur now for a qualified experiencer M if there is some other physical event simultaneous with the event in question which occurs now for M.⁹

A brief description of these states of affairs as they obtain in ordinary experience is helpful to make the application of the mind-dependence condition clear. Grunbaum holds that it is possible to maintain that a physical event E, such as a stellar explosion, occurs now for some experimenter M occurring at $\underline{t}$ if M meets the awareness requirement in his/her/its experience of E. Note that the clock-time of E is wholly irrelevant in this case, for it is unessential that M be aware of E as occurring at any particular time relative to $\underline{t}$ for E to occur now for M at $\underline{t}$. However, should M gaze knowledgeably at a stellar event E which M is informed as having occurred simultaneously with certain past events in M's time-frame, and M's experience of E meets the awareness requirement, then in some sense those events past in M's time-frame occur now for M. A common expression of this

⁹Ibid., p. 207.

particular example is found in the remark, "Look at Alpha Centauri and you're looking 4 years into the past." Of course, the "past" into which you're looking is an event simultaneous with certain events that occurred earlier than and relative to the time of the experience being had at t . Insofar as these past events in M's time-frame occurred simultaneously with the physical occurrence of the Centauri event now present to M, those past events occur now for M at t .

In both of these characterizations of the application of the necessary condition to physical events it is obvious that nowness is attributed to the physical events involved. Hence, apart from the involvement of qualified conceptualized awareness, Grunbaum sees no reason to allow that nowness or temporal becoming has any pertinence to physical events at all. It is for this reason that Grunbaum calls his thesis one of mind-dependence.

Since 1972, when Grunbaum's most recent and most authoritative statement on his thesis appeared, Lynne Rudder Baker has taken over the task of expounding and defending Grunbaum's thesis.¹⁰ However, as I shall now show, Baker has only muddled her mentor's view by introducing into that view new concepts that are inappropriate at best.

In a recent article,¹¹ Baker quotes the two passages I have mentioned above with the purpose of explicating

¹⁰ Ibid., p. 207.

¹¹ Baker, "On the Mind-Dependence."

Grunbaum's complete conditions for events to qualify as now. In characterizing the import of those passages Baker first remarks that they convey a necessary condition for physical events to qualify as occurring now, which indeed they do. Furthermore, Baker correctly acknowledges that this necessary condition is in the case of its application to mental events a sufficient condition as well. However, concerning those same passages Baker also remarks that

The stated condition for a physical event to qualify at t as occurring now is only a necessary condition; to obtain a sufficient condition, we must require that the physical event be quasi-simultaneous with the event of complex awareness. In this way, an event such as an explosion of a star which occurs millions of years before it is experienced, does not qualify as occurring now at the time at which it is experienced. But an explosion in the next room, the experience of which both satisfies the condition of conceptual awareness and is nearly simultaneous with the explosion, would qualify at that time as occurring now.¹²

Baker wrongly attributes such a sufficient condition to Grunbaum's position, and I believe that she does so for two reasons. First, she misconstrues the intent of Grunbaum's thesis, and second, what is implied by her sufficient condition is actually at variance with Grunbaum's view.

On the face of it, there is one text of Grunbaum's that seemingly supports Baker in her call for a sufficient condition for the derivative nowness of physical events, and I take it that this text is the foundation for Baker's claims.

¹²Ibid., p. 342.

It runs:

In particular, I would scarcely countenance making the nowness of the experience of a physical event sufficient for the nowness of the event, and even in such cases as a stellar explosion common sense might balk at this. But all that is essential to my thesis of mind-dependence is that nowness of the experience of at least one member of the simultaneity class to which an event E belongs is necessary for the nowness of the event E itself. And hence my thesis would allow a compromise with common sense to the following extent: allowing ascriptions of nowness to those physical events which have the very vague relational property of occurring only slightly earlier than someone's appropriate experience of them.¹³

Apparently Baker's additional necessary condition that the physical event occur quasi-simultaneously with the event of complex awareness reduces to this "vague relational property" of Grunbaum's, though Baker never actually bothers to explain properly what quasi-simultaneity is.¹⁴

However, it must be stressed that Grunbaum never explicitly embraces something like quasi-simultaneity as an

¹³ Grunbaum, "Meaning of Time," pp. 208-209.

¹⁴ In order to be clear how Baker would include some physical events in a derivative now-relation and exclude other events, it must be shown how the time of a given physical event E roughly corresponds to the time t of a mental event M which is suitably aware of E, for evidently without this rough correspondence of the times of E and M Baker would deny that E can occur now for M at t.

This rough correspondence of the time of E's occurrence relative to the time t of M's occurrence must be explained in terms of an approximate simultaneity of E and M. Obviously if E were legitimately included in a simultaneity class with M, E could not be causally connected with M, since by definition E would thereby be placed outside M's light-cones. But for M to be aware of E presupposes some sort of causal relation between E and M, and the nature of

additional necessary condition for the derivative nowness of physical events, and thus he never admits a sufficient condition for derivative nowness.¹⁵ But moreover, if Grunbaum is construed as embracing such a condition, as Baker holds, then Grunbaum contradicts both the intent and terms of his thesis.

In regard to the relation of his thesis to common sense, Grunbaum clearly sets out his stance:

The relation of the conception of becoming espoused here to that of common sense may be likened to the relation of relativity physics to Newtonian physics. My account of nowness as mind-dependent disavows rather than vindicates the common sense view of its status. Similarly, relativity physics entails the falsity of the results of its predecessor.¹⁶

this relation excludes E from any simultaneity class including M.

Thus, granting some suitable time-frame for M, clock-times may be affixed to E and M as causally connected events, and comparison of the numerical values assigned to the clock-times of the events yields Baker's relation of quasi-simultaneity if the comparison satisfies whatever conventions of temporal contiguity M happens to adopt. If these conventions allow that explosions at $t-1$ are nearly simultaneous with M's occurrence at t , then by M's reckoning those explosions, and all physical events held to occur at $t-1$, qualify as occurring now derivatively for M if M is aware of any physical event E which is a member of the simultaneity class of $t-1$. But if any physical event E' which occurs at $t-x$ is not regarded as nearly simultaneous with M by the adopted conventions, then E' cannot qualify as occurring now derivatively, even if E' is an object of awareness for M and the necessary condition of judgmental awareness of E' is satisfied.

¹⁵ Grunbaum has a text that could be construed as a sufficient condition, but the text is highly ambiguous since it does not have to do with the time of a physical event's nowness. See "Meaning of Time," p. 212.

¹⁶ Ibid., 212-215.

In view of this claim it seems odd that Grunbaum could include any common-sense deliverances of the status of nowness in his formal position, even if the nature of such deliverances is scientifically informed. Yet, this is exactly what Baker does in her article, for by way of introducing her quasi-simultaneity requirement she appeals to examples of occurring now that differ in the respect that the physical events involved are considered to be in one case spatio-temporally nearby to a qualified mental event and in the other case not. But Grunbaum is adamant in his exclusion of such considerations from his thesis.

Of course, for some practical purposes of daily life, a nearby terrestrial event can be held to be simultaneous with someone's experience of it with impunity, whereas the remote stellar explosion of a supernova or an eclipse of the sun, for example, may not. But this kind of practical impunity of common-sense perceptual judgments of the presentness of physical events cannot detract from their scientific falsity. And hence I do not find it as incumbent upon myself to furnish a philosophical account of the status of nowness which is compatible with the now-verdicts of common sense.¹⁷

However, Baker's quasi-simultaneity requirement not only thwarts Grunbaum's intent for his thesis, but the terms of the thesis itself. One fundamental precept that underlies Grunbaum's thesis is that mental and physical events differ from one another in the respect that each kind of event can

¹⁷ Ibid., p. 208.

exhibit irreducible properties which the other cannot. Apparently Grunbaum holds that nowness is one such property, for while certain qualified mental events possess this property, no physical events can.¹⁸ Yet, the upshot of the invocation of Baker's quasi-simultaneity requirement is the establishment of a relational link between mental and physical events which sets chronometric parameters for the attribution of nowness to physical events (see footnote 14). But such a move is clearly contrary to Grunbaum's claim that nowness is a feature of qualified mental events only.

Further, Baker's quasi-simultaneity requirement undermines the intelligibility of Grunbaum's account of the derivative nowness of physical events. Part of the conditions of that account is that a physical event or another physical event simultaneous with it be experienced conceptually. If, however, only physical events quasi-simultaneous with qualified mental events are allowed to occur now, then it is wrong to say that distantly past events can occur now for qualified experiencers. But, as was seen in the case of "looking into the past" by gazing at the stars, clearly some intelligibility can be advanced to the idea. Moreover, aside from the encumbrance of Baker's quasi-simultaneity requirement, Grunbaum's account of derivative nowness can admit such intelligibility. Baker's account, however, is

¹⁸ Ibid., p. 216-217.

driven to appealing to counterfactual experiences of possible experiencers to provide an explanation of how distantly past events can occur now derivatively.¹⁹

In sum, there are various reasons both general and specific to exclude Baker's quasi-simultaneity requirement from Grunbaum's thesis. In light of this apparently unintentional obfuscation of Grunbaum's position, it is essential to clarify what the thesis of mind-dependence entails.

First and foremost, Grunbaum's thesis holds that mental and physical events are distinct kinds of occurrences, and that an essential part of this distinction is that each kind of event can possess properties or relations which are inadmissible to the other. Mental events of a certain variety do qualify as occurring now or having the property of presentness at the time of their occurrences, but no physical events have this property. An attribution of nowness to experienced physical events is made intelligible by means of a proper analysis of the contents of a mental event experiencing the physical event, and thus the intelligibility of predicating nowness to physical events is explained in terms of the mind-dependence of that property. However, no other condition should be appended to the condition necessary for attributing nowness to physical events such as Baker's quasi-simultaneity requirement, for such a condition both

¹⁹Baker, "On the Mind-Dependence," p. 354.

transgresses the distinction between mental and physical events and destroys or unduly complicates Grunbaum's view of the derivative nowness of physical events. Hence, though there is a necessary condition for the nowness of mental events which is also sufficient to predicate nowness to those event, that same condition is only necessary for the derivative nowness of physical events, and there is no firm basic in Grunbaum's texts to supply another condition.

Reactions to Grunbaum's Argument

Now that the thesis itself has been purged of some befuddlement, it is time to turn attention to the arguments that have been advanced for and against it. I do not claim that the following treatment of the exchange is exhaustive, but I do claim that the arguments indicated below are most directly to the issue at hand and thus deserve consideration over others.

The argument that has assumed the highest prominence in the debate has been the so-called "argument from physics," an argument first advanced by Grunbaum and later developed and refined by Baker. Grunbaum's original version reads:

It seems to me of decisive significance that no cognizance is taken of nowness (in the sense associated with becoming) in any on the extant theories of physics. If nowness were a fundamental property of physical events themselves, then it would be very strange indeed that it could go unrecognized in all extant physical theories without detriment to their explanatory success.²⁰

²⁰ Grunbaum, Modern Science, p. 21.

In this guise the argument is little more than an argumentum ad ignorantium, holding against the mind-independence of temporal becoming in a rather insistent tone upon the authority of Grunbaum about the nature of contemporary physics. The argument did not remain at this inchoate stage for long, however, for H. A. C. Dobbs countered with claims that certain areas of physics did indeed include references to the present in their formulations.²¹ Grunbaum responded to these counterexamples by showing that there are no essentially tensed references in these formulations.²²

Paul Fitzgerald has offered comments in this exchange that are helpful.²³ Fitzgerald holds that expressions which attribute nowness to events do actually predicate a property to those events but rather select or point out the events from the temporal perspective of the speaker. In Fitzgerald's opinion any reference to nowness in extant physical theories is of this ostensive character and need not be construed as representative of properties of nowness actually instantiated.²⁴ On the basis of this distinction Fitzgerald awards Grunbaum the victory in this exchange, for Fitzgerald

²¹ Dobbs, "The Present," p. 316 f.

²² Ibid.

²³ Paul Fitzgerald, "Is Temporality Mind-Dependent?" Philosophy of Science Association, Vol. 1 (1980), pp. 283-291.

²⁴ Ibid.

argues that Grunbaum allows for this distinction in his arguments, but Dobbs collapses the ostensive and predicative function of physicalist expressions to actual physically preferred temporal instants.

Moreover, the outcome of this exchange is not irrelevant (if it can be determined), for if it can be demonstrated contra Grunbaum that extant physical theories must indeed take cognizance of nowness in their formulations, then the argument from physics is false. But if Grunbaum demonstrates his own view that no extant physical theories take nowness into consideration, then his argument is made more inductively tenable, though not decisive in its refutation of nowness, for it could be the case that new theories of physics arise that do refer to objective nowness. Thus a victory for Dobbs' arguments would entail a logical victory for him over Grunbaum, but a victory for Grunbaum's rejoinder would entail only an inductive strengthening of the mind-dependence thesis.

In fact it was Baker and not Grunbaum who first framed the argument from physics as an inductive argument and thus removed the noxious air of certitude that first surrounded it.²⁵ Baker recast the argument as follows:

1. Nowness is a mind-dependent property of physical events if and only if failure to take

²⁵Baker, "Temporal Becoming," p. 218 f.

cognizance of nowness is detrimental to the ultimate explanatory success of physics.

2. Extant physical theories fail to take cognizance of nowness without detriment to their explanatory success.
3. Therefore, there is good reason to hold that nowness is not a mind-independent property of physical events.²⁶

This version of the argument is more satisfactory since affirming the premises gives good inductive reasons for holding the conclusion. The argument from physics thus revolves around the affirmation or denial of the first two premises.

These premises have been dealt with in two ways. The first was already seen in the confrontation between Grunbaum and Dobbs, which concerns the predicability of objective nowness. I believe with Fitzgerald that there are good reasons to hold with Grunbaum that such properties are held to be predicable by extant physical theories. However, as I shall show presently, this admission should not persuade us to align with Grunbaum's mind-dependence view.

Another way of dealing with the premises has not to do directly with the nature of extant physical theory, but rather involves the tenability of physical theory according to the mind-dependence theorist as that view meets with actual experience. As Baker says of this approach to the argument, "If any of the attacks which allege that experience

²⁶ Ibid., pp. 221-222.

is inexplicable without physical transiency were to be successful, we would be forced to abandon at least one of the premises of the argument from physics."²⁷ This approach thus deals with the overall conceptual soundness of the mind-dependence thesis, and places the mind-dependence theorist squarely on the defensive.

The attacks made upon the argument from physics in this way have been multitudinous, and to retrace all of them would be tedious and unproductive. However, due to the circumstance that Frederick Ferre has lodged nearly all of these complaints, and that Ferre has reduced his criticisms to the following basic complaint,²⁸ we may on his authority neglect the rest.²⁹

Ferre's fundamental criticism has been around in one form or another since this earliest version appeared in 1969:

For Grunbaum it is theoretically forbidden to say of any person that he is more truly at any clock time than at any other in his lifetime. Since our minds are no less part of the natural order than our bodies, this must apply a fortiori to mental events as well. But the phenomenological fact is that for subjective awareness some mental events are uniquely "favored" over others (in the sense of being judged "now"). Thus a

²⁷ Ibid., p. 223.

²⁸ See footnote 3.

²⁹ Frederick Ferre, "The Self and Physical Transiency," The Southern Journal of Philosophy, Vol. 18 (1980), pp. 107-112.

systematically incoherent division is created between the order of mental events conceived as occurring tenselessly, on the one hand, in a perfect democracy of earlier-later relations wherein none has special claims or privileges, and the order of mental events experienced as occurring transiently, on the other hand, in a remorselessly ruled public succession of present moments.³⁰

And again, this time in 1980 and vis-a-vis Baker:

The problem is that on this theory (of Baker's) I am conceptually aware of "now"-contents at both 1950 and 1980 (on Ferre's world-line) (and at all the relevant points between) and there is nothing in the theory to account for why my experience is in fact not of those clock-times--nothing, that is unless it is illegitimately answered that I do not experience 1950 or 1980 because I am, really, at some other time. But on the Grunbaum-Baker theory I am no more truly or uniquely at my present "now" than at any other "now" on my life's time-line.³¹

Baker's rebuttal resounds:

What Ferre. . . thinks is radically arbitrary is that I (a mental event A_2) a, now at t_2 rather than t_1 in the first place. But Grunbaum has an answer for why the time identified as now by a particular event of "now"-awareness is t_2 : the event of "now"-awareness belongs to the simultaneity class at t_2 . Nowness, Grunbaum agrees with critics, is a factor of experience, and an event such as A_2 qualifies as occurring now at the moment that I experience A_2 and at no other.³²

But Ferre calls such a response "ingenuous." He says, "The problem, I submit, is that nothing on the mind-dependence theory corresponds adequately to the expression

³⁰ Ferre, "Grunbaum vs. Dobbs," p. 280.

³¹ Ferre, "The Self," p. 109.

³² Baker, "Temporal Becoming," p. 230.

'being uniquely at 1950 or 1980' unless the ghost of an objective "now" is quietly invoked."³³ The force of Ferre's reply seems to be this: just because mental events do qualify as now at the times that they occur does not explain why mental events have their now-awarenesses at specific times and not others. Part and parcel of Ferre's position here is that on the mind-dependence view there is no sufficient reason to hold that any bona fide now awareness has logical or temporal priority over any other such awareness. To eliminate such arbitrariness, Ferre's solution comes by way of the invocation of mind-independent nowness.³⁴

Untying this issue is to get at the knotty problem of the argument from physics. Ironically, the explication of the confusion surrounding this issue ultimately will not assist us in awarding the victory to either participant in the debate.³⁵

It is odd that Ferre's argument is carried on the shoulders of a rather common-sense usage of now-utterances to indicate specific events, for it is this very observation that leads Fitzgerald to include that much argument along the lines of the Grunbaum-Baker-Ferre debate is misleading.³⁶

³³ Ferre, "The Self," p. 109.

³⁴ Ibid.

³⁵ Fitzgerald, p. 283 f.

³⁶ Ibid.

But in any case, it is clear that Ferre primarily views nowness as a rather vague property which is picked up and shed by all real events and which individuates the actuality of their occurrences. Thus, having the property nowness, some events differ from others in the respect that those other events do not have it, though they may have had it, or may yet have it (past and future events respectively). Thus, now-awareness discloses events that are ontologically and uniquely now.

It is Baker's misapprehension of Ferre's claim about the transiently individuating, ontological character of nowness that diverts her to considerations about the logical criteria for individuating every instance of that vague property. Thus, she construes Ferre as asking how on her view we may discern one instance of nowness from another. But Ferre is not asking for identity conditions that individuate now-awarenesses at the times of their occurrences in some tenseless way. Ferre's whole point is that nowness indeed individuates events that have that property at the times of their occurrences, but not merely logically. Thus, for Ferre events of any kind pick up and shed this property, but there is no parallel representation of this kind of property acquisition in Baker's view.

Viewed in this way, this dispute concerns the following issues: (a) whether nowness is a property; (b) if nowness is a property, how and to what events should it be

predicated? and (c) does the predicability of nowness have to do with the temporal relations between physical events? Both Baker and Ferre answer (a) in the affirmative, they disagree on (b), and their reasons for disagreeing on (b) reside in their divergent views on (c).

Before diving into my own criticism of Baker and Ferre's views, it is necessary to consider a recent criticism of this debate that I believe is well-intentioned but misses the point of Ferre's rebuttal to Baker. That criticism is advanced by Ronald C. Hoy and is directed against what Hoy takes to be Ferre's view of the self. Hoy maintains that Ferre's objection against the Grunbaum-Baker thesis fails because Ferre embraces a view of a temporally enduring self that is at odds with a bundle theory of the self as is required by the Grunbaum-Baker thesis.³⁷ Hoy's point may be well-taken for those who do subscribe to a view of an enduring self, but it is not necessary for Ferre to embrace such a view in order for him to advance his rejoinder. Rather, if Ferre is understood to mean that a self is a series of successive awarenesses with only tenuous conditions of identity between them, his argument is served just as well. For Ferre need not deny that even on Baker's view now-awarenesses occur only one at a time; his point is that

³⁷ Ronald C. Hoy, "Becoming and Persons," Philosophical Studies, Vol. 34 (1978), pp. 269-280.

on Baker's view there is no reason for preferring one now-awareness over another, and that an appeal to physical causes related to those awarenesses over another either. But given that a now-awareness occurs sometime, Ferre insists that that awareness has a sort of priority over any others that a mind-possessing organism might have in its history despite the fact that the "mind" of that organism is only a concatenation of serially related events. This divergence of Ferre and Baker is really due to their differing opinions about (c) above, as I will presently show, and hence is not based on any view of the self that is necessarily different.

To continue with an analysis of issues (a), (b), and (c), I will first examine the Grunbaum-Baker thesis and its stance on these issues.

As previously mentioned, Baker follows Grunbaum in allowing that nowness is properly predicable of certain qualified mental events and only those events. A mental event qualifies as now if and only if it is judgmentally (propositionally) aware of some portion of its contents at the time t of the mental event's occurrence. But what then does the property nowness consist of? Grunbaum is not much here, for he claims that his thesis serves to articulate the mind-dependence of nowness, though not necessarily to provide an exhaustive explanation of the nature of nowness.³⁸

³⁸ Grunbaum, "Meaning of Time," p. 209.

However, Grunbaum does clue us that he indeed regards nowness as an irreducible feature of mental events: "Why then should it be puzzling that. . .mental events differ from physical events with respect to becoming, while both kinds of events sustain temporal relations of simultaneity and precedence?"³⁹ At any rate, Baker takes him to be committed to this latter position: "But we have seen that Grunbaum is committed to a view of mind that is no more bizarre than that of any dualist who holds that some properties of mental events qua mental events differ from those of physical events."⁴⁰ Yet, even with this admission the nature of nowness as a property is left vague.

I believe that it would be fair to characterize nowness as truly predicable of mental events that exhibit a feature of propositional containment at the times of their occurrence. It is, after all, the propositionality of awareness that Grunbaum stipulates to be the mark of judgmental awareness, though Grunbaum is unclear as to what constitutes such propositionality.⁴¹ His remarks indicate, however, that he assumes that a mind-possessing organism has a propositional state of awareness when that mental state M somehow affirms a proposition of the general form "that-x" where x is some

³⁹ Ibid., p. 217.

⁴⁰ Baker, "Temporal Becoming," p. 231.

⁴¹ Grunbaum, "Meaning of Time," p. 218 (see footnote).

portion of the contents of M . The requirement that M occur at a time t may be neglected in an analysis of the proposition itself.

Ernest Sosa in a recent and penetrating analysis of various concepts of temporal becoming submits that Grunbaum argues for a relational account of nowness which presupposes this distinction: "(i) an explicitly relational notion of the present: e.g., being present at time t ; and (ii) a non-relational notion of the present: being present simpliciter."⁴² Sosa goes on to claim that Grunbaum seeks to reduce so-called non-relational instances of being-present to the relational being-present-at- t . However, if my analysis above is correct, Grunbaum does not seek such a relationalist account of nowness, for Grunbaum apparently endows qualified mental events with non-relational nownesses which are truly predicable of those events and which, in conjunction with a mental event's time of occurrence, is sufficient to logically individuate any single instance of nowness.⁴³ The time t is therefore not relationally intrinsic to Grunbaum's account of nowness, and thus his account cannot be taken to be a relational one. This makes nowness for Grunbaum to be a rather vague, general property that appears to be synonymous

⁴² Ernest Sosa, "The Status of Becoming: What is Happening Now?" The Journal of Philosophy, Vol. 36 (1979), p. 30 f.

⁴³ Ibid.

with all actual instantiations of propositional awareness. Grunbaum's own testimony, which I have already quoted, is that he does regard nowness as an irreducible feature of mental events, and this is why he chooses to characterize his thesis as one of mind-dependence rather than as some reductionist enterprise such as Sosa suggests.⁴⁴ Further, Grunbaum is clearly disinclined to perform such a reduction of so-called non-relationist notions of nowness as far as physical events are concerned. The whole point of his thesis is to deny that any notion of nowness pertains to physical events at all.⁴⁵

Having thus defended my own interpretation of nowness in Grunbaum's view, I must now press on to investigate what nowness qua propositional awareness entails. Sosa apparently takes Grunbaum to mean that such an awareness comprises conscious thoughts about the contents of experiences making up the mental event in question. There is good reason to believe that both Grunbaum and Baker would approve this appraisal of propositional awareness, though their own explication of how mental events express propositional awareness is lacking.⁴⁶ At any rate Sosa criticizes such a view as defective: "People are generally aware of what goes on around them at a time without being self-conscious enough to relate such happenings to their very acts of thought at that time. . ."⁴⁷

⁴⁴ Ibid., p. 31. ⁴⁵ Grunbaum, "Meaning of Time," p. 208.

⁴⁶ See footnote 41. ⁴⁷ Sosa, p. 33.

This criticism, though meant to show the weakness of the relational view of now, hits the underbelly of the Grunbaumian account of nowness, and for the following reasons.

Evidently Grunbaum frames his view of nowness in terms of propositional awareness because he is sympathetic to the physicist's dictum that a particular "now" appended to a physicalistic claim expresses nothing more than the private epistemological perspective of the observer. In keeping with this dictum anything having to do with epistemology is properly excluded from the purview of physics, and presumably also from the objects and properties of objects that physics concerns. Thus, Grunbaum is driven to define nowness as a property of mental events qua certain distinctive features of those events. The feature that Grunbaum selects is the propositional awareness of certain mental events that expresses the knowledge of occurrent circumstances. This propositional awareness in turn requires that the mental events exhibiting such awarenesses express the property of propositional containment.

The force of Sosa's comment is to direct attention to the question of whether Grunbaum's account can be made to be commensurate with the intent of the thesis as outlined above. In what sense of propositional containment can any mental event qualify as one knowledgably aware of its contents? By their own testimony Grunbaum and Baker deny that many waking experiences are of the required propositional

character:

(Grunbaum's thesis) makes the nowness of an event at time t depend on the existence of conceptualized awareness that an experience of the event or an event simultaneous with it is being had at t, and points out the insufficiency of the mere having of the experience.⁴⁸

Say that at t there is a steady drone in the background, which M is not aware of hearing but which M would be aware of hearing if he changed the focus of his attention; Grunbaum's condition rules out such a case of non-judgmental awareness as an awareness which would qualify the background noise as occurring now.⁴⁹

Comments such as these are compatible with the view that Grunbaum takes temporal becoming to be a function of knowing. But if conscious thought is required for mental events to qualify as now, certain commonplace occurrences do not easily fit with Grunbaum's account.

Take the ordinary action of jogging someone's memory. Say that someone sat in a room for quite some time staring at the wallpaper in the manner usually described as a "blank stare." If our subject is later quizzed on what events transpired during the episode s/he might well respond that s/he remembered nothing as having happened. Then we might say something like, "But do you remember that the grandfather clock struck?" And quite plausibly our subject might respond, "Yes! Twice as I recall." How would Grunbaum handle this situation?

⁴⁸Grunbaum, "Meaning of Time," p. 209.

⁴⁹Ibid.

The remembrance can occur now. What of the mental event that occurred in the past and which is being remembered? Grunbaum would answer that the remembered event does not occur now upon being remembered, for as a memory it is merely part of the remembering event.⁵⁰ And yet it seems that in jogging memory in this way we recover some part of what then was at least an awareness of some sort on the part of the past mental event. I would be tempted to say that the past event was implicitly propositionally aware of the clock striking, though certainly not consciously so. But this plausible understanding of what occurs in jogging memory creates great difficulty for Grunbaum inasmuch as the now-status of the past mental event is concerned.

Grunbaum's thesis falters here for two distinct though related reasons. The first is that Grunbaum chose to define the propositional awareness of a mental event in terms of conscious awareness, which he takes to be the sort of awareness one has when actively cogitating about something. But it seems clearly plausible that we do have awarenesses, even propositional awarenesses, in cases where at the time of the registration of those awarenesses we do not actually entertain those awarenesses consciously. As in the counter-example above, Grunbaum's thesis cannot allow a retroactive attribution of nowness to past mental events. But should Grunbaum allow that subliminal or subconscious awarenesses

⁵⁰ Grunbaum, "Meaning of Time," p. 218.

qualify as now, then he has surrendered the raison d'etre for his thesis is that thesis means to show a connection between nowness and judgmental awareness.

The second reason Grunbaum's thesis has trouble accommodating the counterexample has to do with his view that nowness is some sort of property. I have argued that nowness is for Grunbaum synonymous with all instances of propositional awareness, which means that Grunbaum takes nowness to be a generic universal much in the same way that red is a generic universal. I make this comparison for the reason that just as red can be held to be truly instantiated in various though differing instances (crimson, scarlet, etc.), nowness obtains in all those varying instances that propositional awareness takes place. But whereas one would ostensibly wish to say that two instances of red are identical (this maroon and that maroon), one would wish to deny that one now is identical with another. Thus, if it could be shown that one propositional awareness affirms the same proposition as another awareness, and that the contents of the two awarenesses are indistinguishable ("Seeing that x is crimson₁" and "Seeing that x is crimson₂"), then one might be driven to say that the two nows are identical. Such a result, however, flies in the face of the association of now with a particular time and the view that clock-time is serial and irreversible in inertial frames. Thus, it would be prudent to particularize each instance of nowness from all

others. Grunbaum does just this in his requirement that each now-awareness occurs only once and at the particular physical time of its occurrence as determined by some frame. By this requirement even if two now-awarenesses are indistinguishable in terms of the propositions they affirm and the mental contents to which those propositions refer, they are distinguishable in terms of the times they occur.

Though this view of nowness avoids the problem of identical nows, it creates other difficulties. Foremost, mental events may only have nowness instantiated in them at the times at which they occur. While this requirement satisfies some of our intuitions about nowness, the conditions of predication in terms of propositional awareness allows for the plausibility of the case above where a mental event occurs which seems to both have and lack nowness. But if Grunbaum were to relax his conditions of predication and allow that the past mental event did instantiate nowness on the basis that it did exhibit some sort of propositional awareness at the time of its occurrence, then the intent of his thesis to marry nowness with judgmental awareness is thwarted, since it is difficult to imagine how such a consciousness is judgmental (I will deal with this issue momentarily).

The most direct way for Grunbaum to counter the counter-example is to deny that a past awareness such as a blank stare was propositionally aware of anything at all at the time. He might say, for instance, that although some barren

content of a remembered event might well have registered as a sort of awareness at the time of the mental event's occurrence, there was nothing propositionally asserted about these contents until the remembrance itself did so. In this way the past mental event never occurred now, though the remembrance can qualify as such.

Despite the fact that I find such a response adequate for the disposal of some instances like the counterexample, I argue that the counterexample as stated above is nevertheless problematic for Grunbaum. For if it is plausible that a subject remember not only that a clock struck during a blank-stare interlude, but that the clock struck twice, it seems odd to hold that the actual experience of the clock-strikes was non-propositional. Why should the memory be of a certain number of strikes as opposed to another? An obvious answer is that it was implicitly evident to the blank-starer that a certain number of strikes occurred, though the starer did not actually consciously entertain the proposition. Grunbaum might still object that it is not necessary for the past mental event to have had a propositional awareness of the clock-strikes, but merely that our subject replayed the strikes automatically and in a rote fashion--"bong, bong"--during the event of remembering. Nevertheless, it yet remains very conceivable that our subject might not report having used such a mnemonic device, but simply that s/he knows that the clock struck twice. In this case it

seems impossible not to agree that the propositional awareness was implicit in the prior mental event. The conceivability of this reconstruction of the counterexample would make it incumbent upon Grunbaum to prove that his interpretation of the counterexample is correct.⁵¹

Another way for Grunbaum to handle the counterexample would be to reject his requirement that now-awareness be conscious, which would be tantamount to a rejection of the intent of his thesis to equate nowness and knowing. However, would not such a move make the counterexample more amenable to treatment by the thesis? It seems that it could do so by removing the need of insisting that mental events must be cognitively aware of a portion of their contents at the times at which they occur, thus allowing that mental states such as the blank stare can qualify as now-awarenesses even if those mental states are never recognized as such in memory. But in that case what criteria are to be supplied for discriminating propositional awarenesses? Perhaps the criteria of propositional awareness would have to be relaxed to include dispositions, behavioral attitudes, propensities, or the like. It should be recalled, however, that Grunbaum's thesis has as its presuppositional base the view that physical and mental events are distinct and each possesses irreducible properties. But if the property of nowness is extended to any entity that fulfills the loosened criteria

⁵¹ Note that this does not constitute a logical refutation.

for propositional awareness, then Grunbaum's presupposition that mental and physical events are *prima facie* distinct becomes entirely suspect. Thus it appears to behoove Grunbaum to stick to his Cartesianish criteria that now-awareness must be conscious judgments.

On the other hand, can Grunbaum's thesis admit modification so as to tolerate the counterexample better? Could it, for example, embrace a relational account of nowness and evade the difficulties that dog the non-relational view? Unless Grunbaum is willing to sacrifice his whole enterprise, I doubt it. Grunbaum's thesis means to establish that temporal nowness is sheerly inapplicable to physical nature either as property or relation, and thus a reductionism couched in physical terms is closed to him. But if he is dead set on basing his thesis upon a dualism of some sort, a move toward defining nowness as a kind of relation cannot be better than his non-relationalist definition, for then the problem is merely pushed back in terms of what is to be related. Obviously any relationalist account of nowness will have to do with the time of a thing's occurrence essentially, which must form part of the relation either as a clock-time or an adverbial description of the time. But then something must be related to that time relatum, and since Grunbaum's view is one of mind-dependence, we are left back at the point of describing what for his view constitutes the realm of the mental. Hence for the purpose of furthering his thesis, a

relationalist approach to nowness will profit Grunbaum nothing beyond what he obtains from his non-relationalist account.⁵²

To recapitulate this discussion of the Grunbaum-Baker thesis, I will state my findings in terms of the issues (a), (b), and (c) which I outlined earlier. For Grunbaum and Baker, both hold: (a) that nowness is a non-relational, generic property that reduces to all genuinely instantiated instances of propositional awareness; (b) that nowness qua propositional awareness is predicable of only mental events; (c) although the time of occurrence of mental events distinguish and logically individuate instances of nowness, there is no more of a connection between nowness and temporality than this mere logical connection.

We have seen some reasons to agree with Ferre that the Grunbaum-Baker thesis is flawed. As for Ferre's own view, he hasn't bothered to expound upon it, though we must take him as holding some form of objective property doctrine. With Sosa's aid, we can now go on to analyze views like Ferre's and determine whether they are more satisfactory than Grunbaum's and Baker's.

In terms of issues (a)-(c), it seems that Ferre must commit himself to the following minimal claims: (a) nowness is a transitory, objective property; (b) nowness is predicable

⁵²See Sosa, p. 31.

of all events (there is no necessary presupposition about the ontological status of events); (c) since nowness is a transitory property, its predication has to do essentially with the time of an event's occurrence more than in the sense that the time of one event individuates that event's nowness from all others.

Ernest Sosa has stated that any objective property doctrine (hereafter OPD) maintains that there are transitory temporal properties that are irreducible to properties or relations to thoughts or thinkers.⁵³ However, Sosa shows that such a doctrine is troubled by a certain difficulty in the way it must exhibit the exemplification of the property nowness while holding nevertheless that that property is transitory.

Sosa poses these definitions to show his point:

Def. 1. A property or relation is transitory iff it may be exemplified by some entity without being eternally exemplified by that entity.

Def. 2. A property or relation is eternal iff it is not transitory.⁵⁴

He adds that "It is also part of the OPD that there are temporal properties not reducible without remainder to eternal temporal properties."⁵⁵ This clarification is necessary

⁵³ Ibid., pp. 26-27.

⁵⁴ Ibid., p. 26.

⁵⁵ Ibid., p. 27.

because a proponent of OPD must avoid defining the property nowness in such a way as to undermine the transitoriness of that property. Thus for OPD temporal nowness is a temporal property objectively instantiated by events and irreducible to eternal temporal relations or properties or relations of minds, thoughts, or thinkers.

But as Sosa demonstrates there are difficulties with proposing such a view. Suppose that one chooses to affirm the predication of nowness to an event at a certain time by the means of a tenseless proposition such as the following: "If at a certain time it would be correct or would have been correct to affirm the proposition that a concrete event e is present, then at that time e is present."⁵⁶ But a consequence of accepting such an affirmation is that it is true that e is now at any time if it is true at one time, and this implies that nowness is eternally exemplified by e. On the other hand, if one submits a tensed affirmation of nowness for e (e.g., e now-has the property nowness), the tensed copula absorbs the meaning of now and hence there is nothing over and above e which appears to be affirmed. Thus the OPD is beset by this dilemma that either makes nowness an eternal property or makes nowness nothing beyond the mere occurrence of e, which implies that nowness may be reducible to other properties or relations.⁵⁷

⁵⁶ Ibid., p. 28.

⁵⁷ Ibid.

Sosa proposes the following way out of the dilemma. A proponent of OPD can accept tenseless predication and yet hold that there are transitory properties by means of the following principle: "If at a time t it would be (would have been) correct to affirm, with respect to a time t' , the proposition that a certain event is then present, then e is present at t' ."⁵⁸ Though the affirmation of a proposition is tenseless by this principle, the property nowness is affirmed for an event only with respect to a given time. But a drawback of this approach is that it results in what Sosa terms a "bizarre exhuberance" of properties, which he makes as distinct from the OPD by calling it the MOPD (Modified Objective Property Doctrine).⁵⁹ Obviously, properties proliferate under the terms of MOPD because for each of the times at which events occur now there is a unique property of nowness. Sosa finds such ontological proliferation objectionable.

As an aside I remark that Grunbaum's own view of nowness may fall prey to this latter criticism, since ostensibly every different instance of nowness (in a qualified mental event) is a unique particular.

⁵⁸Ibid., p. 29.

⁵⁹Ibid., p. 30.

How might Ferre respond to Sosa's remarks? It is possible that Ferre might reject Sosa's assertion that one can embrace tenseless predication of transitory objective properties only if one likewise embraces a bloated multiplicity of irrepeatable temporal properties. For it seems possible that one can define nowness in a way that makes it feasible to take every instance of that property as identical to every other, but with the recognition that truth-conditions for the propositions expressing such instantiations do not express the transitory aspect of their predication. Thus while it is tenselessly true that "x is now" and "y is now" both hold, those propositions do not capture the temporal truth that x really is now, while y is not. If this way of opting out of Sosa's dilemma is chosen, however, there are several problems to be dealt with. One is choosing a definition of nowness which denotes a property that remains the same throughout all possible instantiations. In view of the diversity of all possible events, it would appear that the only possible candidate for such nowness is existence. But the conundrums involved in the predication of existence would then be made manifest. Another problem would be the specification of a temporal logic that could express the required sort of transitoriness. But such a logic would have to be adaptable to the circumstance that nowness is truly predicable of an event at a certain time, yet, to fit with empirical theories of time, such a logic must conform to

relativized time-frames. Hence a satisfactory temporal logic must assert a truth-value for nowness with respect to a unique time while somehow recognizing that no unique times can be preferred.⁶⁰

Of course, it is possible for Ferre merely to accept the multiplication of entities under the MOPD and, like Mickey Mouse in Fantasia, take the consequences of his splintering. However, unlike Mickey's splinters, which all took on the same broomish appearance, it seems that Ferre must thereby commit himself to a swarming proliferation of nownesses which refuse to take on any similarities whatever.

Since the MOPD itself and alternatives to the OPD are equally distressing, Sosa proposes another view of nowness which he calls the Form of Thought doctrine (FT). In the FT nowness is exorcised from the realm of objective properties by means of accepting as transitory properties only those which Sosa terms are "present-free": that is, objective properties not bound by tensed modes of predication. Thus, these transitory objective properties are tenselessly predicable of their subjects, though the actual instantiation of these properties may obtain at some times and not others. Hence these properties do instantiate in a transitory temporal fashion although an expression of such predication is

⁶⁰ This appears paradoxical for any attempt to make an objective property instantiable in terms of physical time, for physical time must take into account relativistic effects.

tenseless. Nowness itself is handled under the FT by having the propositional attitudes of an individual who expresses the predication absorb it. If 'S believes (believed, will believe) that x is now A (then A)', the FT takes this to mean that 'S believes-as-presently-holding (believed-/will-believe-as-then-holding) that x is A'. In this way FT holds that "there is a sense in which the present-bound properties of pastness, presentness, and futurity (McTaggart's A-series characteristics) are part of the form of our thought and not a part of its content (or objects).⁶¹

The FT does improve on the MOPD because it accepts transitory objective properties that are repeatable and thus it is ontologically light. It also removes the general difficulty of defining nowness as an instantiable property by having the propositional attitudes absorb it. But would Sosa's view be acceptable to Ferre?

I cannot, of course, speak for Ferre, but I can point out some implications of accepting the FT. For one, if Ferre espouses the FT he would have to revoke his stance on (a) which affirms that nowness is an objective (physical) property. His most recent publication indicates that he would balk at such a prospect, and perhaps rightly so.⁶² The whole point of Ferre's complaints against Baker is that he wishes to extricate nowness from the mental realm and

⁶¹Sosa, p. 42.

⁶²Ferre, "The Self," pp. 109-110.

impose it upon physical reality. But it is essential to the FT that nowness is a part of the form of thought. Thus nowness under that view is a mind-dependent or thought-related thing (Sosa gives no analysis of "now" under FT as it is a part of propositional attitudes). So it seems that Ferre cannot embrace FT without surrendering his very position against the Grunbaum-Baker thesis.

Hence none of the various positions--OPD, MOPD, or FT--or any variation of these as discussed above are happy choices for Ferre. Moreover, there are very good reasons to believe that Ferre cannot produce a view that encapsules both the conceptual requirements of his positions and is consistent with prevailing empirical views of time. For, Ferre apparently commits himself to the existence of unique "now"-slices of the physical universe, and such a Newtonian-like view is clearly contradictory to special relativity.⁶³ It is possible that Ferre might better wish to hold that "now"-slices are only held within inertial frames, but then the objectivity of nowness is threatened by the problem of determining what shall constitute a preferred inertial frame in any purported instance of nowness.

Put in another way, Ferre's position produces a conflict between his stances on issues (a) and (c). If Ferre persists in his opinion that nowness is an objective property by (a),

⁶³ Ibid.

then by (c) it appears difficult if not impossible to hold also that nowness is essentially implicated with time. Perhaps then Ferre should surrender his stance on (a) and accept FT, but then again it was seen that FT is not incompatible with the Grunbaum-Baker position, which Ferre wishes to debunk. Ferre is thus placed in an awkward position philosophically with respect to his intention to win the dispute over the argument from physics.

In regard to the problem of temporal location, which Ferre takes to be the crucial weakness of the Grunbaum-Baker thesis, a few comments are in order. It does appear to be the case that since on the Grunbaum-Baker view nowness is a sort of generic property, some conceptual problems do arise in regard to the predication of that property. It is this result which motivates Ferre to say that Grunbaum's account of nowness contravenes experience.⁶⁴ But, on the other hand we have seen that it appears impossible for Ferre to construct a view of nowness which incorporates all that Ferre would have it to do. This suggests, in turn, that something is wrong with the whole Grunbaum-Baker-Ferre debate.

It should be recalled, of course, that this excursion into the Grunbaum-Baker view and Ferre's opposing view was

⁶⁴For a recapitulation of this argument and Grunbaum's possible response, see my "Ferre and the Problem of Temporal Location," Southern Journal of Philosophy, Vol. XX (1982), pp. 133-137.

incurred so that we might decide the victor in regard to the second approach to the argument from physics. But the end-point of this excursion is not to declare a victor at all, but only a mutual defeat. Neither Ferre's view nor the Grunbaum-Baker thesis is without problems and neither deserves unqualified acceptance.

Whitehead's Concept of Temporal Becoming

With the foregoing discussion as background, it must now be considered whether Whitehead's concept of nowness or becoming is any better than Grunbaum's or Ferre's. The debate over temporal becoming certainly has its lessons for any concept of nowness that pretends to adequacy, and this section proposes to see if Whitehead's concept is adequate by that standard. I stress that this assessment of Whitehead's view cannot be entirely comprehensive, because to do so would entail an assessment of Whitehead's whole metaphysical system (at least his ontology), and such an endeavor is monumental if not impossible. Hence, from the outset I take as granted that Whitehead's ontology is a viable one, and with that surmise I can proceed with my analysis.

Lest it be thought that my task is guilty of circularity by my assumption of Whitehead's ontology, I must make it clear what is being assumed. Whitehead's ontology of actual occasions involves an atomic view of reality such that all and only things that have a discrete spatio-

temporal extension are actual.⁶⁵ But this assumption alone has no necessary bearing on the question of the nature of temporal becoming, for it is possible that one may hold such an ontology concomitant with a belief that the temporal relations ordering such entities are tenseless ones. As we shall see, Whitehead does in fact subscribe to a temporal ordering among actual occasions that is compatible with tenseless uses of temporal language.

For Whitehead becoming is intrinsic to the actuality of every actual occasion (PR 22/23; 25/38). Since actual occasions are atomic in character, this immediately raises the question becoming is applicable to the process of formation of each of these entities, the process of the succession of these entities severally, to both or only to only one of these alternatives. However, Whitehead is very sure to surpress an assimilation of becoming with succession early in PR:

Finally, the extensive continuity of the physical universe has usually been construed to mean that there is a continuity of becoming. But if we admit that 'something becomes', it is easy, by employing Zeno's method, to prove that there can be no continuity of becoming. There is a becoming of continuity, but no continuity of becoming. The actual occasions are the creatures that become,

⁶⁵ Alfred North Whitehead, Process and Reality, eds. D. R. Griffin and D. W. Sherburne (New York: The Free Press, 1978), p. 73. In keeping with the standard conventions, references hereafter to this work shall appear in the text abbreviated as PR following by both the Free Press and the original Macmillan 1929 pagination.

and they constitute a continuously extensive world. In other words, extensiveness becomes, but becoming itself is not extensive. (PR 35/53).

These remarks (especially the last two sentences) make it clear that becoming strictly applies only to the process of the formation of actual occasions, and not to the succession of actual occasions. If becoming is eventually claimed as necessary for Whiteheadian time in some sense, this claim is entirely unsurprising, because, as Sosa points out, any obvious sense of becoming that is applicable to ordering a set of entities is reducible to other tenseless relations that obtain between those entities.⁶⁶ In other words, succession as a mere ordering relation does not in and of itself warrant the introduction of another temporal relation over and above precedence and simultaneity.

From this it is clear that Whitehead must require a definition of becoming that applies to the internal, formative character of individual actual occasions and which somehow must be inextricable from the place of those occasions in a temporal sequence of events. To satisfy the first part of these requirements I turn to remarks made by Whitehead in his "Categories of Explanation":

(xxi) An entity is actual, when it has significance for itself. By this it is meant that an actual entity functions in respect to its own determination. Thus an actual entity combines self-identity with self-diversity.

(xxii) That an actual entity by functioning in

⁶⁶ Sosa, p. 30.

respect to itself plays diverse roles in self-formation without losing its self-identity. It is self-creative; and in its process of creation transforms its diversity of roles into one coherent role. Thus 'becoming' is the transformation of incoherence into coherence, and in each particular case ceases with this attainment. (PR 25/28; my italics.)

This passage indicates that Whitehead associates his notion of becoming with an internal "self-significance" of entities. The next Category of Explanation makes this assimilation even more explicit:

(xxiii) That this self-functioning is the real internal constitution of an actual entity. It is the immediacy of the actual entity. An actual entity is called the 'subject' of its own immediacy. (PR 25/38; my emphasis.)

Thus, it is the immediacy of the actual occasion that becomes. This definition mirrors that same sort of definition that Grunbaum uses for becoming in that for Grunbaum also becoming is bound to the internal states of things (minds).

But what then is this immediacy that becomes? As the term suggests, it has to do with the unmediated acquaintance of an actual occasion with its own subjectivity:

It is by reference to feelings that the notion of immediacy obtains its meaning. The mere objectification of actual entities by eternal objects lacks immediacy. It is repetition, and this is contrary to immediacy. But process is the rush of feelings whereby second-handedness attains subjective immediacy; in this way, subjective form overwhelms repetition, and transforms it into immediately felt satisfaction; objectivity is absorbed into subjectivity. (PR 155/234-235; cf. 136-137/207.)

Here it is of relative unimportance how one interprets Whitehead's use of eternal objects so long as it is observed that it is in virtue of these objects that the contents of experiences are repeatable. The intimation of the passage above that subjective immediacy is not repetition is the focal concept for the moment, for it is this principle that guarantees that every instance of becoming (qua subjective immediacy) is unique (cf. PR 35/52; 221/338-339).

The principle that every instance of becoming as an actual occasion is unique may be clarified by appealing to the concept of the "actual world" of actual occasions. An actual world is the set of actual occasions in the causal past of any given actual occasion. "It is for this reason that the meaning of the phrase 'the actual world' is relative to the becoming of a definite actual entity which is both novel and actual, relatively to that meaning, and to no other meaning of that phrase," (PR 28/42). Distinct actual worlds may have some actual occasions in common, but no two actual worlds have all occasions in common (PR 210/321; 211/322). Hence, defined in terms of their actual worlds, actual occasions do possess their feature of subjective becoming uniquely and unrepeatedly, for they possess that feature by reason of a unique causal inheritance.

It may be most expeditious at this point to regard Whitehead's view as of a type we have already examined, namely the MOPD. That doctrine, it will be recalled, espoused objective transitory temporal properties at the cost of

parsimonious propertyhood: there was a distinct property of nowness for every time of occurrence. Whitehead's own definition of becoming appears to make the same sacrifice, since for every distinct actual occasion there is a unique feature of subjective immediacy. Thus we may consider Whitehead's view of becoming as a property view of the MOPD type.⁶⁷

Of course, this means that Whitehead's view of becoming is subject to the criticisms that affect the MOPD, the major one being that a view such as this one violates Occamist principles. In a sense this is an unanswerable indictment, for Whitehead's view undisputably falls within its grasp. However, it may be rebutted that there is some doubt whether any account of predication that intends to satisfy our intuitions about nowness can escape such a criticism.⁶⁸ In favor of Whitehead's view it may be added that his doctrine of eternal objects eases the complaint a bit inasmuch as that doctrine makes some properties repeatable in some sense.⁶⁹

Before I can proceed with the question which seeks to ascertain the relationship of this definition of becoming

⁶⁷Whitehead's view is not easily regarded as relational because of the essential role that the eternal objects play in his account of subjective immediacy. At any rate the eternal objects are the mechanisms by which actual worlds are instantiated.

⁶⁸This raises the issue of the propertyhood of nowness again.

⁶⁹See PR 22/23: "There are no novel eternal objects."

to Whitehead's theory of time, I must first establish that this definition of becoming is Whitehead's preferred one, for there is at least one other passage in which Whitehead seems to use "becoming" in a sense quite different from this preferred one:

The modification of the 'Arrow' paradox, stated above, brings out the principle that every act of becoming must have an immediate successor, if we admit that something becomes. For otherwise we cannot point out what creature becomes as we enter upon the second in question. But we cannot, in the absence of some additional premise, infer that every act of becoming must have had an immediate predecessor. (PR 69/107.)

These comments, coming at the end of a discussion about Zeno's paradoxes, seem to utilize "becoming" in a way that concerns the ordering of distinct actual occasions in terms of a relationship of succession, and such a relationship would appear to involve transiency much in the same sense that Ferre used the term. This would not only render this use of "becoming" inconsistent with the above definition, but it would leave this latter transient sense of becoming open to all the criticisms leveled at the Ferrean concept of becoming.

However, I argue that although Whitehead seems to use "becoming" to mean transiency in the passage above, that meaning need not really apply in this case. For recall these remarks by Whitehead as quoted earlier: "But if we admit that something becomes, it is easy, by employing Zeno's method, to prove that there can be no continuity

of becoming," (PR 35/53; my italics). The point here, which is the identical point in the passage above, is that if it is admissible to hold that something becomes in any sense, then Zeno's paradoxes are sufficient to show that things can become only discretely. Becoming in this context is thus not given any status as a relationship that holds between entities, for it is argued that only a series of discrete entities can themselves exhibit a feature of becoming. And obviously this claim, though controversial, is logically distinct from one which claims that becoming is a relationship of transiency that orders entities.⁷⁰

Now that Whitehead's view of becoming has been adequately defined, it must be considered whether that view composes an essential part of Whitehead's theory of time. What will be found is that under one interpretation of time--what constitutes for Whitehead physical time--becoming has no part. But under another interpretation of time--namely, what is for Whitehead experienced time--becoming is a necessary component. Further, it will be suggested that this latter sense of time is for Whitehead compatible with the former concept at least insofar as it escapes many of the problems that bothered the Grunbaum-Baker-Ferre debate, especially those problems raised by the second attack on the argument from physics.

⁷⁰ The following section treats just this problem.

The relationship of the growth of subjective immediacy of actual occasions to what Whitehead designates as physical time is evident from these passages:

The actual entity is seen as a process; there is a growth from phase to phase; there are processes of integration and reintegration. . . This genetic passage from phase to phase is not in physical time: the exactly converse point of view expresses the relationship of concrescence to physical time. (PR 283/433-434.)

The actual entity is the enjoyment of a certain quantum of physical time. But the genetic process is not the temporal succession: such a view is exactly what is denied by the epochal theory of time. (PR 283/434.)

Thus physical time is composed of at least a subset of all the relations that obtain between distinct actual occasions. Some portion of this set of relations establish ordering relations between actual occasions that are designated to be temporal ones. Now it is imperative to see what relations are designated by Whitehead as constituting physical time.

One such temporal relation is that of simultaneity. Two actual occasions are simultaneous only if neither occasion lies in the causal past or causal future of the other. This is to say that events are simultaneous if they occur in causal independence of each other (PR 61/95; 320/487; 123/188). Causal independence is of course a purely empirical notion, and Whitehead concurs with Einstein that causal relationships are determined for any given event by the fact that no causal influence propagates faster than the

speed of light.⁷¹ Since the relation of simultaneity is expressed in terms of the mutual lack of causal influence, that relationship comprises membership in a simultaneity class or classes.

Conversely, actual occasions also sustain temporal relations in virtue of their causal relationships. Given a particular actual occasion, a time-frame may be established that fixes relations of temporal precedence with respect to that occasion and in terms of the connection of that occasion with other occasions in its causal past and future (PR 65/101; 123/188-189; 320/488). Furthermore, as a consequence of Whitehead's ontology, which is assumed here, the temporal relation of precedence is asymmetrical from the perspective of a given occasion in the history of an enduring object, since that enduring object's constituent actual occasions are ordered in terms of causal relationships that render each individual occasion emergent from a unique actual world (PR 238/365; 237/363). Thus, Whiteheadian physical time is asymmetrical and irreversible for ontological reasons, despite the prevailing opinion of physicists that these are purely empirical questions.⁷²

⁷¹This concordance was grudging on Whitehead's part. He was bothered that such a purely empirical notion lay at the foundation of relativity theory.

⁷²This is required by a denial of a substance ontology. Substances can survive changes over time and suffer temporal reversals, at least in theory.

These two relations--simultaneity and precedence--are all that Whitehead requires in order to describe his actual occasions physically, i.e., causally (PR 236-239/361-365). Though Whitehead often uses phraseology that appears to introduce other relations into the consideration of physical time (note chiefly his remarks on "transiency" at PR 210/320 and 214/326-327 which seem to call for Ferrean becoming; but cf. PR 211/322), his careful remarks and definitions (PR 123 f./188 f. and 319 f./486 f.) are all based solely on causal concepts that result in a view of physical time that is compatible with Minkowskian world-line interpretations.⁷³

Thus Whitehead's concept of becoming is not a necessary part of his account of physical time. There are contexts in which Whitehead refers to the "creative advance" of the world in a fashion that implies that in some sense that the world "becomes" temporally with God's consequent nature (PR 346/524). However, in defense of my thesis I first point out that it may be that such a relationship may not be in physical time at all, since such a grasp of the state of

⁷³ Whitehead had an unfortunate tendency to use Newtonian language. Such uses confuse interpreters by leading them to think that Whitehead injects Newtonian concepts into his theory of physical time, though really such uses reflect nothing more than his intractable skepticism. But when Whitehead defines purely empirical concepts such as the theory of physical time, he is careful to do so in a way that is at least compatible with the Special Theory.

the physical universe would entail some premise about God's omniscience that is not expressible in ordinary causal language.⁷⁴ Second, Whitehead himself intimates that this relationship between God and the world may not be temporal in the physical sense: "This element in God's nature inherits from the temporal counterpart according to the same principle as in the temporal world the future inherits from the past," (PR 350/531). Third, Whitehead also acknowledges that this side of God's nature comprises "as much a multiplicity as it is a unity" (PR 350/531), which seems to indicate that on one side of the relationship, the worldly side, the constitution of the world before God consists merely of a disjunctive class (cf. the meaning of "multiplicity" in PR 30/44), which in part meets the requirements of a simultaneity class as taken from one standpoint.⁷⁵ Given these points, it seems tenable to withhold becoming from Whitehead's account of physical time.

However, there is a sense in which becoming is a necessary feature of Whitehead's view of subjective time, for without becoming qua subjective immediacy there could be no experienced time. As noted beforehand, a view such as this one is commensurate with the MOPD, since every distinct case

⁷⁴ How could God know about the present state of the world if He only obtains knowledge through ordinary causal means? He would be limited by the speed of light.

⁷⁵ The premise about God's omniscience is still necessary.

of subjective immediacy is unique ex hypothesi. Still, it may be queried what constitutes the time which subjective immediacy is acquainted with. Since subjective immediacy is inconsequential to the relations between distinct occasions which results in the temporal ordering of those occasions, it must deal with time in some other sense. This other sense of time is what Whitehead terms "duration." Thus it is durations that subjective immediacy concerns. In order to establish the relationship between durations and subjective immediacy, it is first necessary to define the concept of a duration.

Above it was established that one sort of ordering relation that obtains between actual occasions is simultaneity, which in turn is defined as membership in any and all classes of occasions that happen in causal independence of one another. Whitehead characterizes this relationship for any set of occasions satisfying the membership requirement as constituting a "unison of becoming," "mutual unison," or "concurrent unison" (PR 124-125/190) for all the members of such a set. This is to say that the becoming of each member of the set is causally unrelated to the other members. The one set which includes all the occasions that are in "concurrent unison" with a given actual occasion is that set of all occasions standing outside the light cones of the given occasion. This set constitutes the "simultaneity cones" of that given occasion.

Within the simultaneity cones of a specific actual occasion there are an indefinite number of subsets of actual occasions that are in unison of becoming with that specific occasion (PR 125/191). Such subsets constitute different durations (PR 322/491). It should be noted that the membership of one of these subsets is entirely arbitrary insofar as any occasion within the simultaneity cones is as eligible for membership in a duration as any other in that cone.

There is one duration, however, which is completely unique for every actual occasion. This is the duration that includes all of the immediate present of each actual occasion:

The "classical" theory of time tacitly assumed that a duration included the directly perceived immediate present of each one of its members. The converse proposition certainly follows from the account given above, that the immediate present of each actual occasion lies in a duration. (PR 125/191.)

Further, Whitehead evidently finds the basis for these durations in terms of an actual occasion's ability to project a present for itself, the result of which he terms "presentational immediacy":

The actual occasion is included in its own immediate present; so that each actual occasion through its percipience in the pure mode of presentational immediacy--if such percipience has important relevance--defines one duration in which it is included. The percipient occasion is "stationary" in this duration. (PR 125/191; my italics.)

The reason for Whitehead's stipulation that it is this property of presentational immediacy that determines the duration for a given actual occasion is that he regards some simple actual occasions as having no such unique durations.⁷⁶ Thus, we see that a unique duration is determinable for each actual occasion which exhibits presentational immediacy. This is to say that there is at least one duration for every qualified actual occasion the membership of which is not arbitrary, for (a) it consists of that qualified actual occasion, and (b) it is defined by the nature of the experience of that actual occasion. An occasion satisfying (a) and (b) is said to have a presented duration (PR 125/191).

Thus all actual occasions become (have subjective immediacy), but only certain occasions have the ability to project that becoming into an experienced temporal duration. These occasions have a significant presented duration, and it is the content of the presentation which constitutes the subjective temporal element. For all practical purposes, that subjective temporal element may be identified with presented durations. Hence for all entities that experience a subjective sense of time, those entities must possess a

⁷⁶ Note that this distinction is made in terms of those occasions that have no practical presented duration. But in order to treat those same occasions by some abstract schema (such as physical law), even they must be assigned such unique durations.

significant presentational form of subjective immediacy. It is in this sense that becoming qua subjective immediacy is a necessary condition for experienced time.

Immediately one may see analogies between Whitehead's and Grunbaum's views of becoming, analogies that are surprising given the polemics found in Grunbaum's work against Whiteheadian views of time. But both men marshall becoming into states of subjectivity, Grunbaum by collapsing becoming into judgmental awareness, Whitehead by identifying becoming with subjective immediacy. The major difference between the two appears to be the scope of applying these subjective traits. Grunbaum restricts becoming to conceptualizing beings, whereas Whitehead indicates that perhaps all actual occasions incorporate becoming as a significant element, and that all actual occasions do this in virtue of possessing subjective immediacy.

There are distinct differences in these views, however. Earlier it was argued that Grunbaum's view of becoming is susceptible to certain dualistic difficulties. Whitehead's metaphysics, by the means of the concept of the actual occasion, avoids such problems. It has physical attributes in virtue of its causal connections, and mental attributes which form the experiential basis for the entity. It is this dual nature of the actual occasion which provides the corresponding dualism between physical and subjective time as explained above.

Grunbaum's view was also plagued by the counterexample of memory-jogging, a counterexample made effective due to Grunbaum's very restrictive definition of becoming. Whitehead's definition of becoming as subjective immediacy bypasses such a counterexample by positing that all actual occasions possess becoming.

Also Grunbaum's view fell under the purview of Ferre's problem of temporal location. Since that problem requires an explanation of why experiences happen at the physical times that they do, and Whitehead's view of physical time is no more or less tenseless than Grunbaum's, then Whitehead's view also seems smitten by this problem. But there is an answer available to Whitehead (and no less to Grunbaum as well), and that is that every actual occasion (or mental event) has phenomenological priority of its experienced time at the physical time at which it occurs (tenselessly). Ferre's own response, which requires objective or physical transiency, runs into trouble with Special Relativity. Since both Grunbaum's and Whitehead's views of physical time are at least compatible with this theory, the response that I suggest to Ferre's problem may be more appropriate than his own.

Summary

This section has attempted to unravel the complex issue of becoming, which Whitehead maintains is a part of the

temporal order. Most interpreters of Whitehead have understood him to mean that becoming is an objective physical feature of the world, and that he therefore must hold a position very much like Ferre's. However, I have attempted to show that Whitehead's view of becoming is very much more like Grunbaum's in that both Grunbaum and Whitehead take becoming to be an internal (mental) feature of events, and not an external (physical) one.

II. THE DISCRETENESS OF EPOCHAL TIME

Of the conditions that are deemed necessary for the epochal theory of time, the condition that the temporal elements which make up time be extended, discrete elements are the most prominent. Unfortunately, it also is the condition that has been the most controversial, and as I believe, least susceptible to incisive philosophical analysis. Thus, I confess at the outset of this examination of the discreteness of epochal time that my efforts and conclusions are necessarily limited ones. A very large part of my task will be the exposure of the difficulties inherent in this issue. In the final analysis, I believe that the contributions that philosophy can make toward the resolution of the issue of epochal versus dense time are so very restricted by empirical considerations that much of what philosophers have to say about it is philosophical rubbish. It is my intent not only to refrain from increasing the heap, but to examine why the rubbish already there smells so badly.

A good place to start is to show the conceptual difference between what is properly a philosophical issue, such as the preceding issue concerning temporal becoming, and what is a scientific issue, such as epochal versus dense time. Of course, there is the immediate retort to my suggestion that some issues are not properly philosophical, and that is that all concepts are of philosophical importance. In this

general sense, we cannot evade philosophy in the conduct of life; and though I may agree, I do persist in my view that philosophers sometimes hastily and grandiloquently venture into realms for which they are ill-prepared, and as such are intellectually culpable for their zeal. I believe that such respected thinkers as Whitehead, Grunbaum, and many others are guilty of this kind of carelessness, or should I say of their shared inclination to too readily believe their premature conclusions. Philosophically, I prefer to hold to a guarded skepticism as to the fine structure of space-time, but with the recognition that science appears to work very well with the assumption that time is a dense continuum.

But lest it be thought that I assume there to be a "given" scientific view of time which philosophers are not qualified to criticize, I must be clear in my disclaimer of such an assumption. Physicists themselves far too often lay claim to philosophical "truths" about space-time that are essentially the same mistakes of philosophers supposedly made legitimate by scientific authority. As I see it, science, and especially physics, has done much experimentally to garner genuine authority for its pronouncements. But the authority of these pronouncements is a function of the workability of prediction and explanation, and as such it is essentially a pragmatic authority.⁷⁷ As far as the

⁷⁷My debt to Quine is obvious.

philosophical content of these claims is concerned, they are as speculative as anyone else's.

At any rate, why should I claim that temporal becoming is a proper philosophical issue and the fine structure of space-time is not? One good reason is that the issue of becoming has relevance to ordinary, everyday experience, where the discreteness of denseness of time does not. Proponents of mind-independent becoming have a genuine basis for their position in its seeming obviousness. Nowness is a factor of experience, they contend, which must be a part of the order of things. And, even the opponents of temporal becoming must accommodate this factor in their explanations. Thus, the antagonists in this controversy share some common ground for discussion, and their respective explanations of their positions must somewhere strive to deal with the same facts.

There is no evident parallel equity restraining the debate over temporal structure, no fact, concept, or circumstance which the participants must agree upon or take into account. In fact, this debate is characterized by the startling divergence of starting-points from which the disputants derive their differing positions. For example, apparently in 1924 Whitehead was so impressed by the then-emerging quantum theory that in Science and the Modern World he first embraced his epochal theory of time.⁷⁸ Alternately,

⁷⁸ Alfred North Whitehead, Science and the Modern World (London: The MacMillan Company, 1925). In keeping with

Whitehead's chief opponent in this matter, Adolf Grunbaum, defends his theory of temporally dense event occurrences on his claim that mathematical physics actually operates on the premise that events have the cardinality of a continuum.⁷⁹

This surely provides a reason to look askance at the argument over temporal structure, but it is not sufficient to conclude, as I do, that this issue is not properly philosophical. This stronger claim of mine is founded upon my considered opinion that much of what has been uttered in the course of this argument is dreadfully, uninformed, misinformed, or underinformed. What I mean by this is that it is a prerequisite that one be thoroughly acquainted with the scientific data pertinent to time as well as the philosophical and logical aspects of time. In the sense that I find many investigators severely hampered by their lack of scientific knowledge, I find those investigators' arguments deficient. Thus it is the sense that I regard adequate scientific knowledge (especially quantum theory, thermodynamics, and special relativity) as a necessary condition for being qualified to deal with the problem of temporal structure.

conventions of the literature, reference in the text to this work will be SMW followed by the pagination from the 1925 edition. For the details of Whitehead's move toward an epochal theory, see Lewis S. Ford, "Whitehead's Philosophical Discovery," International Philosophical Quarterly, Vol. 17 (1979), pp. 251-264.

⁷⁹Grunbaum, Modern Science, chapter 3.

that I feel many philosophers who lack this knowledge are precluded from participating in the exchange meaningfully.⁸⁰ Hence philosophy apart from science can make no headway toward the resolution of this issue. If the problem of the fine structure is to be pursued at all, it must be done so by qualified physicists interested in that problem, or at least by philosophers of physics.

With these caveats before us, I shall now turn to an exposition of Whitehead's theory of epochal time. First, I will discuss Whitehead's epochal theory and attempt to discover the reasons for Whitehead's espousal of that theory. Next I will attempt to describe the conceptual nature of discreteness that is required of epochal time. Finally, I will articulate my misgivings about Whitehead's view as taken from a pragmatic viewpoint of quantum theory. In this combined way I hope to provide a reasonable defense of my skepticism in regard to this issue of the fine structure of space-time.

Whitehead and Epochal Time

It is generally conceded by Whitehead scholars that the epochal theory of time makes its debut in SMW. What is not

⁸⁰I am particularly frustrated by the efforts of process philosophers to resolve this issue. Often such discussions rage over hermeneutical matters concerning Whitehead's texts, glossing over the very reasons why one should hold to or reject an epochal theory of time in the first place.

so well agreed upon are the reasons that Whitehead embraced that theory in the first place. There are two different schools of thought in regard to this question: one, that Whitehead gradually developed a theory of events that emerged into the epochal view, and two, that Whitehead suddenly developed reasons that forced him to embrace an epochal theory.

The view that Whitehead gradually developed his epochal theory has some strong support in its favor. Whitehead never actually signals a change of mind about his theory of events, so if such a change took place, the reasons are not to be taken from Whitehead's own authority. Also, it is widely recognized that Whitehead was mildly critical of Einsteinian relativity (especially the general theory), and went so far as to develop in 1922 his own version of it.⁸¹ A reasonable corollary of this divergence from Einstein is that Whitehead was dissatisfied with Einstein's account of events, and thus he devised his own theory of events which hatched into the full-blown theory of epochal time in 1925 with SW. This interpretation entails that the epochal theory of time is merely a metaphysical expression of extant though scientifically expressed concepts in Whitehead's work prior to SMW.

⁸¹ Alfred North Whitehead, The Principles of Relativity (London: Cambridge University Press, 1922); hereafter Rel.

There are, however, certain counterpoints that militate against the persuasiveness of these points. Against the fact that Whitehead did not indicate any changes in SMW pertaining to his theory of events it can be noted that Whitehead was notorious for modifying his views without giving due notice of his doing so. The fact of Whitehead's reconstruction of his theory of objects into his theory of eternal objects has been well-documented, and furthermore there is ample evidence to suggest that the theory of eternal objects did not remain untouched after its enunciation in SMW.⁸²

Indeed, some authors have already distinguished important features of Whitehead's atomic view of events that demarcate it from earlier views.⁸³ Among the important features of the view of atomic events is that of the closure of the actual occasion, whereas is contradistinction the earlier view of events allowed for the overlapping and interpenetration of events.⁸⁴ Thus it would seem that Whitehead's earlier view of events is incompatible with his view in SMW that they are epochal or atomic.

⁸² It has long been my opinion that Whitehead's theory of eternal objects underwent major conceptual upheavals from SMW to PR. At a later time I intend to attempt to publish my thoughts on this topic.

⁸³ For example see Nathaniel Lawrence, Whitehead's Philosophical Development (Berkeley: The University of California Press, 1956).

⁸⁴ This was the case in Whitehead's scientific works.

Another reason to discount the "evolutionary theory" of Whiteheadian time is a result of the effort of Lewis F. Ford. He has introduced textual-critical methods of scrutinizing Whitehead's texts, and he has offered an interesting refinement of the fact that the doctrine of epochal time first appeared in SMW. He has shown that Whitehead discovered that time must be epochal after much of SMW had been written and delivered as the Lowell Lectures given at Harvard in February, 1925.⁸⁵ Hence, all the texts which treat the matter of epochal time are insertions into the original lecture. If this claim of Ford's is defensible, as I believe it is, then Whitehead stumbled across some reason, argument, or fact that stimulated his propounding the epochal theory of time between the delivery of the Lowell Lectures and the publication of them as SMW.

The reasons for Whitehead's espousal of epochal time should therefore be present in SMW, and particularly in those sections of SMW which Ford indicates to be insertions. Such a section is the latter part of Chapter VII, in which the epochal theory of time first clearly emerges, and to which Whitehead himself refers to in PR (PR 68/105) in speaking of that theory. Thus some attention must be devoted to that section which comprises SMW 122-127.

Unfortunately, although this section devotes much to a description of epochal time in terms of Whitehead's theory

⁸⁵Ford, p. 251 f.

of events, there are relatively few reasons given why one should hold to epochal theory in the first place. In fact, the only defense of the epochal theory in that section is that it does not fall prey to Zeno's classic objections. Even more frustrating is the brevity with which Whitehead states his defense. In criticizing views of time that hold that temporal event-points form a mathematical continuum, Whitehead injects, ". . . Zeno would object that a vicious infinite regress is involved. Every part of time involves some smaller part of itself, and so on," (SMW 126). This sketch of Zeno's argument is so vague as to be useless. First, it doesn't indicate which of Zeno's arguments Whitehead is drawing upon, though perhaps it is the Dichotomy or the Racecourse. Secondly, Whitehead makes no effort to flesh out the mathematical issues of the paradoxes and distinguish them from the metrical and kinematic ones, and thus it is unclear why time is impossible. It is clear, however, that Whitehead feels that events cannot possess the order of the Cantorean continuum without some absurdity.

In that same section of SMW Whitehead does refer to another section of SMW--Chapter VIII--in which he discusses the relevance of epochal time to the then infant quantum theory. Part of Chapter VIII has been recognized by Ford as constituting another of Whitehead's insertions into the original text, and as it turns out, that insertion provides some small insight into why Whitehead felt obliged to propose the epochal theory.

In that section Whitehead lays great emphasis on the claims of quantum theory, claims that he feels have relevance to the way that we should view reality:

The discontinuities introduced by quantum theory require revision of physical concepts in order to meet them. In particular, it has been pointed out that some theory of discontinuous theory of existence is required. What is asked from such a theory, is that an orbit of an electron can be regarded as a series of detached positions, and not as a continuous line. (SMW 135).

Indeed, Whitehead must have been very impressed with what he took to be the world-view of quantum theory. His language, above and elsewhere in SMW, strongly suggests that he took the quantum, discontinuous existence of subatomic entities as fact.⁸⁶ Therefore, Whitehead was motivated to align his theory of time with this fact. It is certain at any rate that Whitehead did not base his epochal theory merely upon the supposition that it escaped Zenoist difficulties, for he remarks about this alleged feature of epochal time almost as if it were an afterthought: "Also if this concept of

⁸⁶ Many interpreters of Whitehead believe that in SMW Whitehead subscribed to the view that: one, discontinuous (quantum) existence (such as the type of existence one "primate" has in one minimum duration--SMW 136) is equivalent to vibratory (wave) existence; and two, that these kinds of existence are purely empirical facts. But Whitehead clearly distinguishes between these types of existence, such as to use vibratory existence to explain discontinuous existence (SMW 36). And in the sense that Whitehead feels the need to make discontinuous existence compatible with the more proven empirical wave concept, he seems to feel that discontinuity is more than an experimental hypothesis, but a metaphysical one.

temporalization as a successive realization of epochal durations is adopted, the difficulty of Zeno is evaded," (SMW 136).⁸⁷ But here as elsewhere in SMW, the relevance of Zeno's arguments to epochal time is sketchy at best.

Perhaps in 1925 Whitehead did not fully grasp the significance of epochal time to Zenoist arguments beyond the vague recognition that somehow discretized time evaded the force of some of those classical paradoxes. Whether or not this is the case the pages of SMW cannot tell. The detail of argument is missing; nor can it be inferred. What is explicit, on the other hand, is Whitehead's need to accommodate the impact of quantum theory into his metaphysical world view. I can only conclude that quantum theory led to Whitehead's espousal of epochal time, and not considerations of Zeno's arguments.

A year after SMW's publication, Whitehead delivered a lecture later published in which the relationship of Whiteheadian time to the status of Zeno's arguments does prove to be inferable. In that lecture Whitehead explicitly unpacks his concept of epochal time as requiring supersession of the temporal elements to make that view intelligible:⁸⁸

⁸⁷ Lewis Ford has agreed in conversation that Whitehead did not use Zenoist arguments as a foundation for his epochal view of time.

⁸⁸ Alfred North Whitehead, "Time," Sixth International Congress of Philosophy Proceedings (1927), pp. 59-64; hereafter Time.

No philosopher takes time seriously who either conceives of a complete totality of all existence, or conceives of a multiplicity of actual entities such that each of them is a complete fact, "requiring nothing but itself to exist, God only excepted." If time be taken seriously, no concrete entity can change. It can only be superseded. Also it must be superseded because supersession is part of its real essence, in Locke's sense of the term "real essence." (Time 59).

Several observations should be made here. Whitehead's disjunctive statement makes two things very clear. In the first part of that statement, Whitehead decries theories of so-called "bloc" time, time that sustains tenseless relations of simultaneity and precedence but not relations of past, present, or future (e.g., McTaggart's B-series, or Grunbaum's view of becomingless time). In the second part of that statement, Whitehead argues for an essential incompleteness that results from viewing any event apart from other events. The combined effect of these two points is that Whitehead uses them in support of his view that supersession is an essential part of the temporal order. Obviously events supersede one another in some way so as to constitute an objective relation between the events so related. Hence Whitehead's view of supersession in Time is akin to Ferre's view of the objective transiency of time.

In a later passage from Time Whitehead links the epochality of time to this notion of supersession:

If we combine the notions of supersession and continuity we are at once entangled in a vicious infinite regress.

For if B supersedes A, then the continuity of B requires that some earlier portion of B has

superseded A antecedently to that later portion of B. This argument can be repeated on that earlier portion of B, however, you choose that portion. Thus we are involved in an infinite regress. Also the supersession of A has to commence at what should be the infinite end of the regress. But there is no infinite end. Hence supersession cannot be regarded as the continuous unfolding of a continuum. I express this conclusion by the statement that time is epochal. (Time 63-64, first emphasis mine.)

Why is the first time Whitehead gives us a sufficient idea why a temporal continuum is unsatisfactory in the fashion of Zeno's arguments. Here supersession as transiency (from A to B in the passage) is incompatible with the assumption that the transient elements are themselves infinitesimals. Thus for time to exhibit transiency the temporal elements must be discrete.⁸⁹

Although this argument is definitely of Zeno's type, and as such is much clearer than those Zenoist references in SMW, it remains an unsatisfactory argument in this guise. The reason is that the proposed absurdity revolves around the incompatibility of supersession and continuity. However, supersession understood as objective transiency is a dubious feature, and, as argued in the previous section, it has no place conceptually in modern space-time views. Thus

⁸⁹ Zeno's Racecourse and Bichotomy come to mind as arguments similar to Whitehead's here. But that also suggests that Whitehead may be open to all the classic objections brought against the paradoxes, such as Bertrand Russell's in A History of Western Philosophy (London: George Allen and Unwin, Ltd., 1961), p. 763 f. But Whitehead in PR 68-69/105-107 indicates that he would concur with most of these.

it appears that Whitehead argues in *Time* for the epochality of time based on this rather spurious assumption. However, as indicated heretofore and as I shall argue below, Whitehead abandoned this manner of argument in *PR*.⁹⁰ At any rate, in *Time* Whitehead also takes the trouble to show again that the factual root of epochal time lies in its competitiveness with quantum physics (*Time* 64).

In *PR* the epochal theory of time is elaborated in concert with Whitehead's metaphysical view of the actual occasion, and for this reason *PR* is often seen as a mere continuation of themes and beliefs adumbrated in *SMW*. But the epochal theory of time certainly underwent transformation from *SMW* to *PR*. As I have outlined above, prior to *PR* Whitehead was committed to the objective reality of supersession among actual occasions, which amounts to the belief in physical transiency. But, as I have argued previously, apparently in *PR* Whitehead abandoned this objective concept of supersession, choosing rather to absorb supersession (as becoming) into the makeup of individual actual occasions, and thus relegate the objective temporal relations between actual occasions to only simultaneity and precedence.

⁹⁰ I should specify that Whitehead abandoned supersession as a ground of criticism in *PR*, and expanded his criticism to include any two-termed relation which supposedly holds between infinitely receding relata. See the following text for the details of this argument.

Of course, such a transformation is bound to affect Whitehead's opinion of the relationship of Zenoist arguments to epochal time such as he advanced in *Time*, for he has in *PR* dropped the ground of absurdity which he established by his introduction of the concept of supersession in *Time*. And, as we see from the text of *PR*, the arguments from Zeno are treated much differently indeed.

First, it is patently apparent that in *PR* Whitehead feels that much in Zeno's paradoxes is irrelevant to the issue or simply muddle-headed. In speaking of William James' support of epochal time Whitehead notes that "James also refers to Zeno. In substance I agree with his argument from Zeno; though I do not think that he allows sufficiently for those elements in Zeno's paradoxes which are the product of inadequate mathematical knowledge," (*PR* 68/106). Whitehead also notes that he agrees "that a valid argument remains after a removal of the invalid parts," (*PR* 68/106)

What Whitehead considers to be these invalid parts is not certain, but Whitehead does make some useful comments on this. For example, he chastises Zeno's "Arrow" paradox because it introduced kinematical considerations which obscure what he takes to be the crucial temporal issues (*PR* 68-69/106). Similarly he derides the "Racecourse" as invalid,

being based on a mathematical fallacy (PR 69/107).⁹¹

What is most interesting is that part of Zeno which Whitehead takes to be entirely valid. The passage which sets out Whitehead's view of the validity of Zeno's arguments is important, and has been, I think, misunderstood for the most part. Hence I shall quote it in full:

The argument, so far as it is valid, elicits a contradiction from the two premises: (i) that in a becoming something (res vera) becomes, and (ii) that every act of becoming is divisible into earlier and later sections which are themselves acts of becoming. Consider, for example, an act of becoming during one second. The act is divisible into two acts, one during the earlier half of the second, the other during the later half of the second. Thus that which becomes during the whole second presupposes that which becomes during the first half-second. Analogously, that which becomes during the first half-second presupposes that which becomes during the first quarter-second, and so on indefinitely. Thus if we consider the process of becoming up to the beginning of the second in question, and ask what then becomes, no answer can be given. For, whatever creatures we indicate presupposes an earlier creature which became after the beginning of the second and antecedently to the indicated creature. Therefore there is nothing which becomes, so as to effect a transition into the second in question. (PR 68/106).

On the first reading it might be thought that this passage merely echoes the thought of Time, and excised from the context of PR these two distinct statements appear to be very similar. However, the basis for the contradiction set

⁹¹ Again I point out that these statements are in total agreement with classic criticisms of Zeno. Whitehead would agree with Grunbaum's remarks in Modern Science, Chapter 2, for example.

up in Time is that temporal continuity cannot allow for the transiency of what is supposedly continuous. If, on the other hand, Whitehead abandoned the concept of transiency between actual occasions in PR as I argued in the previous section, then it seems unlikely that the basis for the apparent contradiction in the passage above can be the same as that for Time. As I shall show, Whitehead's point in the passage above has nothing to do with temporal transition at all, although a superficial reading of it, especially the last sentence, may indicate otherwise.

To resolve what Whitehead takes to be a contradiction above, obviously one of the two premises must be sacrificed. It is just as obvious that premise (ii) is put to the torch. Note, however, that Whitehead performs an apparent reductio ad absurdum upon (ii) not by appealing to the nonsense of transiency in a process of becoming that is infinitely divisible, but by showing that a two-termed relation supposedly holding between dense continua is an unintelligible one, for if the relation is continuously applied to infinitely receding relata, no ultimate relata for the relation can be found. Thus it appears to Whitehead that the relation applies to nothing. Whitehead carries on this particular argument with the relations "earlier" and "later" though

ostensibly any two-termed relation would suffice.⁹² But of course Whitehead wishes to defend his epochal view of time, and thus he chooses to work with temporal examples. The moral is that for any temporal relation to hold between real entities, those entities must be discrete and cannot recede infinitely.

Seen in this way, one might readily object that Whitehead really performs no reductio at all, but rather that he only denies (ii) in a roundabout way. It is true that there seems to be no obvious absurdity in holding that relations may hold between continuously dense relata, so Whitehead's reductio, if we may call it that, is not purely a logical one. Indeed it seems the case that Whitehead's point is merely a disguised empirical claim: viz., it doesn't seem empirically possible that real temporal relations can hold between real elements that are subdivisible unendingly. I think Whitehead himself recognized the empirical content of his argument, for he states immediately following the passage quoted above that: "The difficulty is not evaded by assuming that something becomes at each non-extensive instant of time. For at the beginning of the second of time there is no next instant at which something can become," (PR

⁹² I don't believe that Whitehead's choice of earlier- and later-than as the relations which he deals with in this argument is accidental. I believe that he came to see that relations of simultaneity and precedence are the only relations that actual entities sustain as external temporal relations.

68/106; my emphasis). What is this but a bald assertion that nextness is a concept necessary to the understanding of relations between real temporal elements? And if the elements of a temporal series exhibit nextness relations, then those elements must be discrete. However, at no point does Whitehead demonstrate that this nextness feature is logically necessary, but only that it must characterize real temporal components. Thus Whitehead's claims about temporal discreteness and temporal nextness are not purely logical ones, but they have some sort of non-logical ground.

If my arguments carry weight, then the ultimate justification of Whitehead's theory of time is that it reflects what Whitehead took to be the ontological import of quantum theory. Whitehead's use of Zeno's arguments is meant as a support of this contention which, unfortunately, sometimes is overshadowed by the Zenoist references themselves. But unless Whitehead's epochal assumptions have some other than the basis of his "valid" reconstruction of Zeno's arguments, he is lost. For as I have shown, there is nothing logically absurd about relations that hold between infinitely regressive relata unless it is already supposed that real temporal elements do not in fact exhibit such a regress. Thus what is left of the basis for Whitehead's epochal theory is his indebtedness to quantum theory.

There are questions that remain. Does quantum theory have any importance for the way that we think about time as

Whitehead suggests? What is this relation of nextness that discrete elements have to one another? In the sections that follow I examine these questions in reverse order and in greater detail.

The Nextness Relation

Now it is necessary to discuss the nextness relation and distinguish it from other temporal relations. Obviously nextness, or temporal contiguity, applies only to a temporal series whose elements are discrete rather than dense, for a continuum of elements may not, by definition, possess individual members that can be cardinally ordered in a one-to-one correspondence with the natural numbers. Hence, as Grunbaum shows, the temporal ordering of dense continua must be based upon a relation which is independent of the possibility of the temporal contiguity of two temporal points.⁹³ For Grunbaum this primitive ordering relation is betweenness, and if such a relation is definable consistently, then there is a sense that a time-point may be said to be between two other time-points, though it is inadmissible to say that any time-point is next to another.⁹⁴

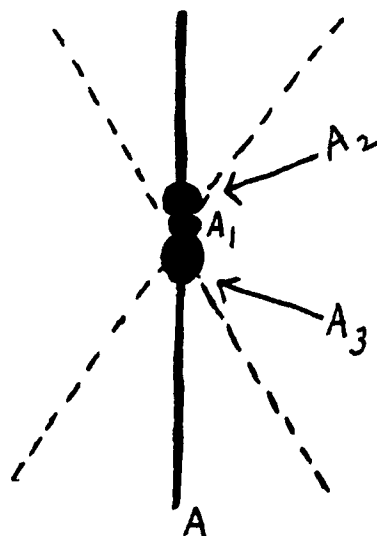
However, in an epochal theory of time, the time-points of a temporal series are not punctal in the typical Euclidean sense, but they have durational extension, and thus in principle they may be ordered denumerably. As a result, one time-point may legitimately be said to be next to another, and thus the relation of nextness in an epochal theory must be an intelligible one.

⁹³ Grunbaum, Modern Science, pp. 70-75.

⁹⁴ Ibid.

But under the epochal theory, what then is the relationship of nextness and betweenness? Betweenness, as Grunbaum has argued, does not necessarily involve nextness, but of course this wholly depends upon whether the temporal series exhibiting betweenness is assumed to be a dense one or not. If the series is assumed to be discretely constituted, then a time-point that is defined as between two other time-points may or may not also be temporally next to those time-points.

In order to further understand the relationship of nextness to other relations, it will be necessary to resort to a world-line interpretation of the epochal theory. Therefore, in the diagram below let A represent the career of a spatio-temporally continuous object, and let A_1 , A_2 , and A_3 represent particular discrete events of A . Moreover, in view of the idea that the events of A are not densely ordered, let A_1 represent a preferred discrete spatio-temporal location from which the causal past and causal future of A_1 are set off by the forward and rearward light cones (the dotted lines). Let A_2 and A_3 be discrete events that are, by definitions, temporally contiguous to A_1 (A_3 is that event of A just prior to A_1 's occurrence, and A_2 is likewise just consequent to A_1 's occurrence). Let's see if we can characterize nextness from this representation.



Taking nextness as an unanalyzed primitive and in the intuitive sense utilized in the diagram, right off it is obvious that A_1 is next to A_2 , A_2 is next to A_1 , A_1 is next to A_3 , A_3 is next to A_1 , but A_2 and A_3 are not next to each other. Thus nextness appears to be a symmetrical, reflexive, non-transitive relation that holds between at least two discrete temporal elements. Of course, this characterization is erected on a circularity that presupposes an understanding of the relation. Such circularity should be excised from the concept of nextness, and thus nextness should be analyzed in terms of some other, more primitive relation. But what relation?

An examination of what is required of an epochal theory may provide an answer. First, an epochal theory of time should be formulated so as to be compatible with contemporary space-time views as much as possible. I have argued earlier that Whitehead attempted to do just this, and this

is the reason that in characterizing nextness I chose to resort to a Minkowskian-like interpretation of the career of a spatio-temporally identical object. Second, an epochal theory requires that events are discrete spatio-temporal elements.

The result of these requirements is that an epochal theory departs from the usual space-time view of physics precisely in that events in the former theory are discrete as opposed to the mathematical density that they must possess in the latter. Surely this difference is a great one, and yet they must hold some formal characteristics in common. One such characteristic is that both dense and epochal theories must be congenial to a consistent ordering of events in terms of the relation of betweenness. This relation of betweenness, I submit, is that a more primitive relation is needed in order to consistently define nextness.

Betweenness is a concept that is not without its own difficulties even as defined by Grunbaum in his defense of mathematically dense time.⁹⁵ Yet, as Grunbaum asserts, and I must agree, it is impossible to lay the formal groundwork of temporal order unless a tenable definition of betweenness is possible. As was noted earlier, it is true that in the epochal theory of time specific cases of nextness and

⁹⁵ Hugh M. Lacey, "The Causal Theory of Time," Philosophy of Science, Vol. 35 (1968), pp. 332-354.

betweenness have a conceptual overlap, so that betweenness might be defined by nextness in those cases. However, it was also noted that the definitions of nextness and betweenness are not equivalent, the reason being that all possible cases of betweenness include all instances of nextness, but not vice-versa. Thus, betweenness is the more general, hence more primitive relation.

I am merely going to assume that betweenness is definable consistently in an epochal theory, and although this assumption may be criticized for its presumptuousness, the objection may not proceed from the corner of the dense time theorist. For, any criticism of a formal definition of betweenness in an epochal theory must apply mutatis mutandis to a dense theory as well.

This may seem quite a bewildering claim. Yet, the reason I insist that an epochal theory must attempt a definition of betweenness that shares conceptual ground with a dense time theory is that I see no alternative to basing betweenness on some sort of notion of causality. There are certainly problems with doing this, but it must be remembered that both Grunbaum and Whitehead have it incumbent upon them to make their definitions of temporal topology and order relevant to modern conceptions of space-time, and that conception is certainly founded upon causality. Grunbaum's theory utilizes causality as a primitive in the notion of "k-connectedness," a concept of causality that is peculiar

at best.⁹⁶ Whitehead's epochal theory, on the other hand, relies on a notion of "causal efficacy," a relation that Whitehead explains amply by example but poorly conceptually.⁹⁷ However defective either or both of these notions are, obviously both men feel compelled to evoke this empirical relevance from their temporal definitions. How causality can be worked into the conceptual foundation of betweenness without circularity or triviality I do not know, but nevertheless I concur that somehow it must be there.⁹⁸

With these warnings before us, I shall now offer a definition of nextness that presupposes the relation of betweenness as defined by some prior causal conception. Two events x and y are temporally next to each other if and only if x and y are causally related and there is no event z which is temporally between x and y in any time frame.

As defined, nextness may only obtain between causally related, hence temporally related events. Thus, events which occur in causal independence of each other cannot sustain this relation. This is to say that the relation defined above is strictly a temporal one.

⁹⁶ Grunbaum, Modern Science, pp. 70-75.

⁹⁷ One of Whitehead's best explanations of causal efficacy is the abstruse passage PR 236-239/361-365. The upshot of this section is that temporal order based upon this notion of causal efficacy leads to a concept of time that is a priori anisotropic and irreversible.

⁹⁸ But see J. J. C. Smart, "Causal Theories of Time," The Monist, Vol. 21 (1969), pp. 385-395.

Also, though it is easy to conceive x and y as events temporally next to one another as parts of a self-identical spatio-temporal object, it must be seen that x and y may be any events such that they are causally related in some time frame. This qualification is really two-fold. First, the events are to be causally connected rather than connectible so as to avoid troublesome modal considerations.⁹⁹ Second, the occurrence of these events must be relativized to any time frame in which it is ascertained that the causal connection is secured. The effect of these qualifications is to dispose of the possibility of a preferred time frame.

Earlier on it was seen that nextness as a relation is a symmetrical, reflexive, non-transitive relation that holds between at least two events. This definition does not reply to the question of whether an event may sustain nextness relations to more than one event. Since nextness is based on causality, it seems logical to say that an event may have as many nextness relations as there are events which satisfy that relation to that event. Thus, to recur to the diagram, if A_1 has another event B which does not form an event-part of A but nevertheless fulfills the definition of nextness to A_1 (i.e., B lies in A_1 's light-cones and there is no event

⁹⁹ Ibid.

between A_1 and B in any time frame), then A_1 and B are also next to each other. There is no way to determine a priori how many nextness relations an event sustains temporally, but in view of the discreteness of events as hypothesized by the epochal theory, the number of events next to any given event must be denumerably finite.¹⁰⁰

It should be evident that the preceding account of nextness made only indirect reference to Whitehead. Since this relation is at the heart of the epochal theory of time, it would seem appropriate that my remarks be made relevant to Whitehead's comments about nextness. I have left this task until the end of my investigation because, as it turns out, Whitehead's remarks about this relation are very sketchy.

Whitehead does not employ the word "nextness" to refer to events that are juxtaposed to one another; his term is that one event is thus "contiguous" to another. Whitehead discusses this relation only once in PR and is defined thusly: "Let two actual occasions be terms 'contiguous' when the regions constituting their 'standpoints' are externally connected," (PR 307/468). Obviously contiguity for

¹⁰⁰F. Bradford Wallack has suggested that there are as many actual entities in the world as there are functional individuals, which results in the overlapping of actual entities temporally. Such a view presumably makes the problem of the individuation of actual entities one of the convention, and thus resolves conventionally. See her book, The Epochal Nature of Process in Whitehead's Metaphysics (Albany: State University of New York Press, 1980).

Whitehead reduces to this notion of external connection. What then is it for two occasions to be externally connected? In PR 297/453 we find "external connection" defined as follows: "Two regions are 'externally connected' when (i) they are connected, and (ii) they do not overlap." Disregarding (ii) for the moment, when we inquire as to what constitutes connection, we find that it is for Whitehead as undefined primitive, illustrated only by diagrams (PR 295-296/450-451). Furthermore, Whitehead says of connection: "A set of diagrams will illustrate the type of relationship meant by 'connection.' The two areas, A and B, in each diagram exhibit an instance of connection," (PR 294/449). Thus, Whitehead apparently felt no compulsion to flesh out the concept of connection, and this lack of initiative on Whitehead's part dispossesses contiguity of any real conceptual content.

Doubtlessly Whitehead would assent to the proposition that temporal contiguity has its foundation in the causal objectification of actual occasions in one another. Why Whitehead did not avail himself of this belief in his definition of contiguity has to do with Whitehead's intention to utilize "connection" in his system to refer to the kind of connection exhibited in both spatial and temporal relationships. Whereas temporal connection does indeed involve causal objectification, spatial connection involves "coordinate division," which is a means of defining spatial

relationships from the perspective of each occasion and in terms of potentiality (PR Part IV, Chapter I). The formal definitions found in PR 294 f. mean to employ "connection" to refer abstractly and unselectively to either spatial or temporal connection.

Thus, if we restrict attention to the matter of defining temporal contiguity, I believe that Whitehead should find my remarks about the relationship of nextness and betweenness fitting. His own definitions lead to the remark that externally connected regions cannot have a region that "mediately" connects them, and this is tantamount to the claim that no regions next to one another can have a region between them (PR 294 f.). In so far as such betweenness is embroiled in the conceptions of causality and nextness, Whitehead's opinions about their interrelationships could not deviate very much from my own.

Quantum Theory and Epochal Time

The relationship of quantum theory and the epochal theory of time requires an examination, because Whitehead took the former as implying the latter. I've shown previously that the epochal theory is defined by Whitehead on a two-fold ground. One ground is that, in Whitehead's words, the epochal theory is "required by the consideration of Zeno's arguments, (PR 68/105). But I have also shown that Whitehead's use of Zeno amounts to no more than a convenient

subterfuge for his assertion of temporal atomism. Thus the second ground of Whitehead's defense of the epochal theory--quantum theory--becomes all the more important as the very reason for his embrace of epochal time.

The relationship of space-time to quantum theory is cast into murkiness because of a longstanding controversy among physicists as to the epistemological import of quantum theory. This controversy is ordinarily dated from the Sixth Solvay Congress of physicists held in Brussels in 1930 with the antagonistic positions personified by Albert Einstein and Neils Bohr. At the center of the controversy was the interpretation of Heisenberg's uncertainty principle, which holds that the precise conjunctive measurement of certain conjugate properties (the classic canonical conjugates are position and momentum) is impossible. Einstein's position in this debate was that such a principle cannot reflect upon the actual constitution of nature, which must be invested with real properties all of which are in principle determinable with arbitrary precision, thus making the uncertainty principle inconsistent or incomplete. Bohr, on the other hand, maintained that the uncertainty principle is both consistent and complete in the sense that it encapsules the real structure of the world insofar as measurement is possible, and thus uncertainty is an epistemological fact with regard to quantum phenomena. Through an exchange of thought-experiments and counterarguments, Bohr's view,

called the complementarity interpretation, held the day at the congress, and still is the accepted view of the majority of physicists.¹⁰¹

What significance does the complementarity interpretation have for the relation of space-time to quantum theory? First, note that under either Einstein's or Bohr's view, the Heisenberg principle concerns only the properties of quantum objects as those properties are measurable; uncertainty does not concern the spatio-temporal disposition of quanta (I will deal with the famous time-energy relation in a moment). In this sense the uncertainty principle utilizes spatio-temporal concepts that are presupposed for quantum objects rather than predicated of those objects. So it seems that Heisenberg's principle does not influence our opinion of the fine-structure of space-time on the basis of its results directly. Second, one particular complementarity relation, that one between time and energy, discloses that temporal operators in quantum computation have a unique status which sets them apart conceptually from operators which denote

¹⁰¹"A given theory T admits a complementarity interpretation if the following conditions are satisfied: (1) T contains (at least) two descriptions D_1 and D_2 of its substance-matter; (2) D_1 and D_2 refer to the same universe of discourse U (in Bohr's case, microphysics); (3) neither D_1 nor D_2 , if taken alone, accounts exhaustively for all phenomena of U; (4) D_1 and D_2 are mutually exclusive in the sense that their combination into a single description would lead to logical contradictions." This definition of complementarity is taken from Max Jammer, The Philosophy of Quantum Mechanics (New York: John Wiley and Sons, 1974), p. 104.

other conjugal components. In fact, as I will show below, time cannot be treated as an operator at all.

Some physicists have attempted to place the time-energy uncertainty relation on a par with the position-momentum relation. However, as Max Jammer explains, the position-momentum relation is significantly different from the time-energy relation:

The generally accepted view, however, was that these two relations differ fundamentally. The position-momentum relation, it was pointed out, is a straightforward consequence of the commutation relation $[q, p] = i\hbar$ between the Hermitian operators representing these variables. On the other hand it was claimed that an analogous derivation of the time-energy relation could not be established, since, as Pauli showed, time cannot be represented by a Hermitian operator T satisfying with the energy operator (Hamiltonian) H a relation $[T, H] = i\hbar$. Such a relation, generalized in the usual way to $[f(T), H] = i\hbar \frac{\partial f}{\partial T}$ and applied to the unitary operator $f(T) = \exp(iaT)$, a being a real number, would imply that if ψ_E is an eigenfunction of H with eigenvalue E , $\exp(iaT)\psi_E$ is also an eigenfunction of H , but with eigenvalue $E + a\hbar$. Hence, since a is arbitrary, the eigenvalues of H would necessarily cover the real line from $-\infty$ to $+\infty$, in contradiction to the existence of discrete energy spectra.¹⁰²

Two comments about this paragraph may help to explicate it. First, if the formalism surrounding the elaboration of the position-momentum relation is sound (and it is not in the scope of my competence to question this), then simply because a above is arbitrary, and a may be irrational, then some eigenvalues of H as required by some operator values of

¹⁰²Ibid., p. 141.

T conflict with experimental results. Thus, on an empirical basis time cannot be treated as a typical, discrete Hermitian operator. Second, this result flows quite resolutely from the fact that a may be any real number. What this shows is that values of T vary as a function of a, and this evidences the conceptual reciprocity of the two. Therefore, time as a dense parameter is ensconced at the very level at which that theory is mathematically formulated, and in this sense time must be looked upon as a parameter, and not as a predicate expressible as an operator.

Hence, if the structure of quantum theory is true, at least in some pragmatic sense of "true," then it cannot be the case that time is in any sense quantized as Whitehead believed. Whitehead may be excused for his hasty inference, however, for two reasons. The first is that Whitehead drew his conclusion at a time when quantum theory was in its infancy, and only sketchy details of that theory were available for Whitehead's thought. But also Whitehead was logically forced into his opinion that time was quantized in virtue of his ontological commitments. Prior to his metaphysical writings Whitehead was immovably convinced that substantival realism was erroneous, and this rejection of the ontology of self-identical objects persistent through time most naturally gave way to an ontology in which the objects constituted time itself. Thus, though now in retrospect we may evaluate Whitehead's error with regard to his

misinterpretation of quantum theory and its relation to time, we may appreciate that there were other considerations which motivated Whitehead's embrace of his interpretation in the first place.

Conclusion

In this section I've attempted to show that the very condition that makes Whitehead's theory of time epochal--that is, the discreteness of the elements that constitute time--is a complex concept that is controversial at best. First, I've attempted to show that the reason Whitehead first adopted an epochal theory is that he believed that quantum theory required such a view. Second, I attempted to define nextness, a relation essential to epochal time, as some sort of intelligible concept. I found that nextness requires betweenness as part of its concept, and that this requirement puts epochal time much on the same footing as dense time as far as their mutual need to involve some notion of causality is concerned. Lastly, I found good reason to doubt that Whitehead's epochal theory is really consistent with modern quantum theory.

I can only conclude that the question of the fine structure of space-time is an open one, at least in the sense that there may be views alternative to quantum theory which may yet arise and be founded upon a theory of epochal time. Practically speaking, however, I think that

Grunbaum's view is the working hypothesis of contemporary physics, but this indicates more about the mathematical foundations of physical theory than a necessarily accurate picture of space-time itself. Workability is a high recommendation for this hypothesis, but Whitehead's epochal theory remains at least a logically possible alternative.

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