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THE DEVELOPMENT AND THE IMPACT OF
ALFRED NORTH WHITEHEAD'S
PHILOSOPHY OF TIME
1915 - 1929

by

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Thesis presented to the School of
Graduate Studies, University of Ottawa,
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CHAPTER I

INTRODUCTION

T. S. Eliot once wrote of Bradley's philosophy, "We fight rather to keep something alive than in the expectation that anything will triumph."¹ In my opinion, this statement describes the spirit of Whitehead's writings from 1915 to the publication of Process and Reality in 1929. Certainly during this period no overall triumphs can be claimed for either Whitehead's philosophy of nature or his specific reflections on time. Yet much has been kept alive by forming the foundation for new visions and new developments.

This dissertation will focus on Whitehead's philosophy of time and the importance that the problem of time had on Whitehead's philosophy during a fourteen year span (1915-1929). The purpose of the dissertation is to prove the following argument. Premise one is that the lack of a definite philosophy of time explains why Whitehead had to abandon his initial philosophy of nature which is found in the writings from 1915 to 1925. Premise two is that the writings from 1925 to 1929 mark a transition in Whitehead's thoughts in which the epochal theory of time reveals the

¹T. S. Eliot, "Francis Herbert Bradley," in Selected Essays, N.Y.: Harcourt, Brace and World, 1950, p. 399.

need for and the direction of his metaphysics, which is found in the writings from 1929 to 1947. The conclusion is that Whitehead's struggle with the perceptions, concepts, and the problems of time had a significant impact on and gave direction to his philosophical development.

I have focused on the writings between 1915 and 1929 because they have received little attention from Whiteheadian scholars. This period of Whitehead's thought is rich with insights, some of which are insufficient while others survived to maturation and issued forth as viable ideas in Process and Reality, Adventures in Ideas, and Modes in Thought. When traced through their development, these ideas, and particularly the concept of time, provide the scholar with a richer understanding of Whitehead's metaphysics and help guard against misunderstandings. The study of the writings from 1915 to 1929 is also exciting because of the learning experience provided by viewing a distinguished philosopher grappling with different ideas, and following their formulation as they are developed and communicated. For process philosophers the becoming of an idea or occasion should be as important as their issuing forth. In dealing with the writings from 1915 to 1929 I am dealing with the process as well as with the ideas. By understanding the problems, the tentative solutions, and the process (which Whitehead provides in attempting to understand

and to integrate time into his philosophy), I plan to prove my argument and show Whitehead's conceptual triumphs, shortcomings and the necessity for Process and Reality (1929).

Organizationally, I believe that Whitehead's philosophical writings can be distinguished and divided into three periods: 1915 to 1925, 1925 to 1929, and 1929 to 1947.² The first period (1915-1925) is distinguished by his attempt to develop a philosophy of nature that is closed to mind. The major works of this period are: An Enquiry Concerning the Principles of Natural Knowledge (1919), The Concept of Nature (1920), and The Principles of Relativity (1922). Chapters two through five analyze Whitehead's philosophy of nature and philosophy of time. The groundwork for premise one is provided in chapters two and three, and the proof is found in chapters four and five.

The second period (1925-1929) is a transitional one. It is distinguished by Whitehead's attempt to harmonize and to account for all human experiences, whether mystical, symbolical, epistemological, metaphysical, scientific, poetic or theological. The major works of this period are Science and the Modern World (1925), Religion in the Making

²While the author believes that there are ample reasons for distinguishing these periods from each other, it is also realized that there is an overlapping and a continuation of ideas from one period to another. It should also be noted that Principia Mathematica is not included as part of his philosophical works because of its emphasis on mathematical logic. However, the Principia Mathematica is referred to in the dissertation when the material necessitates such reference.

(1926), Symbolism Its Meaning and Effect (1927), and "Time" (1926). Chapters six through ten analyze Whitehead's philosophy of time and provide the groundwork and proof for premise two. My conclusion integrates the chapters and premises to provide the proof of my argument, and presents my reasons why Whitehead's philosophy of time offers a viable alternative to today's dominant constructs of time.

The final period reveals Whitehead's solutions to the problems generated by time, nature, and mind by systematically joining them into a metaphysical whole. While this period is beyond the scope of this dissertation, the major works of this period are: Process and Reality (1929), Adventures of Ideas (1933), and Modes of Thought (1938).

In Whitehead's first philosophical period (1915 to 1925), his philosophy of time developed inferentially from his philosophy of nature³ and from his critiques of other accounts of nature, notably Newton's and Einstein's notions. Chapter two establishes the hypotheses, nomenclature and importance of time in Whitehead's philosophy of nature. The main objectives of this period are: a) To develop a philosophy of nature which is closed to mind; b) To develop a philosophy of nature which is based on the connectiveness and the interrelationship of the fundamental entities in nature, events.

³The terms "philosophy of nature" and "philosophy of science" will be used interchangeably in this dissertation.

By closed to mind in hypothesis (a) Whitehead means that mind does not make any important contributions to the content of nature. This is important because Whitehead's philosophy of nature was an attempt to break with the philosophical traditions of Descartes, Locke, and Kant with respect to this subject. For these latter philosophers, nature and the entities of science are constructions in our mind. The result of these philosophies is that the scientists never perceive the nature they are investigating. They only perceive the appearances of nature. In rejecting this tradition Whitehead dramatically proclaimed that nature was closed to mind. By this he means that mind places nothing in nature. While man can construct metaphysical and epistemological accounts of nature and mind, Whitehead's philosophy of science pertains to the knowledge of nature, the entities of nature and the laws of nature without the addition of mind. In this way Whitehead distinguishes his philosophy of science from metaphysics and epistemology and to do otherwise results in the "bifurcation of nature."

Thus Whitehead provides the reader with the scope and parameters of his philosophy of nature and the criteria to judge his success. The scope is a systematic understanding of nature as it is. The limits of the study are nature as enclosed within itself, and nature as closed to mind. The criterion for success is to avoid bifurcating nature.

By hypothesis (b) Whitehead intends to reveal the reality of nature as a dynamic, interconnected process in opposition to the discrete atomism of the materialistic perceptions of reality. This hypothesis presents the reader with the meaning and content of Whitehead's philosophy of nature.

Chapter two also explains Whitehead's meaning for such key terms as: nature, events, extension, significance, and duration. These terms are used throughout the 1915-1925 writings, and it is important to know Whitehead's restricted use of them.

The final function of chapter two is to establish time as an essential part of Whitehead's philosophy of nature. Whitehead makes time part of the very fabric of nature. Thus any difficulties with the notion of time will have profound effects on his overall philosophy. The demonstration of time as essential is found within Whitehead's meaning of nature and events. I will show that for Whitehead nature is a process, and that this process is of events which are occurring now as unchangeable and unique entities. The becoming of events and their passage into other events is nature unfolding, which necessitates an emphasis on time rather than space as a fundamental principle of nature. Thus time emerges from within the very process of nature and that extension is a derivative of time. The notion of events as unique also provides Whitehead with another charac-

teristic of time: its direction. The aspect of nonrecurring events allows Whitehead to argue that time is one directional. Our sense perceptions of nature and the relationship between events provide a third characteristic of time: continuity. We perceive events passing into other events and not as a succession of discrete instants. Sense perception presents a continuous passage of events. This continuity can only be accounted for by the continuity of nature and the continuity of time.

Demonstrating that time is a fundamental aspect of nature and explaining key terms and hypotheses are not sufficient for an understanding of Whitehead's philosophy. To prove his hypotheses Whitehead must first demonstrate that the presuppositions of classical mechanics, which relies on discrete, abstract, self-sufficient entities (i.e., the instant and the point), bifurcate nature and produce a philosophy based on separation and disconnectiveness. Secondly, Whitehead must show that the contemporary relational alternative in physics (namely, relativity) bifurcates nature and is not truly relational. Thirdly, he must devise a philosophy of time found in nature and capable of providing the temporal matrix for the relations of events. Finally, Whitehead's alternative relational philosophy must account for nature and be as applicable as the theories he criticizes. Chapters three, four, and five discuss these developments in Whitehead's thought.

Chapter three presents a brief examination of Newton's, Kant's, and Einstein's philosophies and demonstrates that all three theories bifurcate nature. Whitehead shows that the claimed experiential reality of the instant, so necessary to all three philosophies, is not experiential but an abstraction. Whitehead also shows that classical mechanics creates a model of nature that is discontinuous and based on discreteness.

Whitehead's criticism of Newtonian physics, in particular his critique of absolute time, absolute space, the instant, and the point, reveal important aspects of Whitehead's notion of time. The first aspect is that time is not separate from space in nature. Intellectually one can treat time independently from space, but in terms of sense perception one cannot separate the two in nature. The result is Whitehead's acceptance of the Einsteinian notion of the union of space and time and the abandonment of the Newtonian belief in the independence between time and space. (While Whitehead proclaims the union of time and space he does not hold that they are the same, for indeed, space is derived from duration for Whitehead.)

Other aspects of Whitehead's perception of time emerge from his analysis and criticisms of Einstein's system of relativity. In addition to the union of space and time, those characteristics of time are: the existence of an infinite spatio-temporal matrix (though each of us only

perceives a singular series at one time); the notion of real simultaneity between events; the uniformity of time-space; the homogeneity of space; the importance of symmetry; and the need to distinguish time from time measurement systems.

A further aspect is Whitehead's abandonment of the instant as the fundamental unit of time. Duration is what is perceived, thus the instant, because it fails "by definition" to have passage, can only be a mental entity and not a natural entity.

Having demonstrated that classical mechanics and relativity bifurcate nature, Whitehead begins to build an alternative philosophy. He tries to do this with his method of extensive abstraction (chapter four) and with his treatment of the congruence of time and the temporal modes (chapter five). I contend that Whitehead fails to avoid bifurcating nature in his explanations of the practical utility of the instant, and the measurement of time and the temporal modes (the past, the present, and the future). Thus Whitehead is forced to abandon his initial philosophy of nature, which is my first premise.

The practical utility and simplicity of the instant and the point force Whitehead to develop a method and explanation to account for them in this theory. His answer is the method of extensive abstraction (chapter four). The method is brilliant but Whitehead must rely on the concept of temporal unlimitedness to preserve the usefulness of the

instant, but there is no sense perception of temporal unlimitedness. The result is that Whitehead is trapped. If he tries to preserve the practical utility of the instant with his method, he bifurcates nature. If he abandons the idea of temporal unlimitedness, then his method fails to be as viable as the theories he criticizes. Whitehead retains temporal unlimitedness and thereby contradicts hypothesis (a) by bifurcating nature, and thus partially verifying my premise one.

A similar problem occurs in chapter five. After successfully criticizing the mathematical and the scientific systems of measuring time as tautological and bifurcating nature, Whitehead must fill the void with his own system. Again his idea and his system are good alternatives, but I will show how they ultimately fail. Whitehead believes that the congruence of time is dependent on the passage of nature, with endurance and repetition as key aspects. He carefully relates his notion of congruence back to sense perception. But I will contend that Whitehead's approach to congruence bifurcates nature because he needs memory to account for repetition, and memory needs mind. Whitehead also has problems with the difference or identity of the passage of nature with the passage of thought. Once again, Whitehead's hypotheses will not be confirmed, but his failure will support the first premise of my argument.

Chapter five is concerned additionally with Whitehead's analysis of the temporal modes. While Whitehead's examination of the temporal modes reveals a close affinity to Bergson's description of the temporal modes and demonstrates a viable alternative to the mathematical model, he is still unable to explain the temporal modes without an appeal to mind which results in the bifurcation of nature.

Thus chapters two through five will demonstrate Whitehead's philosophy of nature and his failure to construct his philosophy without bifurcating nature when coping with concepts of time. Indeed, as I will show in my analysis of the writings from 1925 to 1929, Whitehead opens nature to mind thus allowing him to account for some of the phenomena of time left unaccountable during the period of 1915-1925.

Chapters six through ten deal with Whitehead's writings from 1925 to 1929. These chapters provide the foundation and arguments for my second premise, which focuses on the epochal theory of time. The writings from 1925 to 1929 mark a transitory period in Whitehead's thoughts, from the exclusion of mind from nature to the inclusion of nature with metaphysics. This transition is marked by a lack of clarity with respect to direction, goals, terminology and what should be preserved from earlier thoughts. These aspects are reflected in his treatment of the epochal theory of time (chapter nine) which becomes the pivotal point in Whitehead's philosophic development and provides him with the direction for his metaphysics.

Chapter six states Whitehead's hypothesis for this period and his expanded meaning of his fundamental entities, the actual occasions. Whitehead's hypothesis during this period is that one can integrate the logico-mathematical philosophy of Principia Mathematica with the aesthetic and poetic intuitions of Wordsworth and the other Romantic poets. Through this hypothesis Whitehead intends to harmonize the simplicity, order, logic and utility of the scientific theories and philosophies of nature with the intuitive and poetic perceptions of the whole of nature as an organism; thereby allowing for change, connectiveness, value and endurance. His method for accomplishing this integration is the development of a relational philosophy. The measure of success or failure is based on how well Whitehead's relational philosophy is harmonized. Whitehead's relational philosophy is embodied in his epochal theory of time, and the success or failure of his philosophy is dependent upon the success or failure of his epochal theory of time.

From this hypothesis I have drawn my second premise. The thrust of chapters six, seven and eight are to provide the foundation and need for Whitehead's epochal theory of time (chapter nine). Chapter ten represents Whitehead's attempt to resolve some of the problems that develop from his epochal theory of time.

Whitehead's intention to integrate mind, sense perception and intuition into a new interpretation of reality

is seen in the expanded meaning of his fundamental entity, the actual occasion or the event, as discussed in chapter six. Actual occasions are simple, creative, indivisible, novel, atomic units with mental and physical poles. The actual occasion is not to be interpreted as the basic unit for a new materialistic atomism. What Whitehead is trying to establish is a new relational philosophy based on qualitative atomisms.

This new relational philosophy needs more than the definition and description of the fundamental entities. Indeed the integration and relationship of actual occasions is not accounted for by definitions. To develop his relational philosophy he needs a philosophy of time (the epochal theory of time) to provide the temporal matrix for the relationship of occasions and a notion of unity that can explain the mental and physical fusion of occasions (prehension). Whitehead's epochal theory of time, primarily, and the doctrine of prehension, secondarily, provide the bases for verification of Whitehead's hypothesis.

The denial of simple location (chapter seven) is Whitehead's refutation of materialistic atomism. This chapter is important for an understanding of Whitehead's position during this period of writings. First, the doctrine of simple location expresses the fundamental axiom and the consequent axioms of mathematical physics. The denial of simple location demonstrates alternatives open to Whitehead,

and it establishes the need for a relational philosophy, in particular a new relational philosophy, which explains why he develops the notions of prehension and the epochal theory of time.

Secondly, the denial of simple location will allow Whitehead to maintain and to sharpen his earlier criticisms of Newton, Kant, and Einstein (chapter two) without the problems of the bifurcation of nature. Thus the criterion for success changes from the ability to keep nature closed to mind to the ability to avoid the doctrine of simple location. The failure to avoid simple location is the fallacy of misplaced concreteness and to avoid this fallacy one must keep the abstract from being regarded as concrete.

Additionally, the denial of simple location will show that while matter can be conceptually isolated we must not forget and must account for occasions as dynamically connected entities. This concept justifies Whitehead's notion of actual occasions and specifies the kind of qualitative atomism he desires. Fourthly, induction is a viable source of knowledge. By adhering to the doctrine of simple location induction is destroyed, so by denying simple location Whitehead is able to preserve sense-perception as a legitimate part of knowledge.

Having established the need and reasons for a new relational philosophy in chapter six (actual occasions) and seven (the denial of simple location) the dissertation

proceeds to the proof of premise two. Chapter eight (prehension) is concerned with the means and method by which atomic occasions are unified. Whitehead's answer is found in his doctrine of prehension. While this chapter reveals an ambiguity in terminology and an incompleteness and confusion in the idea of prehension, an idea is revealed that will be developed into one of Whitehead's fundamental categories in his metaphysical works.

This chapter also demonstrates the need for a temporal matrix and an account of the becoming of occasions. Prehension remains a secondary idea in this period (1925-1929), but when joined with the epochal theory of time, prehension forms the basis for Whitehead's new relational philosophy. While prehension can provide some account for the relationship between existing occasions and the denial of simple location can assure that we account for occasions correctly, neither of these two ideas can explain how occasions come to be. To explain the becoming of occasions and thus the process of nature Whitehead must develop a philosophy of time. He attempts this with his notion of the "epochal theory of time," which is his theory of becoming.

Not only does this theory represent Whitehead's alternative philosophy in its clearest form, but it also reveals the major difficulties that his philosophy has in this period. Thus this chapter nine provides the proof for my second premise and a measure of the degree of failure Whitehead experiences in demonstrating his hypothesis.

The epochal theory of time is the foundation of Whitehead's theory of the process of becoming. How an occasion ceases to be or comes to be is of vital concern to any relational philosophy. In order to contrast Whitehead's theory, I will present some of the different alternatives open to Whitehead and why he rejects them. First, the different theories of continuity as presented in the writings of Aristotle, Aquinas, Maxwell and Einstein are examined. Whitehead's rejection of these theories rests upon the problems of the infinite regress and the preservation of the uniqueness and novelty of actual occasions. Following Whitehead's format in Science and the Modern World, the theory of quantum mechanics is examined after the continuum theories. Whitehead is sympathetic to this alternative and it influences his philosophy of time, but he does not accept quantum mechanics in its entirety.

Having shown that the alternatives which are open to Whitehead are unacceptable to him, his epochal theory of time is presented. Time is the "sheer succession of epochal durations," and natural process requires a "duration involving a definite lapse of time, and not merely an instantaneous moment." But while this definition of time allows Whitehead to account for some unification and integration, it fails to address the question of the becoming and existence of actual occasions. Thus the theory allows for discontinuity in the micro world in opposition to the perceived continuity in the

macro world. These two problems demonstrate Whitehead's inability to develop a truly relational philosophy in this period of writings. The problems with the epochal theory of time can only be resolved through the development of a full metaphysical system. The epochal theory provides the direction that this metaphysics must take because the metaphysical account must resolve the problems raised by the epochal theory.

The problem of continuity versus discontinuity remains unsolved during the 1925-1929 period but Whitehead attempts to solve it with the notions of causal efficacy and presentational immediacy (chapter ten). However, Whitehead's attempt is unsuccessful.

Before continuing with the dissertation, I believe that it is best to recall Whitehead's own words on the frustration of dealing with time:

The theory which I am urging admits a greater ultimate mystery and a deeper ignorance...It is impossible to meditate on time and the mystery of the creative passage of nature without an overwhelming emotion at the limitation of human intelligence.⁴

⁴A. N. Whitehead, The Concept of Nature, Cambridge: Cambridge University Press, 1964, p. 73.

CHAPTER II

THE MEANING OF NATURE

It is interesting that Whitehead should have attempted to develop a systematic philosophy of nature in isolation from other areas of philosophical inquiry. At the very outset of one of his first major philosophical works, The Concept of Nature, he states unequivocally that a philosophy of nature or science should be considered in isolation from any metaphysics or epistemology:

...any metaphysical interpretation is an illegitimate importation into the philosophy of natural science. By a metaphysical interpretation I mean any discussion of the how (beyond nature) and the why (beyond nature) of thought and self-awareness. In the philosophy of science we seek the general notions which apply to nature, namely, to what we are aware of in perception. It is the philosophy of the thing perceived, and it should not be confused with the metaphysics of reality of which the scope embraces both perceiver and perceived. No perplexity concerning the subject of such knowledge can be solved by saying that there is a mind knowing it.¹

This may seem to be a direct consequence of Whitehead's early training as a mathematician. It has been suggested

¹The Concept of Nature, p. 28. See also An Enquiry Concerning the Principles of Natural Knowledge, the Preface. Other quotes reaffirm Whitehead's commitment to this point. "What we ask from the philosophy of science is some account of the coherence of things perceptively known." Ibid., p. 29.

that as a trained mathematician he would look for measurement and thus to empirical perception as a basis for science. But this stands in contrast to his subsequent development, and it may be seen as an attempt to reconcile his views with the empiricism that was current at the time. What is clear is that Whitehead attempted to limit the basis of his philosophy to sense perception. While this self-imposed restriction bore many positive results, it was ultimately barren and did not yield the desired systematic philosophy of nature. It seems to me that Whitehead came to see this inadequacy when he attempted to explain time, for he became rapidly conscious of the fact that time could not be adequately explained on the basis of mere sense perception. Whitehead's strategy, at this time, is dictated by his aims.

He offers us two hypotheses for this period:

- (a) to develop a philosophy which is closed to mind; and
- (b) to develop a philosophy of nature which is based on the connectiveness and interrelationship of the fundamental entities in nature, events. Hypothesis (a) was developed because Whitehead wanted to construct a philosophy of nature, unencumbered by metaphysical and epistemological entanglements, he boldly asserted that nature was independent of thought,

"Natural philosophy should never ask: What is in the mind and what is in nature?" (Ibid., p. 30).

"In other words, science is not discussing the causes of knowledge, but the coherence of knowledge. The understanding which is sought by science is an understanding of relations within nature." (Ibid., p. 41).

if by thought we mean nature as part of mind.² Thus nature is closed to mind, which means that mind does not make any important contributions to the content of nature. The result is that instead of relying on mind as a means of interpreting nature, Whitehead argues that nature can only be revealed in sense perception.³ He claims that this methodology is the hallmark of his philosophy. He then examines two other theories of

²"Nature as disclosed in sense perception is self-contained as against sense awareness, in addition to being self-contained as against thought." The Concept of Nature, p. 4.

"Nature is closed to mind." Ibid.

This argument that nature is independent or closed to mind and thought is easily misunderstood. Whitehead is not arguing that mind or thought are not important parts of nature nor is this statement of phenomenology. What Whitehead is claiming is that sense perception can present information that can be relied on without reference to other acts of perception or the meaning of perception. This closure of nature "means that in sense perception nature is disclosed as a complex of entities whose mutual relations are expressible in thought without reference to mind, that is, without reference to either sense awareness or thought." Ibid., pp. 4-5.

As stated this closure of nature is easily misunderstood. Both C. D. Broad (in his article "Alfred North Whitehead (1861-1947)" in Mind, vol. 57, 1948, pp. 139-145) and R. W. Sellars (in his article "Concerning 'Transcendence' and 'Bifurcation,'" in Mind, vol. 31, 1922, pp. 31-39) seem to evidence this misunderstanding. Both claim that because nature is independent of mind Whitehead has violated his own system and bifurcated nature. While our first impressions might lead us to accept Broad's and Sellars' deductions, a closer examination of Whitehead's text would dispell their contentions. Whitehead is trying to argue that the problems associated with nature as revealed by the perceiver and in the perceived, as well as the synthesis of the knower and the known, are metaphysical or epistemological concerns, and not the subject matter of philosophy of science. Thus Whitehead does not deny the legitimacy of these types of inquiries but he claims that a philosophy of nature can and must be built without them.

³The Concept of Nature, p. 4; p. 8.

nature which, he maintains, result in a bifurcation or division of nature. While one of the theories deals with nature as apprehended in awareness and the other claims that nature is that which causes the awareness, they have a common meeting ground, namely the mind.⁴ He wishes to consider nature in a way that does not lead to the bifurcation of nature. This clear intent to keep nature closed to mind has two important consequences. First, as mentioned earlier, it provides a methodological first principle, namely that sense perception is basic for a comprehensive philosophy of the natural sciences. In other words, nature is disclosed in and through sensory perception. Second, a philosophy of science which is satisfactory must not lead to a bifurcation of nature.

By hypothesis (b) Whitehead intends to reveal the reality of nature as a dynamic, interconnected process in opposition to the discrete atomism of the materialistic perceptions of reality:

The fundamental assumption to be elaborated in the course of this inquiry is that the ultimate facts of nature, in terms of which all physical and biological explanation must be expressed, are events connected by their spatio-temporal relations, and that these relations are in the main reducible to the property of events that they can contain (or extend over) other events which are parts of them. In other words, in the place of emphasising space and time in their capacity of

⁴Ibid., pp. 30-31. For a complete presentation on bifurcation see Chapter III of The Concept of Nature.

disconnecting, we shall build up an account of their complex essences as derivative from the ultimate ways in which those things, ultimate in sciences, are interconnected.⁵

This hypothesis establishes the meaning and content that Whitehead seeks to develop in his philosophy of nature.

Before we can examine Whitehead's philosophy as developed from these two hypotheses we must first become acquainted with some of the important terms used and establish the importance of time in this philosophy of nature.

Whitehead offers his readers two views of nature during this first period in his philosophical development. The first view is that the externality of nature is revealed by the relation of extension.⁶ This spatial conception of nature is perhaps not surprising given Whitehead's mathematical orientation. Time and the dynamic aspect of nature are secondary in this account of nature, and one is left with only quantifiable elements: space and the spatial relationship of objects. By this account, time is to be interpreted in terms of space and quantified in terms of spatial references. This conception of nature reveals Whitehead's continued acceptance of the Newtonian world-view, as opposed to the views that Einstein was beginning to formulate during those years. While this view of nature was common to

⁵An Enquiry Concerning the Principles of Natural Knowledge, p. 4.

⁶"The externality of nature is the outcome of this relation of extension." Ibid., p. 61.

Galileo, Descartes and Newton, it was to prove inadequate in explaining duration, process, and novelty. For these reasons,⁷ Whitehead quickly abandoned this account of nature, and sought one that is both bolder and more adequate to the needs of a philosophy of the natural sciences.

His second view is simply that "nature is a process."⁸ This is a radical shift in Whitehead's early philosophy, for it means that space is no longer the primary focus of a comprehensive study of nature. The focus is now time, and extension becomes a derivative concept, hinging on the notion of process.⁹ To understand nature, one must now understand duration and the process of nature. In other words, Whitehead abandons the conception of nature or the analysis of nature in terms of entities considered as extensional for a consideration of nature in terms of emergence, persistence, causation, and novelty of entities. Hence, without the concept of time, nature itself cannot be understood. Before a comprehensive philosophy of nature can be attempted one must be clear about the notion of time. Although its

⁷This way of describing the externality of nature in terms of the relation of extension is abandoned by Whitehead in the notes to the second edition of An Enquiry Concerning the Principles of Natural Knowledge: "... 'process' is the fundamental idea, was not in my mind with sufficient emphasis. Extension is derivative from process, and is required by it." (p. 202).

⁸The Concept of Nature, p. 53.

⁹An Enquiry Concerning the Principles of Natural Knowledge, p. 202, and p. 4.

meaning was to be revised and deepened and perhaps modified to some extent,¹⁰ Whitehead remained committed to this second view of nature as a process throughout all his later writings.

But if nature is a process, it must be a process of something. But what? To this question Whitehead answers: events. He believes that sense perception yields events as the "most concrete fact capable of separate discrimination."¹¹ Thus the most important characteristic of events in this early Whiteheadian philosophy is their status as concrete, rock-bottom entities. We should not confuse Whitehead's term event with the more general word thing. Events are not things. Whitehead never addressed himself to the distinction of events and things, except to comment, "If I had time, it would be interesting to consider more closely these concepts of events and things."¹² It is clear from his writings that a thing is composed of a group of events and not a single event. In other words, a thing for Whitehead is an aggregate, a collection of events. In a phrase that cannot be commended for its clarity, Whitehead defines events as "the relata of

¹⁰See Adventures of Ideas, N.Y.: Macmillan Co., 1961, p. 274.

¹¹The Concept of Nature, p. 189; see also p. 19 and "Time, Space and Material," Aristotelian Society: Supplement, 1919, p. 47, and An Enquiry Concerning the Principles of Natural Knowledge, p. 77.

¹²A. N. Whitehead, "Space, Time, and Relativity," in Whitehead's Interpretation of Science, Ed. by A. H. Johnson, N.Y.: Bobbs and Merrill, 1961, p. 107.

the fundamental homogeneous relation of 'extension.'¹³ It seems that he is hoping here that real benefits will accrue from this characteristic of events. First, it seems that events represent nature as a unity of time and space, for time and space are to be derived, to some extent, from the relation of extension.¹⁴ Since we perceive events in both time and space, a definition of extension is useful toward an understanding of the unity of our perception of events. Events extend over each other in time and space. Whitehead says "every event extends over other events which are parts of itself and every event is extended over by other events of which it is part."¹⁵ This view has led Hammerschmidt to define the Whiteheadian concept of event in a clearer way as "any actual occurrence with an extended spatio-temporal locus."¹⁶

¹³An Enquiry Concerning the Principles of Natural Knowledge, p. 61.

¹⁴Ibid., see also The Concept of Nature, p. 52 and P. F. Schmidt's comments in Perception and Cosmology in Whitehead's Philosophy, New Brunswick, N.J.: Rutgers University Press, 1967, p. 31. This argument that time and space are derived from events is a change from Whitehead's stated position in "Uniformity & Contingency." There an event was a four-dimensional space-time unit. In other words events were defined in terms of space-time. Now, in his philosophical writings, time and space are relations of events. See "Uniformity & Contingency" in Alfred North Whitehead: The Interpretation of Science, Selected Essays, ed. by A. H. Johnson, N.Y.: Liberal Arts Press, 1961, pp. 108-124.

¹⁵An Enquiry Concerning the Principles of Natural Knowledge, p. 62.

¹⁶W. Hammerschmidt, Whitehead's Philosophy of Time, N.Y.: Kings Crown, 1947, p. 101.

The characteristics of an event are unchangeability, uniqueness, and continuity. It would seem paradoxical that Whitehead should claim that events are unchangeable since he asserted that nature is a process, a process that is a process of events. How can there be a process if the fundamental entities of that process are unchanging? Whitehead answers that the events in themselves do not change, but only the relationship to other events with respect to time and space changes.¹⁷ Because of a possible confusion created by the word change with respect to the relation between events, Whitehead suggests that we replace that word by the word passing. Thus events do not change, but pass; in other words, there is a "passage of events" based on extension. In Whitehead's own words, "The passage of an event is its passing into some other event which is not it."¹⁸

In addition to being unchangeable, events are also unique.¹⁹ By this Whitehead wishes to emphasize two points. First, events are actual, they are what become in nature. Secondly, an event can never repeat itself. This is important because Whitehead believes that nature is novel and creative.

¹⁷An Enquiry Concerning the Principles of Natural Knowledge, p. 62.

¹⁸Ibid., see also C.D. Broad's comments in "Review of Whitehead's 'An Enquiry Concerning the Principles of Natural Knowledge,'" in the Hibbert Journal, vol. 18, 1920, pp. 401-402.

¹⁹An Enquiry Concerning the Principles of Natural Knowledge, p. 61.

If an event can never recur, then every event is novel. Nature is the continual process of events that pass. Hence nature is both creative and unique. This aspect of non-recurring events allows Whitehead to argue that time is one-directional. Whitehead also argues that nature has a third characteristic: continuity. Events are continuous because they are extended. The "continuity of nature," he says, "is to be found in events."²⁰ While each event is unique, Whitehead claims an overlapping of events indicates the continuity between them. However each event is individual, and does not overlap. Thus we apprehend this continuity of nature when we are aware of the passage of events. This characteristic of events will be modified in the second philosophical period, but during this first period Whitehead uses the event to account for continuity in nature. It is only at a later date that Whitehead will argue that the fundamental units of nature are discontinuous and atomic. Continuity will become one of the more troublesome problems for Whitehead's philosophy (see chapter nine). For now we must be concerned with the meaning of events.

It should be noted that there are different kinds of events, the most important of which is called the percipient event. This event possesses the additional characteristics

²⁰Ibid., p. 66.

of the "here present."²¹ This "here present" quality of the percipient event furnishes a frame of reference within which other events are perceived:

Our 'percipient event' is that event included in our observational present which we distinguish as being in some peculiar way our standpoint for perception. It is roughly speaking that event which is our bodily life with the present duration.²²

So a percipient event is a locus of events with a focal point in a duration. In the words of Professor Schmidt:

That with which the duration is simultaneous and to which it is presented is the event 'here-present' which is called the percipient event. ...it (the percipient event) is one of the finite events limited in both its spatial and temporal aspects, included in the duration defined by the apprehended event.²³

The percipient event, while a specific kind of event, will become important in our analysis of Whitehead's philosophy of time because of its essential relation to duration.

In brief, then, the event is the basic concrete entity revealed in perception. Events provide extended and continuous entities, they possess a temporal and spatial locus. They are also unique and unchanging.

Extension for Whitehead is derivative from process and a fundamental relation between events.²⁴ We may now

²¹Ibid., p. 70; see also The Concept of Nature, p. 107.

²²The Concept of Nature, pp. 187-188; see also N. Lawrence's comment in Whitehead's Philosophical Development, N.Y.: Greenwood Press, 1968, pp. 40-42.

²³P.F. Schmidt, Perception and Cosmology in Whitehead's Philosophy, pp. 48-49.

²⁴The Concept of Nature, p. 52; see also An Enquiry Concerning the Principles of Natural Knowledge, p. 61.

inquire into its meaning and use in this first period. Extension refers to the relationship between events. This relationship is the inclusion of events, i.e., one event contains other events as a whole may be said to contain parts. Whitehead provides us with the following example of extension. "Imagine," he says, "all nature within the Senate house during Caesar's death extends over all nature within Pompey's statue during that death."²⁵ Let us note here that Whitehead only uses the term extension to refer to events, and hence we can define extension as the relation of inclusion between a whole and its part. This overlapping of events is important in his philosophy of time. First, since events exhibit the relation of extension, extension is a property of events. Secondly, since events are extended, they cannot be considered as instants or points, for points and instants are by definition not extended. Points and instants are not events and hence not fundamental elements of reality. This led Whitehead to abandon in part all those scientific theories which rest on points and instants, namely those of Newton and Einstein. Whitehead contends that it is imperative to formulate a theory of nature in which time and space are based on events, i.e., extended entities. (More will be said about Whitehead's criticism of

²⁵"Time, Space and Material," p. 47.

points and instants in the next chapter.) Thirdly, extension provides us with a means of both describing and understanding how process occurs. Extension is the way nature develops:

Nature develops, in the same sense that event E become part of event E' which includes (i.e., extends over E and also extends into the futurity beyond E. Thus in a sense the event E does change, namely in its relations to the other events which were not and which become actual in the creative advance of nature...²⁶

This quotation also discloses a fourth consequence of Whitehead's concept of extension: extension is no longer said to belong exclusively to spatial relationships, as classical physicists believed, but belongs to temporal relationships also. In fact, temporal extension becomes the prototype of extension in the Whiteheadian view of nature. Thus, one event extends into the future because of its inclusion in another event.

Whitehead claims that our perception of relatedness contains two factors: the "discerned" and the "discernible."²⁷ The discerned is merely our immediate perception in which we discriminate individual differences between related events. Our perception, however, cannot specify the individual relations between the events, but only that they are related

²⁶ An Enquiry Concerning the Principles of Natural Knowledge, p. 62.

²⁷ Whitehead deals with our perception of the "discerned" and the "discernible" in Chapter III of The Concept of Nature and Chapter IV of The Principle of Relativity, Cambridge: Cambridge University Press, 1922; only in The Principle of Relativity the terms are changed so that "cognisance by adjective" replaces the "discerned" and "cognisance by relatedness" replaces "the discernible."

and are the "entities fulfilling the functions of relata in these relations."²⁸ What is discerned is a specific relationship. The discernible is the perception of the relatedness of an event beyond its discerned characteristics. This second perception reveals the temporal endurance and spatial spreading of an event beyond its particularities. Whitehead gives as an example a red patch.²⁹ When we perceive a red patch, we know that there is an event specified by red here and now. This is discerned perception, but while we are perceiving it in this limited sense, we actually know more, namely that we perceive its enduring reality in space and time beyond the mere here and now. This is our discernible perception, hence the discernible is the spatio-temporal relatedness of the event in itself and in relation to the rest of nature occurring around it. Whitehead uses the concept of significance to extricate the importance of the discernible. He defines significance as follows:

This disclosure of an entity as a relatum without further specific discrimination of quality is the basis of our concept of significance...Thus significance is relatedness, but it is relatedness with the emphasis on one end only of the relation.³⁰

²⁸The Concept of Nature, p. 49.

²⁹The Principle of Relativity, in Alfred North Whitehead: An Anthology, ed. by F.S.C. Northrop and M.W. Gross, N.Y.: Macmillan, 1953, p. 338.

³⁰The Concept of Nature, p. 51 (underlining mine). The doctrine of significance presented here is defined more clearly and is expanded from the definition of significance presented in An Enquiry Concerning the Principles of Natural Knowledge, p. 12, as Whitehead indicates in a note at the end of The Concept of Nature, pp. 197-198.

This concept of significance plays an important role in Whitehead's philosophy of nature. First, the doctrine of significance is essential to explain our perception of the endurance of events as past, present, and future since our immediate discerned perception only reveals the percipient event and does not allow us to assume that there is an internal connection between events. The second point follows from the first. Namely, the doctrine of the significance of events is essential if Whitehead is to argue for the uniformity of nature.³¹ Since events occur in nature, we are told about the relatedness of events in reference to the perceptions of the observer. If this were the only consideration possible, the relatedness of events would become relative to the observer and nature would not be uniform, or at least could not be said with certainty to be uniform. If this relativism were accepted, Whitehead would indeed be doing what he claims should not be done, bifurcating nature by introducing mind.

The concept of significance is also related to his concept of organism as the intelligibility of the unity of being. Schmidt has shown this very clearly:

³¹ "The Philosophical Aspects of the Principle of Relativity," in Alfred North Whitehead: The Interpretation of Science, ed. by A. H. Johnson, pp. 140-141. See also "Uniformity & Contingency," Ibid., pp. 121-123 and The Principle of Relativity, Chapter II.

The doctrine of significance also makes understandable the unity of being, which is a fundamental notion of biological science. For a given natural entity now possesses in a definite expressible sense internal parts necessarily related in a definite manner, or else that natural entity would not be what it is. The events which the situations of these parts belong to are in a pattern of relatedness. Such extended inter-related wholes revealed in the analysis of perception provide the foundation for the key biological concept of an organism.³²

Later, in his second philosophical period, Whitehead will use the doctrine of significance to elaborate his theory of prehension and causal efficacy.³³ In the second period, the concept of significance is subsumed and transformed in the concept of prehension. I will explain this more fully in the chapter on prehension (chapter eight). With the aid of the concept of significance, Whitehead later devised the theory of causality based on the perception of internal relatedness that served him in his criticism of Hume.

Whitehead, then, presents a doctrine of extension based on the perception of relatedness. This extension of nature is not merely spatial but essentially temporal, and extension is used to explain how nature, through events, progresses or develops. Perception of extension is divided into the discerned and the discernible, and the significance of events is said to stem from the discernible. It is this

³²P. F. Schmidt, Perception and Cosmology in Whitehead's Philosophy, p. 75.

³³"The doctrine of significance provides a new theory of causality based on a new view of internal relatedness." Ibid. See also Whitehead's work, Symbolism Its Meaning and Effect, Cambridge: University Press, 1928.

significance of events which allows Whitehead to explain the endurance of events in a temporal structure as well as their uniformity and the uniformity of nature and space-time.

Events are also characterized by duration, or the temporal passage of nature. Whitehead's temporalizing of nature sharply contrasts Newton's spatializing of nature. The result is that nature begins to have a temporal rather than a spatial physiognomy. Duration, in fact, is the essential relationship that enables one to understand Whitehead's philosophy of time. Whitehead defines duration as thus:

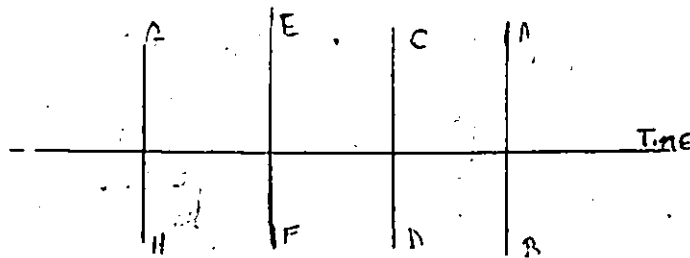
(a)...certain whole of nature which is limited only by the property of being a simultaneity...thus a duration is a definite natural entity. A duration is discriminated as a complex of partial events, and the natural entities which are components of this complex are thereby said to be 'simultaneous with this duration.'...A duration is a concrete slab of nature limited by simultaneity which is an essential factor disclosed in sense-awareness.³⁴

We may note here first that for Whitehead duration is real and not merely an abstract stretch of time. By making duration "a definite natural entity," he acknowledges durations as parts of nature. Secondly, the limitation of duration is not spatial but temporal. Hence, duration can be conceived

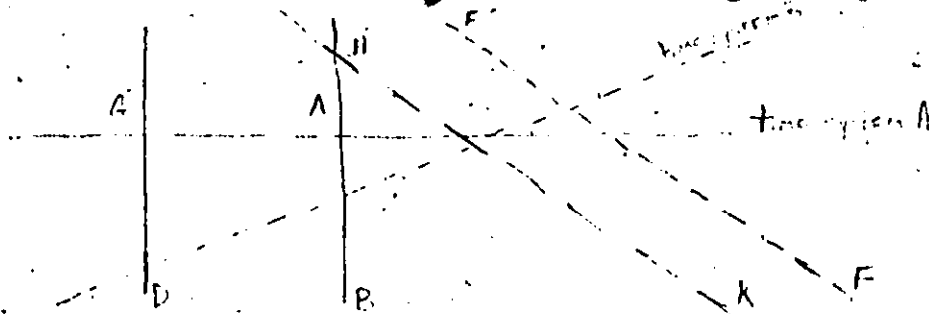
³⁴The Concept of Nature, p. 53. (underlining mine). Whitehead also defines the duration as "a temporal slab of nature; and is all that there is, subject to the temporal limitation inherent in the awareness. This awareness of the whole is directly sensed, and is not a detailed discrimination of its parts. This sense for the being of nature is accompanied by a diversification of the duration into parts, which are more or less clearly discriminated." "Time, Space and Material," p. 27.

as spatially unbounded, and limited only by the condition of being simultaneous with the "now present."³⁵ For Whitehead, simultaneity refers to the relatedness in the "now present." Thus duration is spatially infinite but temporally bounded. Whitehead illustrates this by the following diagram:

The slab of nature forming a duration is limited in its temporal dimension and unlimited in its spatial dimensions. Thus it represents a finite time and infinite space. For example, let the horizontal line represent time; and



assume nature to be spatially one-dimensional, so that an unlimited vertical line in the diagram represents:³⁶



This spatial unlimitedness within the temporal bound of the "now present" allows Whitehead to maintain the Newtonian

³⁵"A duration is in a sense unbounded; for its is, within certain limitations, all that there is. It has the property of completeness, limited by the condition "now-present;" it is a temporal slab of nature." An Enquiry Concerning the Principles of Natural Knowledge, p. 69.

³⁶Ibid., p. 111.

one-time system, since only time is limited and space is not limited. Whitehead retained a single uniform time system in order to be able to make statements about the whole of nature at a particular "now present." Since duration is spatially unlimited, we have a class of infinite events, a fact that Whitehead considers important.

This conception of duration, however, contained a number of difficulties that compelled Whitehead to revise his notion of time. The major problem is that if duration is defined as spatially unlimited but temporally limited or bounded, there is no account of temporal unlimitedness, and "such a description ... would obviously be circular, since Whitehead will later define space and time in terms of durations and their properties."³⁷ Hence, Whitehead was driven to modify his doctrine of duration to include temporal unlimitedness.³⁸ By temporal unlimitedness he means that "there are no maximum durations and no minimum durations."³⁹

The inclusion of temporal unlimitedness broadens Whitehead's meaning of duration. First, as stated above, it allows for both space and time to be defined in terms of duration. Secondly, now that durations are temporally

³⁷R.M. Palter, Whitehead's Philosophy of Science, Chicago: University of Chicago Press, 1960, p. 31.

³⁸Whitehead tells us this in a note at the end of An Enquiry Concerning the Principles of Natural Knowledge, p. 204.

³⁹The Concept of Nature, p. 59.

unlimited they lack the exactness and the precision that durations had before. The benefit is that durations can in no way be viewed in terms of instants. Thirdly, the meaning of temporal unlimitedness does not require every duration to be without limits, but rather that such limits depend on perception and are not sharply defined.⁴⁰ Fourthly, because of the addition of temporal unlimitedness, Whitehead can state that "durations are events with a quality of unboundedness. They form the sole class of infinite events."⁴¹ Finally, the inclusion of temporal unlimitedness⁴² did not alter the definition of duration as something real, or the general description of perception of the whole of nature as occurring in our immediate present. Duration refers to the temporal inclusion of events in the present totality of nature, now limited solely by simultaneity. This present simultaneity, or this present totality of nature, is unbounded in space and indefinite in time. Hence, duration becomes the temporal aspect of nature from which the concept of time must be derived.

The foregoing explanation of the concept of duration illustrates the problem of discussing Whitehead's philosophy.

⁴⁰An Enquiry Concerning the Principles of Natural Knowledge, p. 69.

⁴¹"Time, Space and Material," p. 47.

⁴²Whitehead abandons this concept of temporal unlimitedness when he develops the notion of epochal time. See chapter nine.

of time. Although the meaning of time, as such, is not directly discussed in Whitehead's writings, it is apparent from the whole of this chapter that time is of fundamental importance to Whitehead's discussion and development of a philosophy of nature. Whitehead focuses on concepts of duration, extension, and significance to elaborate his philosophy of nature, our examination of these various concepts reveals that their fundamental aspects lie within a discussion of time. Since our objective is to pursue Whitehead's philosophy of time and the influence of this philosophy on the development of his thought, we will work within the confines of his attempt to create a systematic philosophy of nature. Because Whitehead's philosophy of time is derived inferentially from his philosophy of nature and from his critiques of other systems of nature, we must now turn to his criticisms of other philosophies of nature, notably Newton's and Einstein's, and focus on the notions of time they advocate. From such criticisms Whitehead's philosophy of time can be apprehended.

But the demonstration of time as an essential part of the fabric of nature by an analysis of the nomenclature and the positing of hypotheses is not sufficient for determining the worth of Whitehead's philosophy. We must examine the process by which he attempted to prove his hypotheses. His process consisted of showing: (a) the presuppositions and theory of Newtonian physics bifurcate nature; (b) the

theory of relativity bifurcates nature; (c) his philosophy of time is grounded in nature and capable of providing the temporal matrix for the relations between events; and (d) he must demonstrate that his philosophy can account for nature and be as useful as those theories he criticizes.

In chapter three Whitehead will fulfill conditions (a) and (b) for the establishment of his hypotheses. The chapter will also provide some of Whitehead's characteristics of time thereby providing a partial demonstration of point (c).

CHAPTER III
WHITEHEAD'S CRITIQUE OF THE NOTION OF TIME
FOR NEWTON, KANT, AND EINSTEIN

Having established the importance of time in Whitehead's philosophy of nature, it is my intent now to examine Whitehead's criticisms of Newton, Kant, and Einstein in his writings of 1919-1924. From these criticisms important elements of Whitehead's philosophy of time gradually begin to emerge and he establishes a partial proof for his hypotheses by demonstrating that Newton's, Kant's, and Einstein's alternatives bifurcate nature.

Since time is a property of nature, Whitehead saw himself compelled to state his reasons for considering wrong-headed, any philosophy of nature which considered nature as a property of time. The Newtonian system is a major philosophical and scientific theory which treats nature in relation to time. Newton devised a universal mechanics to explain nature by using a very limited number of basic concepts: matter¹, time, space, and motion. Only

¹Newton describes matter in terms of mass. Mass is described as a product of density and volume. Yet in contemporary terms, density is described as mass per unit volume. The result is that Newton's arguments about matter are circular in light of today's thinking, and for this reason the topic will not be pursued further.

time and space need concern us here. Newton, it will be recalled, describes time and space as follows:

Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without regard to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year.

Absolute space, in its own nature, without regard to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies, and which is vulgarly taken for immovable space; such is the dimension of a subterraneous, an aerial, or celestial space, determined by its position in respect of the earth. Absolute and relative space are the same in figure and magnitude; but they do not remain always numerically the same. For if the earth, for instance, moves, a space of our air, which relatively and in respect of the earth always remains the same, will at one time be one part of the absolute space into which the air passes; at another time it will be another part of the same, and so, absolutely understood, it will be perpetually mutable.²

Milič Čapek offers the following comments on Newton's conception of a time, which flows without a regulator: "Time flows no matter whether something changes or not; in its own nature, time is empty and is so only in accessory and contingent way filled by changes. Changes are in time, they are not time itself."³ Hence, absolute time, for Newton, is

²Isaac Newton, The Mathematical Principles of Natural Philosophy, tr. A. Motte, F. Cajori: London: Nelson and Sons Ltd., 1947, p. 6.

³M. Čapek, The Philosophical Impact of Contemporary Physics, New Jersey: Van Nostrand Co., 1961, p. 36.

independent of motion⁴ and relies on nothing other than itself. Newtonian time, unlike Galilean or Einsteinian time, does not require material objects "in it" to be a comprehensible or an explanatory construct. Absolute time is just that, absolute, and it is not relative to anything else, which is the second fundamental concept, it is unchanging.

Newton's conception of absolute space is well described by John Keill, one of his early followers:

We conceive Space to be that, wherein all Bodies are placed...; that it is altogether penetrable, receiving all Bodies into itself, and refusing Ingress to nothing whatsoever; that it is immovably fixed, capable of no Action, Form, or Quality; whose Parts it is impossible to separate from each other, by any Force however great; but the Space itself remaining immovable, receives the Successions of things in motion, determines the Velocities of their Motions, and measures the Distances of the things themselves.⁵

Hence, absolute space is a homogeneous mathematical construct which has no need of a subject. In Keill's description, it is something akin to a material body except that material bodies are always in reference to absolute space. Absolute space does not rely on anything for its existence, and there is no interdependent or interconnecting view of space and time in Newtonian physics. Both are completely autonomous.

⁴In practice motion is not conceived as independent of space and time for Newton. In fact, velocity is measured by change in location (space) divided by change in time ($V = Dx/Dt$).

⁵J. Keill, An Introduction to Natural Philosophy, London: Andrew Millar, 1758, p. 115.

This is, of course, a startling view of time and space to anyone who would wish to claim that physics is grounded in empirical evidence.⁶ The evidence adduced by Newton for absolute time and absolute space is from an experiment that is intended to demonstrate the difference between absolute and relative motion. This experiment, simply the rotation of a pail filled with water, is quite well-known and has often been discussed in the literature. When a pail is filled with water, the surface is flat, but if a pail is spun rapidly on its axis, the pail, because of centrifugal force, will gradually communicate its motion to the water which will recede little by little from the center and gradually take on a concave surface until it acquires the same rotation and velocity as that of the pail. At first the surface of the water is flat, thus indicating that "its true circular motion had not yet begun." The increasing concavity of the water surface suggests that "the real

⁶"I frame no hypotheses; for whatever is not deduced from the phenomena is to be called an hypothesis; and hypotheses, whether metaphysical or physical, whether occult qualities or mechanical, have no place in experimental philosophy." I. Newton, The Mathematical Principles of Natural Philosophy, p. 547. See also Burtt's discussion on this in E. A. Burtt, The Metaphysical Foundations of Modern Physical Science, London: Routledge and Kegan Paul, Ltd., 1932, 2nd. edition, pp. 244-245. In fact, Newton's laws say that absolute (fixed) space is undetectable by physical experiment. Only those Newtonian laws in the fields of electricity and magnetism, by postulating ether, opened up the possibility of detecting absolute space. The result was that a number of ingenious and skillful experiments were constructed in an effort to detect evidence of the motion of the earth through an ether - to search for the absolute frame of reference. The most noteworthy of the attempts was the Michelson-Morley experiment.

circular motion of the water" increases until such time that the water "had acquired its greatest quantity," meaning the greatest quantity of real circular motion. Newton interpreted this as experimental evidence for the existence of absolute rotational motion.⁷ He argued, in consequence, that an object can have absolute, though not always observable, rotational motion as long as it has absolute homogeneous space in which to move and an absolute, smooth, flowing time during which it carries on this motion. Hence, Newton attempted to escape describing time in the vulgar way by reference to perception or sense-awareness. Absolute space and time transcend sense-awareness and their perfect consistency abides in the realm of the absolute.

Whitehead originally accepted the general Newtonian viewpoint, which can be seen clearly in "On the Mathematical Concepts of the Material World." Here he claimed that time is instantaneous: "Time must be composed

⁷While it appears that this experiment demonstrates absolute motion, it doesn't. All this experiment does is posit the possibility of absolute rotational motion. If absolute motion is equated with absolute rotational motion then Newton is in difficulty, since it does not account for motion in a straight line. In fact Newton has a serious problem with the notion of absolute motion because his first law states that one is unable to distinguish rest from uniform motion in a straight line. This inability to distinguish rest from uniform motion is not accounted for in the rotational pail experiment. Thus this experiment does not establish absolute motion or absolute space. (For further information consult Ernst Mach's The Science of Mechanics, trans. by T.J. McCormack, LaSalle: Open Court, 1960, 6th edition, pp. 287-288.)

of instants ... Instants of time will be found to be included among the ultimate existent of every concept."⁸ This is not as surprising as might be expected since Euclidian geometry is a part of Newtonian physics, namely, it is the language in which the Principia Mathematica is written. With the advances of non-Euclidian geometry in the early part of the 20th century, Whitehead began to have doubts about the validity of Newtonian physics, inasmuch as it spoke of nature in terms of absolute space and time. In his article "The Axioms of Geometry," he rejects the concept of space as a purely numerical construct.⁹ But the attack on Newtonian physics, especially against the concepts of absolute space and absolute time, really begins with An Enquiry Concerning the Principles of Natural Knowledge, and is pursued more radically in The Concept of Nature, as well as in the article, "Time, Space, and Material," and The Principles of Relativity. Whitehead objected to absolute time and absolute space¹⁰

⁸"On The Mathematical Concepts of the Material World," in Philosophical Transactions, Royal Society of London, series A, Vol., 205, 1906, p. 467.

⁹"No decisive argument for either view [relative or classical physics] has at present been elaborated." A. N. Whitehead, "The Axioms of Geometry," Encyclopedia Britannica, 11th. edition, Vol. 11, p. 734

¹⁰See Chapter II. See also: "Also, time as a succession of instants corresponds to nothing which falls within my own direct knowledge. I can only think of it metaphorically either as a succession of dots on a line or as a set of values of an independent variable in certain differential equations. I cannot dissociate time from concrete nature, and then know nature as at an instant of time; nor am I aware of any fact which is instantaneous nature." "Time, Space, and Material," pp. 45-46.

since we have no sense-awareness of them. Whitehead considered that Newton had attempted to account for sense-perception in terms of both mathematical formulæ and the concepts of absolute time and absolute space.

Time and space would appear to provide these all-embracing relations which the advocates of the philosophy of unity of nature require. The perceived redness of the fire and the warmth are definitely related in time and in space to the molecules of the fire and the molecules of the body.¹¹

But this view, of course, leads to a bifurcation of nature, for a classical concept of time as expounded by Newton and enlarged by his followers has "tacitly crept from books on mathematical physics into general scientific thought as expressive of the ultimate structure (of nature and time)."¹²

Whitehead realized the superficially negative implications of making space and time absolute categories:

Time is the ordered succession of durationless instants; and these instants are known to us merely as the relata in the serial relation which is the time-ordering relation, and the time-ordering relation is merely known to us as relating the instants. Namely, the relation and the instants are jointly known to us in our apprehension of time each implying the other.¹³

¹¹The Concept of Nature, p. 33.

¹²"Time, Space, and Material," p. 44.

¹³The Concept of Nature, p. 33. See also Whitehead's description of the effects of absolute time and space on the concept of nature: "Suppose we now assume absolute time and absolute space. What bearing has this assumption on the concept of nature as bifurcated into causal nature and apparent nature? ... The theory now is this: Causal events occupy certain periods of the absolute time and occupy certain positions of the absolute space. These events influence a mind which there upon perceives certain apparent events which occupy certain periods in the absolute time and

Absolute space is defined in terms of extensionless points placed in an ordered relation.¹⁴ Thus absolute space implies the following: (a) "a space-ordering relation, which holds between points," and (b) "a space-occupation relation between points of space and material objects."¹⁵

But Whitehead's criticism of absolute space and time does not rest solely on our inability to perceive exemplifications of such categories. The doctrine to which Whitehead especially objects in the general Newtonian cosmology

occupy certain positions of the absolute space; and the periods and positions occupied by the apparent events bear a determinate relation to the periods and positions occupied by definite apparent events. Delusions are apparent events which appear in temporal periods and spatial positions without the intervention of these causal events which are proper for influencing of the mind to their perception." Ibid., pp. 37-38.

¹⁴Ibid., pp. 35-36. "Space ... is a system of extensionless points which are the relata in space-ordering relations which can technically be combined into one relation. This relation does not arrange the points in one linear series analogously to the simple method of time-ordering relations for instants. The essential logical characteristics of this relation from which all the properties of space spring are expressed by mathematicians in the axioms of geometry." See also: "The extremely valuable work on the foundations of geometry produced during the nineteenth century has proceeded from the assumption of points as ultimate given entities. This assumption, for the logical purpose of mathematicians, is entirely justified. Namely the mathematician asks, What is the logical description of relations between points from which all geometrical theorems respecting such relations can be deduced? The answer to this question is now practically complete; and if the old theory of absolute space be true, there is nothing more to be said. For points are ultimate simple existents, with mutual relations disclosed by our perceptions of nature." An Enquiry Concerning the Principles of Natural Knowledge, p. 161.

¹⁵The Concept of Nature, p. 36.

is the conception of an instant. He is not alone here, and there seems to be general agreement among a number of distinguished thinkers, such as Broad,¹⁶ Bachelard,¹⁷ Bergson,¹⁸ Whitrow,¹⁹ Russell,²⁰ and Alexander²¹ on this crucial issue.

In An Enquiry Concerning the Principles of Natural Knowledge, Whitehead begins his attack on this classical structure, and more specifically, on the notions of the instant and the point. In his first line of attack he argues that since velocity cannot take place in an instant of unextended location, the notions of the instants and the point render velocity impossible. Velocity must refer to past and future events, as well as to direction, but this is impossible in the instant.²²

¹⁶C. D. Broad, Examination of McTaggart's Philosophy, Cambridge: University Press, 1938, vol. II, part I, pp. 267-268, 275-277.

¹⁷G. Bachelard, L'intuition de l'instant, Paris, 1932, pp. 24-25, 38-39, 64-65, 97.

¹⁸H. Bergson, Creative Evolution, N.Y.: Macmillan and Company, trans. by A. Mitchell, 1911.

¹⁹G. J. Whitrow, The Natural Philosophy of Time, N.Y.: Harper Torch, 1963, pp. 153ff; 312.

²⁰B. Russell, Our Knowledge of the External World, London: Macmillan, 1914, pp. 123-130 and especially p. 148.

²¹S. Alexander, Space, Time and Deity, 2 vols., N.Y.: Dover Press, 1966, vol. I, pp. 43-52, 144-147, 150-151 and especially pp. 120-124.

²²"The ultimate fact embracing all nature is (in the traditional view) a distribution of material throughout all space at a durationless instant of time, and another such ultimate fact will be another distribution of the same

Whitehead adds that if "nature at an instant" is the expression of an ultimate element of reality, then it should be evidenced in other sciences concerned with nature, such as biology. There appears to be little support for instants and points in such sciences.

In biology the concept of organism cannot be expressed in terms of a material distribution at an instant. The essence of organism is that it is one thing which functions and is spread through space. Now functioning takes time. Thus a biological organism is a unity with a spatio-temporal extension which is of the essence of its being. This biological conception is obviously incompatible with the traditional ideas.²³

In addition to the fact that some of the sciences cannot and do not use the concept of the instant, recent developments in physics do not indicate that nature should be understood in terms of points and instants.

Reflections on Maxwell's equations reinforce his [Whitehead's] objections to instantaneous configurations of unextended points as the ultimate facts. For (a) they involve vectors, all of which need two points to define their directions; (b) the density of electrical charge which enters into these equations is meaningless if you

material throughout the same space at another durationless instant of time. The difficulties of this extreme statement are evident... No room has been left for velocity, acceleration, momentum, and kinetic energy, which certainly are essential physical quantities.

We must therefore in the ultimate fact, beyond which science ceases to analyze, include the notion of a state of change. But a state of change at a durationless instant is a very difficult conception. It is impossible to define velocity without some reference to the past and the future. Thus change is essentially the importation of the past and of the future, into the immediate fact embodied in the durationless present instant." An Enquiry Concerning the Principles of Natural Knowledge, pp. 159-160.

²³Ibid., p. 160.

literally confine yourself to unextended points; and (c) the differential with respect to time is meaningless if you literally confine yourself to instantaneous configuration.²⁴

In The Concept of Nature, Whitehead developed a second line of attack on Newtonian points and instants.

In the first place it seeks for the cause of the knowledge of the thing known instead of seeking for the character of the thing known: secondly it assumes a knowledge of time in itself apart from events related in time: thirdly it assumes a knowledge of space in itself apart from events related in space.²⁵

This general criticism led Whitehead to believe that in order to explain nature adequately one must replace the notion of instant with duration and the concept of point with that of extension. Whitehead did not deny that the concepts of instant and point had a fundamental role to play in mathematics and in contemporary physics, and they are preserved, albeit radically modified, in his method of extensive abstraction which we will discuss in the next chapter.

From Newtonian physics Whitehead turned to Einstein's new theory of relativity. We must now inquire into Einstein's theory, which proposes relative time and space as a replacement for absolute time and space. The theory of relativity

²⁴C.D. Broad, "Review of Whitehead's: An Enquiry Concerning the Principles of Natural Knowledge," The Hibbert Journal, vol. 18, 1920, p. 398.

²⁵The Concept of Nature, p. 39.

was developed during the collapse of Newtonian physics.²⁶

It filled the void left by the departure of classic physics and it can be said that Einstein in his Special Theory of Relativity filled a vacuum. In order to understand the Special Theory of Relativity with which we will be mainly concerned, we must briefly explain "inertial frames," special relativity, and the "twin paradox".

Einstein stressed that one cannot view nature without looking at it from a particular vantage point. In this sense every observer defines a frame of reference. In principle, all observers, all frames, are equally good to describe nature provided that we use such methods as those of the general theory of relativity. But the simplified treatments given by Newton, and by Einstein in his special theory of relativity, hold only in a limited class of frames, which are called "inertial frames." These treatments are interesting and physically relevant since the geocentric

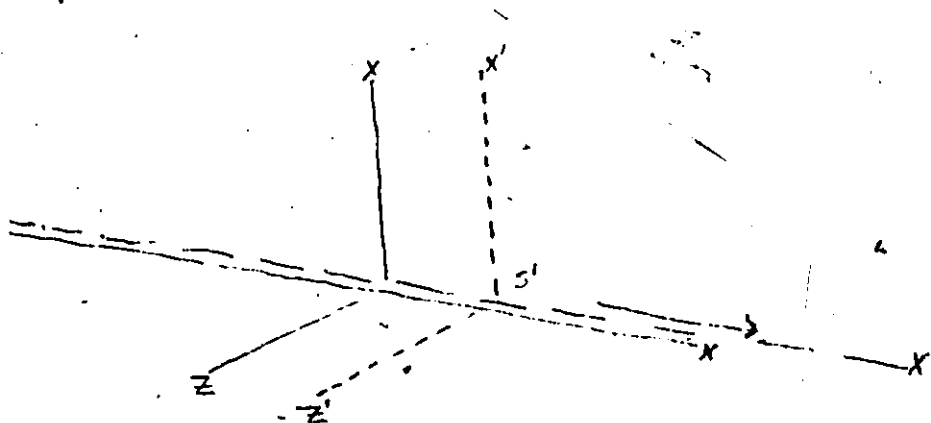
²⁶The Michelson-Morley experiment was a terrestrial test of the ether drift hypothesis - the search for an absolute frame of reference. While the null result of the ether drift experiment did not immediately overthrow Classical Mechanics, the ultimate result was the collapse of the notion of the absolute frame of reference and consequently the collapse of Newtonian physics. (I am aware that strenuous efforts were made to save the ether drift hypothesis after the Michelson-Morley experiment. But even the ad hoc claim that the earth drags the ether with it, while explaining one set of experimental observations, failed with respect to other sets - such as, astronomical observations.)

frame closely approximates an inertial frame.²⁷ Thus if two observers change their relative velocity, then at least one of them does not define an inertial frame during the period of change.

The discovery that the speed of light in a vacuum is constant for all observers in inertial frames prompted Einstein to consider what meaning could still be attributed to the traditional concepts of time and space, in particular to observed time and space intervals between two events. By an event, he meant an occurrence which an observer could characterize as happening at a point in space and time. In principle, Einstein held that the time of an event could be measured only by an observer in the immediate neighborhood of that event. The result obtained by this first observer could only be used by a second observer some distance away, if both observers were at rest in some inertial frame of reference. But suppose that a second observer a distance away moves with respect to the first observer. Then, only in the special case where the relative velocity is constant, are there formulae which can be used to connect the space and time intervals between the two events as seen by one observer with those seen by the other observer. These formulae apply as follows: Suppose two inertial frames,

²⁷The geocentric frames only approximate inertial frames in that geocentric frames are both rotating and revolving. Thus they are non-inertial. However, this doesn't appear significant in most experiments.

which we will call $\underline{S}$ and $\underline{S}'$, have coincident and similarly directed X - axes. Let the space and time coordinates of an event be $\underline{x}$ and $\underline{t}$ for $\underline{S}$; and $\underline{x}'$ and $\underline{t}'$ for $\underline{S}'$. Let $\underline{dx}$ and $\underline{dt}$; $\underline{dx}'$ and $\underline{dt}'$ denote the spatial and temporal intervals between two given events, for $\underline{S}$ and $\underline{S}'$ respectively. Let $\underline{S}'$ be moving at velocity $\underline{v}$ relative



to the positive x - direction. Then the fundamental equations of special relativity, comprising the Lorentz Transformation Formula, assert that:

$$dx' = (dx - vdt) \cdot (1 - v^2/c^2)^{-1/2}$$

$$dt' = (dt - vdx/c^2) \cdot (1 - v^2/c^2)^{-1/2}$$

$$\text{let } b = v/c; \text{ let } g = (1 - v^2/c^2)^{-1/2}$$

Then we may rewrite the equations;

$$dx' = g (dx - bc dt)$$

$$dt' = g (dt - b dx/c)$$

As can be seen, these equations yield the same result no matter which frame we agree to call S and which we agree to label as S'. From the equations we can conclude that if the velocity of S' relative to S is V, then the velocity of S relative to S' is simply -V. Furthermore, for small velocities, the equations reduce to the Galilean transformation equations.²⁸

Consider two events that both occur in the neighborhood of an observer A who is fixed with respect to S. Here dx is equal to zero. From the above equations we have: $dt' = g(dt - b \cdot 0/c) = g dt$; or $dt = g^{-1} dt'$. From the definition of g , we know that g is never less than unity; g^{-1} is never greater than unity. Hence, B, an observer in S', finds that the A - time between the two events is less than his own. But this A - time is simply the difference in readings given by A's clock, which moves relative to B. Thus, for B, "a moving clock runs slow." The same argument can be applied to A. In fact, for all observers, a clock moving relative to them runs slowly. This claim that A and B both find each other's clock runs slow has two important consequences. The first is the destruction of the Newtonian thesis that time is absolute and independent from space. In the light of their independence throughout the history of

²⁸For small velocities the equations reduce to $dx' = dx - v dt$. This equation assumes time in absolute and observable space is relative, since it depends on velocity.

philosophy and science, this notion of joining time and space is a revolutionary idea. The second result is the apparent paradox that occurs when this phenomenon is applied to space-travel.

Einstein rejects Newton's concept of time as something invariant, public, and independent of space. Instead, time must be viewed as in union with space, in a continuum. This union of space and time is called the space-time continuum; and has led to the view of the universe as four dimensional. However, Einstein's position is in disagreement with the phenomenon of common-sense observations, which hold that time is public and constant. This perception is supported by our ordinary observations and measurements of objects at low levels of velocity. Unfortunately, this common-sense perspective is unable to account for the time discrepancies in measuring particles in high-speed accelerators, where the velocities of the particles approach the velocity of light (c). Here time is not the same at two different positions. Because of these observations, time can no longer be viewed as public and constant but as private and variant, in relation to velocity and spatial frames. This time is joined with space to make four-dimensions. While in union these dimensions of space and time are not equivalent; if they were, nature would be a "changeless whole."

Credence for this four-dimensional perspective is also provided by the calculations of tensor calculus. In determining the distance between two points (O and A) in a three dimensional universe, it was discovered that one had only to extend the Pythagorean Theorem (used in calculating the distance between two points in two dimensions) to include the third spatial dimension. The result was $OA = \sqrt{x^2 + y^2 + z^2}$. The development of the calculus for four dimensions discovered that the basic Pythagorean Theorem could be further extended to account for the additional dimension of time (t) and the velocity of light (c). Thus to calculate the distance between two point (O,A) in four dimensions, we need the equation: $OA = \sqrt{x^2 + y^2 + z^2 - (ct)^2}$. This uniform use of the Pythagorean Theorem warrants further confidence in the validity of the union of space and time, since the theorem, for the most part, can be used in calculating the distances between points in two, three, or four dimensions.

The application of Einstein's notion of time to space-travel has amusing and apparently paradoxical consequences. The results are usually codified under the names: "twin paradox", "clock paradox", or "time paradox". In this paradox we are presented with two twins, one of them (A) makes a trip to a distant star (S) and returns to earth, while the other twin (B) remains on earth. Before leaving "A" and "B" synchronize their respective clocks. "A" travels at a high constant velocity to "S", when he reaches "S", he

decelerates in order to turn around, and then accelerates to reach the same high constant velocity for his return to earth. Upon returning "A" and "B" compare their respective clocks and find that "A"'s clock has advanced less than "B"'s clock did. Indeed "A" will be physically younger than "B", since it is assumed that all processes - be they chemical, mechanical, or biological - that take place within "A"'s journey must go as slowly as his clock did. It is this element that appears surprising. So it is paradoxical that "A" and "B" appear to be in inertial frames, "A"'s clock ran slower than "B"'s clock because "A" is at rest while "B" is moving. However if both are in inertial frames then either "A" or "B" could claim that he was at rest with respect to the other's motion. Thus "B" can conclude that he is at rest while "A" is moving, resulting in "B"'s clock going slower than "A"'s clock. The result, if both are in inertial frames, is that each can claim that his/her clock ran slower than the other's clock. The paradox is: which is right?

For Einstein, there is no paradox because "A" is not in an inertial frame during the whole voyage, due to the deceleration and acceleration at the star. Thus "B" cannot claim he is at rest while "A" is moving since "A" is not in an inertial frame. But the reason why "A"'s clock runs slower than "B"'s clock does not rest on the deceleration and acceleration around the star. The justification for

"A"'s clock is that time is not absolute but variant, as we have seen, and that time is dependent on space and velocity. Thus "the total amount of time retardation predicted by the Special Theory for the spacetraveler will depend ... on the velocity of the rocket relative to the earth, assumed constant, and the total distance of the trip."²⁹

As we have seen, Einstein's conception of the universe is significantly different than the one formulated by Newton. In place of Newton's absolutes, Einstein defines a system moving uniformly with respect to an inertial system as itself an inertial system. This principle of relativity is stated at the outset of Einstein's theory. Also, initially given is the principle that the velocity of light has the same value (c) with respect to any inertial observer. From these two principles Einstein develops a notion of time. Time can no longer be perceived as public, constant, absolute, and independent from space. The view of time as private, variant, and in union with space drastically alters our calculations about reality, since time is one of the standards for measuring reality. Because of this meaning of time, new explanations about simultaneity and temporal modes (past, present and future) were proposed. Also the seemingly surprising conclusion of the "twin paradox" will have to be considered. Einstein's results offered a new cosmological view that was not, however, immune from attack.

²⁹J.A. Coleman, Relativity for the Layman, Middlesex, England: Penguin Books, 1969, p. 77.

Well versed in both Newtonian physics and Einstein's alternative, Whitehead finds Einstein's physics superior to Newton's in many ways. In fact, many facets of the theory of relativity are adopted by Whitehead as seen in his early mathematical works³⁰ and more clearly in his later philosophical ones.³¹

Whitehead espouses Einstein's position on the union of space and time. This union of the space-time continuum is not always consistent with Einstein's view (as will be seen)

³⁰ I refer to a quote previously used from "The Axioms of Geometry." No decisive argument for either view (Newton's or Einstein's) has at present been elaborated. "The Axioms of Geometry," p. 734.

³¹ Whitehead is beginning to accept some of Einstein's theory by 1919 but he is skeptical as revealed in a conversation on September 11, 1945 with L. Price: "I had a good classical education when I went up to Cambridge early in the 1880's, my mathematical training was continued under good teachers. Now nearly everything was supposed to be known about physics that could be known - except a few spots, such as electromagnetic phenomena, which remained (or as it was thought) to be co-ordinated with the Newtonian principles. But for the rest, physics was supposed to be a closed subject. Those investigations to co-ordinate went on through the next dozen years. By the middle of the 1890's there were a few tremors, a slight shiver as of all not being quite secure, but no one sensed what was coming. By 1900 Newtonian physics were demolished, done for! ... Speaking personally, it had a profound effect on me. I had been fooled once, and I'll be damned if I'll be fooled again! Einstein is supposed to have made an epochal discovery. I am respectful and interested, but also skeptical. There is no reason to suppose that Einstein's relativity is anything more final than Newton's Principia. The danger is dogmatic thought." Quoted in M. Jordan, New Shapes of Reality, London: Allen and Unwin Ltd., 1968, p. 105 from L. Price, Dialogues of Alfred N. Whitehead. See also: "The Idealistic Interpretation of Einstein's Theory," Aristotelian Society Proceedings, vol. XXII, 1921. Whitehead's contribution is found between pp. 130-134. In this discussion Whitehead claims that Einstein's theory will aid the realist philosopher, and not the idealistic tradition of Descartes, Spinoza, or Leibniz as advocated by H. Carr.

nor does it mean that time cannot be distinguished from space.

In Whitehead's opinion time is only one side of space-time and is an abstraction insofar as it ignores the spatial side of what is really a single manifold. But although 'there can be no time apart from space, and no space apart from time' still space and time are quite readily distinguishable by everyone and may be treated in partial independence of each other for expository or critical purposes.³²

Whitehead also endorses the Einsteinian conception of an infinite set of spatio-temporal series.³³ The Newtonian model held that there was only one spatial and one temporal series, a world series with a past, a present, and a future. But Whitehead believes that, while there is an infinite set of spatio-temporal series in our perception, he perceived only a singular series. This is the interpretation that would lead Whitehead to disagree with Einstein, particularly over the conception of simultaneity.

Palter suggests that there is another possible area of agreement between Whitehead and Einstein:

Whitehead's formulation of the theory of tensors differs significantly from Einstein's only at the early stages, when fundamentals are being discussed; their later elaborations of special tensors (like the Riemann-Christoffel tensor) are essentially the same...³⁴

Whitehead adopted these points in the light of the

³²W. Hammerschmidt, Whitehead's Philosophy of Time, p. 4.

³³"Time, Space, and Material," pp. 49-50; "Uniformity and Contingency," p. 12; An Enquiry Concerning the Principles of Natural Knowledge, p. 32.

³⁴R. M. Palter, Whitehead's Philosophy of Science, p. 190.

superiority of Einstein's physics. However, he believed that Einstein's theory contained major inadequacies, as a philosophy of science. These inadequacies made Whitehead a serious critic of relativity. There are four principal areas in which he is at variance with Einstein. First, he rejected Einstein's theory of gravitation; secondly, he criticized the concept of heterogeneous space, needed in the general theory of relativity; thirdly, he objected to Einstein's thesis on simultaneity and its effects on the so-called "twin paradox;" and fourthly, he rejected Einstein's dependence on the "instant."

Whitehead developed a theory of gravitation³⁵ in an attempt to bridge the gap between Newton's theory of action at a distance (i.e. the idea that bodies can exert forces on one another without the agency of a medium between them) and Einstein's theory of no action at a distance³⁶ (i.e. electromagnetic and gravitational fields). As Palter expresses it:

Whitehead's theory of gravitation involves action-at-a-distance propagated with a certain finite velocity. Whitehead's rejection of both the Newtonian and the Einsteinian approaches to natural philosophy stems from his emphasis on both the continuity and the atomicity

³⁵Whitehead's theory of gravity was a viable alternative to the Einsteinian theory until 1971 when C.M. Will demonstrated that Whitehead's theory, which had predicted a time dependence for the ebb and flow of the ocean tides, was completely contradicted by experience. For more information see C.M. Will, "Relativistic Gravity in the Solar System, II: Anisotropy in the Newtonian Gravitational Constant," Astrophysics Journal, vol. 169, pp. 141-156, 1971.

³⁶A. Einstein, Relativity: The Special and the General Theory, trans. by R.W. Lawson, N.Y.: Henry Holt & Co., 1920, p. 74.

of nature. Newton's conception of permanent atoms of matter persisting through absolute time and, in particular, the continuity among the successive instantaneous spaces. The conception of a completely unified physical field (Einstein's ultimate objective) makes unintelligible the very possibility of knowledge to finite and therefore partially ignorant minds.³⁷

The second disagreement arose because Whitehead basically assumed that nature is revealed in sense-awareness and that events are internally related. Sense-awareness reveals relatedness; all events are related. But if we accept Einstein's argument that the structure of space-time is not uniform, but rather changes according to the matter distributed in space-time,³⁸ then we cannot maintain relatedness in the Whiteheadian sense because by doing so we would fail to

³⁷R.M. Palter, Whitehead's Philosophy of Science, p. 194. In this quote Palter makes reference to Dr. Synge's article, which this author refers readers to for additional information. J.L. Synge, "Orbits and Rays in the Gravitational Field of a Finite Sphere According to the Theory of A.N. Whitehead," Proceedings of the Royal Society of London, CCXI, 1952, pp. 303-319, especially p. 308. The question of gravitation is not central to this dissertation so it is being left at this point; for those interested in the Whiteheadian theory of gravity, the following articles and texts are significant: C.B. Rayner, "Whitehead's Law of Gravitation in a Space-Time Constant Curvature," Physical Society of London Proceedings, vol. 68, 1955, pp. 944-950, especially pp. 947-949. C.B. Rayner, "The Effects of Rotation of the Central Body on Its Planetary Orbits, After the Whitehead Theory of Gravitation," Proceedings of the Royal Society of London, CCXXXII, 1955, pp. 135-148.

³⁸Einstein's position is: "According to the general theory of relativity the metrical character (curvature) of the four-dimensional space-time continuum is defined at every point by the matter at that point and the state of that matter. Therefore, on account of the lack of uniformity in the distribution of matter, the metrical structure of this continuum must necessarily be extremely complicated." F.C. Northrop, "Whitehead's Philosophy of Science," in The Philosophy of Alfred North Whitehead, ed. by P.A. Schilpp, Evanston: Northwestern University, 1941, p. 185.

have the uniformity revealed by sense-awareness. Whitehead's position can clearly be seen in the following statement:

(Events) ... are mutually significant of each other. The uniform significance of events thus becomes the uniform spatio-temporal structure of events. In this respect we have to dissent from Einstein who assumes for this structure casual heterogeneity arising from contingent relations. Our consciousness also discloses to us this structure as uniformly stratified into durations which are complete nature during our spacious presents.³⁹

Whitehead felt that Einstein's methodology and underlying epistemology had the same weakness as those he had criticized in Newton's philosophy. According to Whitehead, both Newton and Einstein failed to establish the primacy of sense-awareness. They based their respective physics on abstractions and hence, in the Whiteheadian sense, sinned by bifurcating nature. Northrop comments on this in the following way:

First, a theory may be quite satisfactory from the standpoint of a physicist, yet false from the standpoint of the philosopher of science. Our consideration of the epistemological consequences of the bifurcation of nature makes this clear. The physicist does not have to face these epistemological problems; hence this weakness in his theory does not come to his attention, at least not in his capacity as a physicist. But the philosopher of science must face the epistemological consequences of a given set of basic concepts for physics as well as their purely scientific and experimental consequences. There is nothing necessarily to prevent a scientific theory from being quite adequate from the scientific standpoint and equally inadequate from the epistemological standpoint. Whitehead believes this to

³⁹The Principle of Relativity, p. 313, see also p. 297. See also "Uniformity & Contingency," pp. 114-115; An Enquiry Concerning the Principles of Natural Knowledge, pp. 32-33. The Concept of Nature, pp. 144-146. Whitehead also affirms homogeneous space in Science and the Modern World.

be the case with respect to Einstein's physics, in the form in which Einstein has left it. Consequently, if, in order to make the primitive concepts of science adequate with respect to their epistemological consequences, it is necessary to deviate from present scientific doctrines, then, unfortunate as this additional reconstruction in our scientific theory may be, it must be made. The failure of all attempts of modern philosophers to solve the epistemological problems bequeathed to modern philosophy by the modern scientists' bifurcation of nature gives weight to Whitehead's conclusion.⁴⁰

Whitehead's philosophy of science is an attempt to break with this bifurcation of nature, as can be seen in his emphasis on homogeneous space:

... by rejecting Einstein's theory of space as a relation between physical objects and substituting for it a relational theory which conceives of space as a relation between immediately sensed phenomenal events. By defining objects, both 'perceptual' and 'scientific' in terms of 'adjectives' which enter into events in external relations; while conceiving of the relation between events as internal and quite independent of the 'ingression of objects,' Whitehead has a meaning for space quite independent of matter and hence can express the notion of the motion of any or all objects in terms of a relation of objects.⁴¹

Thus by emphasizing the internal relatedness of events as a major component of his theory of space, he is able to retain nature as revealed in sense-awareness.

Whitehead was objecting to a major tenet of relativity and contemporary physics. We must inquire whether or not his reliance on sense-awareness is justified, and to do this let us use one of Einstein's own examples to test Whitehead's argument for "homogeneous uniform space":

⁴⁰F. S. C. Northrop, "Whitehead's Philosophy of Science," in Schilpp, The Philosophy of Alfred North Whitehead, p. 185.

⁴¹Ibid., p. 176.

I stand at the window of a railway carriage which is travelling uniformly, and drop a stone on the embankment, without throwing it. Then, disregarding the influence of the air resistance, I see the stone descend in a straight line. A pedestrian who observes the misdeed from the footpath notices the stone falls to earth in a parabolic curve.⁴²

Einstein explains the difference between the two observers as a difference between two "systems of co-ordinates":

The stone transverses a straight line relative to a system of co-ordinates rigidly attached to the carriage, but relative to a system of co-ordinates rigidly attached to the ground (embankment) it describes a parabola. With the aid of this example, it is clearly seen that there is no such thing as an independently existing trajectory, but only a trajectory relative to a particular body of reference.⁴³

Whitehead copes with this example by suggesting that the Einsteinian solution would eventuate in the inability to measure or to explain anything. Here again we appeal to Northrop:

Assume that the old concept of a physical object is still meaningful, even after the rejection of absolute space, and hence that it is meaningful to think of space as a relation between physical objects. According to the traditional and current theory these physical objects are made up of particles such as chemical atoms or physical electrons which are in motion. By space we must mean then a relation between these entities. But clearly, since these entities are in constant motion, the relatedness between them must be one thing at one instant of their motion and a quite different thing at another. It follows therefore that space should never have the same metrical properties at any two instants of time. Yet even Einstein's theory assumes that it does. Thus, when one stops thinking about Einstein's physical relational theory in the abstract, and actually expresses it in terms of the real physical objects which physics tells us exist, the type of

⁴²A. Einstein, Relativity: The Special and General Theory, N. Y.: Henry Holt and Co., 1920, p. 9.

⁴³Ibid., p. 10.

approximate metrical constancy in space which Einstein's theory requires is not the one which space, conceived as a relation between the existent objects of physics would provide.⁴⁴

If this is the case, we must then concur with Whitehead that if space is not uniform we cannot formulate a consistent explanation of observed phenomena. Although this is a negative argument, and does not prove Whitehead correct, it does weaken Einstein's case. Yet if we consider the phenomena as a relatedness between events, we then have "the character of a systematic uniform relatedness between events which is independent of the contingent adjectives of events."⁴⁵ This formulation is a plausible alternative to the solution offered by Einstein.

The argument for uniformity leads Whitehead to reject Einstein's explanation of simultaneity. This can be seen in his disagreement about the "twin paradox." Einstein, it will be recalled, maintains that simultaneity for events separated by space is not intuitively given but is based on the physical constant c (light). Einstein speaks of distant events as being simultaneous if light signals from the two distant events reach a mid-point between at observed simultaneous times.⁴⁶ The discussion of inertial frames and spec-

⁴⁴F. S. C. Northrop, "Whitehead's Philosophy of Science," p. 192; see also The Principles of Relativity, p. 336.

⁴⁵The Principles of Relativity, p. 336.

⁴⁶See A. Einstein, Relativity; The Special and General Theory, chapter VIII.

ial relativity early in the chapter gives some idea of Einstein's position. Whitehead argues in An Enquiry Concerning the Principles of Natural Knowledge that Einstein fails to consider the underlying problem.⁴⁷ His first argument against the 'signal theory' is:

There are blind people and dark cloudy nights, and neither blind people nor people in the dark are deficient in a sense of simultaneity. They know quite well what it means to bark both their shins at the same instant.⁴⁸

Whitehead's argument is not satisfactory because Einstein does not claim that light signals are important for an explanation of neighboring events. In fact, Einstein would agree with Whitehead that the perception of simultaneity for events that lie side by side is intuitive. Einstein uses the 'signal theory' when he refers to distant events. Thus, it is hard to see why Whitehead is objecting to Einstein. Whitehead's criticism is merely an introduction to his argument against Einstein's claim that the velocity of light is uniform. This position seems to make more sense, since for Whitehead, "simultaneity is a definite natural relation,"⁴⁹ revealed in sense-awareness; and as such we must inquire whether or not light maintains a constant velocity in the

⁴⁷In fact it seems to me that Whitehead is building a strawman argument and then defeating it.

⁴⁸An Enquiry Concerning the Principles of Natural Knowledge, p. 55.

⁴⁹The Concept of Nature, p. 53. Also: 'simultaneity is an ultimate factor in nature, immediate for sense-awareness,' The Concept of Nature, p. 56.

media of our observations:

... our only experience of light is as moving through a medium, the air, glass, water, etc. We believe that these mediums affect the velocity of light. Accordingly we should be reduced to founding the very meaning of equal lapses of time upon the behaviour of light under circumstances of which we have no direct experience.⁵⁰

Whitehead then argues that "the determination of simultaneity in this way is never made, and if it could be made would not be accurate; for we live in air not in vacuo."⁵¹ While it is true that we perceive things "in air and not in vacuo," this light "in air" travels at a uniform velocity and, while it is different from its speed "in vacuo," it still serves as the standard. While there may be merits for basing simultaneity on sense-awareness rather than the uniform velocity of light in vacuo, this approach is not entirely persuasive.

Whitehead has other arguments, the main one resting on his doctrines of significance, duration, and percipient events.⁵² (See Chapter two for a definition of percipient events in terms of the "here-now" in duration.) This perception is intuitive and the "present-whole" is perceived in extension:

⁵⁰"The Problem of Simultaneity: A Symposium," Proceedings of the Aristotelian Society, supplementary volume III, July 1923, p. 39.

⁵¹An Enquiry Concerning the Principles of Natural Knowledge, p. 54.

⁵²"The simultaneity of the whole of nature comprising the discerned events is the special relation of that background of nature to the percipient event." Ibid., p. 68.

Thus nature, as we know it, is a continuous stream of happenings immediately present... Within this present stream the perceived is not sharply differentiated from the unperceived: there is always an indefinite 'beyond' of which we feel the presence...⁵³

This beyondness gives rise to externality. Northrop elaborates on this idea as follows:

The initial fact disclosed in sense awareness, according to Whitehead, is the extension of all intuitively given nature in the process of passing. Clearly, what we immediately apprehend is everything which we apprehend. This, according to Whitehead's description, is an extended manifold which does not have an immediately sensed largest extension or an immediately sensed smallest extension. Moreover, of this manifold, passage and duration are immediately perceived as constituting its very nature. We do not immediately sense nature at an instant, nor do we immediately sense geometrical points with a minimum of extension. Instead, we immediately intuit an extended manifold which is enduring through time and passing. Thus sense awareness supports the primacy of passage.⁵⁴

What we intuit then is not instants or partial events but a complete event which is the whole of nature simultaneous with the percipient event, which is itself part of that whole."⁵⁵ This percipient event is the limitation of the duration.⁵⁶ But the duration "is in a sense unbounded; for it is within certain limitations, all that there is."⁵⁷ This leads Northrop to state:

⁵³Ibid., p. 69.

⁵⁴F. S. C. Northrop, "Whitehead's Philosophy of Science," p. 195.

⁵⁵An Enquiry Concerning the Principles of Natural Knowledge, p. 68.

⁵⁶Ibid., pp. 68-69. See also my comments on page 28.

⁵⁷Ibid., p. 69.

Clearly, events that happen at the same time are not separated temporally; hence they can only be separated spatially. Thus Whitehead succeeds in using the concept of simultaneity applied to the whole of nature to define the spatial relatedness of events at a given moment of time.

It is to be emphasized that when the intuited concept of simultaneity for spatially separated events throws into one class all events happening in a given now, this now must be conceived, because of the fundamental property of duration characterizing all events, not as an instant but as a now with temporal extension.⁵⁸

Whitehead has tried to develop a notion of simultaneity that can be expanded beyond events side by side to encompass events spatially separated beyond sense-awareness. The interweaving of events into a spatial and temporal whole⁵⁹ leads Whitehead to believe that simultaneity can be explained without reference to light signals,⁶⁰ and that simultaneity can

⁵⁸F. S. C. Northrop, "Whitehead's Philosophy of Science, p. 196.

⁵⁹As Hammerschmidt indicates: "Events are known to extend as far as can be imagined. Every event implies another which adjoins it and extends beyond it. We do not know these events in all their sensory content or adjectival nature. We do know them in their basic significance as a spatio-temporal region expressive of spatio-temporal relations," Hammerschmidt, Whitehead's Philosophy of Time, p. 53.

⁶⁰Professor Einstein's reaction to Whitehead's thesis on simultaneity is revealed in a conversation with Northrop: "A few weeks ago I had a lengthy discussion with Professor Einstein with respect to the fundamental assumptions of his theory of relativity. Late in the discussion this question of Whitehead's difference from Einstein with respect to the simultaneity of spatially separated events arose. Einstein said, 'I simply do not understand Whitehead.' I replied, 'There is no difficulty in understanding him. When Whitehead affirms an intuitively given meaning for the simultaneity of spatially separated events, he means immediately sensed phenomenological events, not postulated public physically defined events. On this point he is clearly right. We certainly do see a flash in the distant visual space of the sky now, while we hear an explosion beside us. His reason for maintaining that this is the only kind of simul-

be the foundation of science.

Our immediate sense-data are apprehended by us as involved in a simultaneous complex forming a three-way spread, with a fourth dimension which is the temporal flux. The problem of science ... is to determine a distribution of characters within this immediately perceived flux which shall express the dependence of the future on the past. Thus I see the twinkling light-point which is my sense-datum of a star; it is an element of the immediate simultaneous three-way spread of Nature, passing in time. It is the problem of science to conjecture the characters in the three-way spread of the past which shall express the dependence of the three-way spread on my present experience upon the past history of Nature. These characters are collections of molecules (called the real star), some hundreds of years ago, and light-waves in subsequent years up to the present time, and finally disturbances in my body. With this point of view simultaneity is the foundation of science.⁶¹

Whitehead's disagreement with Einstein's notion of relative simultaneity seems to be based on the concern to avoid the bifurcation of nature into physical events and observed events. In an attempt to avoid this, Whitehead tries to resurrect the Newtonian thesis of absolute simultaneity. To accomplish this, as we have seen, Whitehead refuses to accept the postulate of the invariance of the velocity of light. If this postulate can be successfully challenged,

taneity which is given arises from his desire, in order to meet epistemological philosophical difficulties, to have only one continuum of intuitively given events, and to avoid the bifurcation between these phenomenal events and the postulated physically defined public events.' Einstein replied, 'Oh! Is that what he means? That would be wonderful! So many problems would be solved were it true! Unfortunately, it is a fairy tale. Our world is not as simple as that.' F. S. C. Northrop, "Whitehead's Philosophy of Science", p. 204.

⁶¹"The Problem of Simultaneity: A Symposium", pp. 40-47.

then a case can be made for the absolute simultaneity of events. Whitehead's challenge to the invariance of the velocity of light "in vacuo" by stating the variance of the velocity of light in a medium is unconvincing since we can always correct our calculations for the medium. By failing to discredit the constant velocity of light, Whitehead is also unsuccessful in his criticism against space-time relationships depending on the observer.

We can be sympathetic with Whitehead's desire to have absolute simultaneity where observers, regardless of their spatio-temporal framework, can accurately report the same occurrence, since this notion of simultaneity would avoid the bifurcation of nature into physical events and observed events. Unfortunately, Whitehead's arguments so far have not been persuasive.⁶² However, if we turn our attention to his critical comments on the "twin paradox," we will find a more fruitful criticism of the Einsteinian concept of simultaneity.

Einstein's formulation of the "twin paradox" has been discussed.⁶³ Whitehead concurs with the relativists' mathematical formulations of the problem, but disagrees with the philosophical and cosmological interpretations of the

⁶²An argument that would be persuasive is that relative simultaneity would distort our perception of cause and effect. However, this is not the case - cause and effect still have the same relationship for both observers, even if they disagree as to when the occurrence happens.

⁶³We have seen Einstein's presentation of the paradox earlier in this chapter.

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mathematical results.⁶⁴ His criticism of the paradox is three-fold.

Whitehead's first criticism is based on deceleration and acceleration, in other words, the non-inertial frames of the spaceship: the acceleration at the departure from earth; the deceleration and then the acceleration at the star; and the final deceleration upon arrival at earth. These movements of the spacecraft are fundamental factors for the analysis of the motion of the craft. These movements are non-inertial, and thus are not within the realm of the theory of special relativity, but possibly these movements can be explained by the general theory of relativity. (However, I believe that the move to general relativity would not be beneficial, since different physicists derive different interpretations of the same information given in general relativity).⁶⁵

Einstein would probably concur with Whitehead's contention that the crux of the problem is with the non-

⁶⁴"We (Whitehead and Carr) are both agreed as to the mathematical theory; accordingly I doubt whether he, (Carr), and many mathematicians, have been successful in interpreting that theory in terms of the realities of our experience." "The Problem of Simultaneity: A Symposium," p. 35.

⁶⁵See, R. H. Dickie, Theoretical Significance of Experimental Relativity: N. Y.: Gordon Breach, 1964; and P. G. Roll, R. Krotkon and R. H. Dickie: "The Equivalence of Inertial and Passive Gravitational Mass", Annals of Physics (U.S.A.) vol. 26, 1964, pp. 442-517; and H. P. Robertson and T. W. Noonan, Relativity and Cosmology, Philadelphia: W. B. Sanders, 1968; and R. D. Sard, Relativistic Mechanics, N. Y.: W. A. Benjamin, 1970.

inertial motions, but he would reject Whitehead's conclusion. In rebuttal, Einstein could claim that the relativistic formula predicts asymmetrical aging by the factor g . This, coupled with the fact that the effects of deceleration and acceleration can be made mathematically negligible, is claimed to result in the disappearance of the paradox.

For Whitehead the disappearance of the paradox is only illusory. To relativists, like Carr, the result of making the non-inertial frames of motion mathematically negligible simply means that those non-inertial movements do not constitute "an essential fact of the life history of any body."⁶⁶ This is exactly what Whitehead rejects. Not only does it bifurcate nature into mathematical (essential) events and non-mathematical (non-essential) events, but also the relativist's thinking fails to grasp that the life-history of an event encompasses all the time frames of that event. To disregard an aspect of an event's history because it is mathematically unimportant might be good mathematics, but is poor philosophy. To view the paradox or nature in this one-dimensional (mathematical) approach is similar to the surgeon, who, after a difficult operation, comes out to the patient's family and announces that the operation was a success but the patient died.

For Whitehead, then, the failure to include all the movements in the life-history of an event makes the

⁶⁶ Ibid., p. 40.

relativist analysis of the paradox unacceptable. This failure also leads to a distortion in the notion of time.

Whitehead's second criticism emerges from his analysis of the systems of congruence employed by the relativist solution to the "twin paradox." He notes three measuring systems: synchronized clocks, the revolutions of the earth, and light signals.⁶⁷ After analyzing each of these systems, Whitehead is at a loss to know what is being measured. In all three accounts, time can only be defined as the product yielded by the systems. Time is not independent of the measuring system. Time does not exist until the measurements and calculations are completed; then time emerges as the product. Thus if the measuring system reports an asymmetrical time measurement, then the times in the "twin paradox" are different. For Whitehead, the only results of this procedure are confusion and circularity; confusion because it does not say what is being measured, and circular because it is measuring and affirming the truth of our measuring systems at the same time. The technique involves assuming as true what has yet to be proved. Thus Whitehead criticizes the very foundations and presuppositions of the relativistic notion of time, revealing both its lack of clarity and, to use a Feyerabend term, its "theory ladenness."

The third criticism arises from Whitehead's belief

⁶⁷ Ibid., see particularly pp. 36-39. It should be noted too that Einstein prefers the signal thesis.

that the universe is in symmetry, which is in contrast to the asymmetrical conclusion of the "twin paradox." This belief in symmetry has not been demonstrated by Whitehead. For Whitehead to criticize a theory on the basis of a pre-supposition, like symmetry, is a violation of his own contention that sense-perception must be our operating first principle.

Einstein's theory of relativity does not argue for or against the principle of symmetry per se. In special relativity the symmetrical universe usually predominates, whereas asymmetry predominates general relativity. While Whitehead does not support his contention that nature operates symmetrically, I believe he is correct in challenging the asymmetrical presentation that Einstein puts forward. While he is not necessarily correct in holding to symmetry, he is correct in challenging a theory that holds both symmetry and asymmetry when the definitions are not compatible. If nature operates symmetrically, then Whitehead's position would have some basis; but this has not been established or refuted.

In philosophical terms, Whitehead has revealed several weaknesses and major problems with the relativists' account of the "twin paradox". He has challenged the attempt by Einstein to resolve the paradox solely within the theory of special relativity. He has questioned the measuring systems, revealed the inadequacies in the relativists' meaning of time, raised the specter of circularity as well as "theory

ladenness" in the Einsteinian account, and demonstrated a preference for a symmetrical view of the universe.

Thus our presentation of Whitehead's analysis of Einstein's world-view has uncovered a number of important items for understanding Whitehead's notion of time: the union of space and time; the perception of an infinite spatio-temporal matrix (though we perceive only a singular series); the notion of real simultaneity between events; the uniformity of time-space; the homogeneity of space; the notion of symmetry; the variance of the speed of light; the importance of the temporal history of an event; the need for distinguishing between time and time measurement systems; and the importance of sense-perception. These concepts, some worthwhile, others poorly constructed, will eventually help us in understanding Whitehead's notion of time. Before we can embark on the endeavor of weaving these and other concepts into the fabric of a Whiteheadian concept of time, we must understand a few of Whitehead's criticisms of the Kantian notion of time.

Throughout this chapter we have seen repeated statements by Whitehead concerning the necessity and role of sense-perception. In Kant's philosophy, sense-perception is unable to provide either science or philosophy with infallible truth and cannot even provide the grounding for truth. For Kant the world is not the amorphous mass of Cartesian extension or Lockean sensations or Humean impressions. It is the world of pure reason and intuition. Kant's notion of time arises from his epistemological enquiries and his belief

in the Newtonian conception of the order of nature.⁶⁸ "In fact, Kant's philosophical system must be conceived as an ideological superstructure erected on the foundation of physics modeled for an absolute space, an absolute time ..."⁶⁹ For Kant neither space nor time exist outside the knower. Time is not an idea derived from things known but an "a priori" intuition.⁷⁰

Time is not an empirical concept that has been derived from any experience. For neither coexistence nor succession would ever come within our perception, if the representation of time were not presupposed as underlying them a priori. Only on the presupposition of time can we represent to ourselves a number of things as existing at one and the same time (simultaneously) or at different times (successively).

Time is a necessary representation that underlines all intuitions. We cannot, in respect of appearances in general, remove time itself, though we can quite well think time as a void of all appearances. Time is, therefore, given a priori. In it alone is the actuality of appearances possible at all. Appearances may, one and all, vanish; but time (as the universal condition of their possibility) cannot itself be removed.⁷¹

If Kant is correct then Whitehead's philosophy is in serious difficulty. Whitehead counters the Kantian thrust by attacking Kant's acceptance of absolute time, time as pure succession, time as independent of space, and the "a priori" nature of time. The same arguments that Whitehead employed against

⁶⁸ H. Reichenbach, The Rise of Scientific Philosophy, Berkeley: University of California Press, 1951, pp. 42-43.

⁶⁹ Ibid., p. 44.

⁷⁰ Intuition refers to the immediate awareness of something.

⁷¹ T. D. Waldon, Kant's Critique of Pure Reason, Oxford: Clarendon Press, 1958, pp. 74-75.

Newton's notions of absolute time, pure succession, the instant, and the independent status of time are applicable against Kant, but Whitehead must address the problem of time as "a priori." Whitehead suggests in his article, "Space, Time and Relativity," that the doctrine of "a priori" time,

... should be given a different twist, which in fact turns it in the opposite direction - namely, that in the act of experience we perceive a whole formed of related differentiated parts. The relations between these parts possess certain characteristics, and time and space are the expressions of some of the characteristics of these relations.⁷²

Whitehead is claiming that our experience of extension, which is immediate, cannot be separated from our notion of time and space. In other words, one cannot grasp time and space without extension. Kant is unable to perceive extension in experience, yet he claims to perceive time and space as a priori. Whitehead develops his critique of Kant later in his philosophical development in the work, Symbolism Its Meaning and Effect (1926). During this period he states:

We have first to make up our minds whether time is to be found in nature or nature found in time. The difficulty of the latter alternative - namely of making time prior to nature - is that time becomes a metaphysical enigma. What sort of entities are its instants or periods? The dissociation of time from events discloses to our immediate inspection that the attempt to set up time as an independent terminus for knowledge is like the effort to find substance in a shadow. There is time because there are happenings and apart from happenings there is nothing.⁷³

⁷²A. N. Whitehead, "Space, Time, and Relativity," in Alfred North Whitehead, The Interpretation of Science, ed. by A. H. Johnson, N. Y.: Liberal Arts Press, 1961, p. 100.

⁷³The Concept of Nature, pp. 65-66.

Kant's difficulty is that he bifurcates nature. In doing so, he fails to understand the limits of reason. As a mathematician Whitehead was aware of the faultiness of Kant's mathematical intuitions, such as "the whole is greater than its parts." Thus Whitehead was very skeptical of Kant's assurances about reason.⁷⁴

These criticisms of Newton, Kant, and Einstein have been drawn together from a variety of Whitehead's writings during the period of 1915-1924. As we have seen, they serve to further articulate and bring to the surface Whitehead's notions of time and, most important, to show the development of his thoughts. For example, I have noted that prior to 1919 Whitehead held a Newtonian view of time, specifically the notion of the instant and the serial property of time. But beginning in 1919 with An Enquiry Concerning the Principles of Natural Knowledge, Whitehead initiates an analysis of Newton that will lead to his rejection of the notions of

⁷⁴If we look at the properties of infinite sets we see that two collections of things are claimed to be of equal cardinality when they are arranged in a one to one correspondence to each other. Note the set of all positive integers (1,2,3,4,....), called class Y. Remove from class Y all of the even numbers, leaving the set of odd numbers (1,3,5,....), called class Z. From Kant's perspective, intuition tells us that class Y is greater than class Z. However, a one to one correspondence can be established between classes Y and Z. Thus the classes Y and Z have equal cardinality, demonstrating that the intuition that the whole is greater than any of its parts does not necessarily hold in infinite collections. Kant probably wouldn't accept this argument, but Whitehead could reply (in this imaginary dialogue) that not even Kant's mathematical intuition can account for a hierarchy of infinities, i.e. the set of real numbers (0-1) is greater than the set of positive integers - itself an infinite set.

absolute space, time, and motion, of points and instants, because Newton's theory leads to a bifurcated notion of reality. We have also seen that Whitehead seeks to retain absolute simultaneity and the importance of sense-perception. To achieve this, he engages in an extensive dialogue with the relativists.

It is in this chapter that we have seen Whitehead's rejection of the alternative theories of nature open to him. He found this move necessary in order to reveal the need for a different approach and a different theory of nature. He has done this. In addition we can begin to see the kind of alternative philosophy that Whitehead is trying to develop by examining the characteristics of time that have been inferred from his criticisms. But Whitehead must accomplish more than this. He must develop an alternative philosophy which satisfies his own criterion and which will account for nature as successfully as those theories he has rejected. This is particularly true with respect to Whitehead's rejection of the instant. He must develop a method and an explanation that will preserve the simplicity and usefulness of the instant without bifurcating nature. He believes that his method of extensive abstraction will do this, and our attention is now directed to an examination of this method.

CHAPTER IV

THE METHOD OF EXTENSIVE ABSTRACTION

In the preceding chapters we considered some of Whitehead's objections to the traditional notions of points and instants, in nature. Whitehead realized that these concepts played an important role in mathematics and physics, and he considered it incumbent upon himself to provide an explanation of this role and to incorporate it into his new philosophy of nature.

Whitehead was able to receive some help in this task from Alexander, who argued that the instant is a logical construction and that its function is to distinguish moments not evidenced in the duration.¹ Alexander attempted to use the notion of the instant, not as a natural entity, but as a logical construction in order to distinguish events presented in the specious present. Whitehead was sympathetic with Alexander's approach,² but his problem was more specifically

¹Alexander, Space, Time and Deity, N. Y.: Dover, 1966, vol. 1, pp. 39-40.

²"Instantaneousness is a complex logical concept of a procedure in thought by which constructed logical entities are produced for the sake of the simple expressions in thought of properties of nature. Instantaneousness is the concept of all nature at an instant, where an instant is conceived as deprived of all temporal extension." The Concept of Nature, p. 57.

to explain the instant for which he had no sense-awareness in terms of natural entities: "Unless we do so, our science, which employs the concept of instantaneous nature, must abandon all claim to be founded upon observation."³ Whitehead, therefore, does not eliminate the concept of the instant from his philosophy; he attempts to integrate it in sense-awareness. His method of extensive abstraction is designed to achieve this goal.⁴

Hammerschmidt indicated one of the primary purposes of this method of extensive abstraction, namely:

To discard the classical idea of continuum as a mere closely packed collection of discrete points and to substitute for it the conception of the continuum as an exhibition of the interconnectedness of regions, derived from their basic extensiveness.⁵

Another aim is to demonstrate "how the geometric relations between points issue from the ultimate relations between the ultimate things which are the immediate objects of knowledge."⁶ Ultimately, this method was used as an attempt to reveal the true nature of the relation between

³Ibid.

⁴See A.N. Whitehead, "La Theorie Relationniste de l'Espace," Revue de Metaphysique et de Morale, vol. 23, 1916, p. 423. The method of extensive abstraction is intended to preserve scientific objects, such as points and instants, as ingredients of events, although these objects are not perceived; and demonstrate how these useful scientific objects are derived from actual events.

⁵Hammerschmidt, Whitehead's Philosophy of Time, p. 43.

⁶An Enquiry Concerning the Principles of Natural Knowledge, p. 5.

mathematics and nature.⁷

Whitehead uses three key words in speaking of extensive abstraction: "extension," "cogredience," and "abstractive set."⁸ We have already seen the meaning he attaches to extension;⁹ let us now turn to "cogredience," which he defines as:

the preservation of unbroken quality of standpoint within the duration. It is the continuance of identity of station within the whole of nature which is the terminus of sense-awareness. The duration may comprise change within itself, but cannot - so far as it is one present duration - comprise change in the quality of its peculiar relation to the contained percipient event.¹⁰

This "preservation" is achieved by one event, and one event only per duration, and as Whitehead puts it, "must be temporally present throughout the duration and exhibit one specific meaning of 'here.'"¹¹ This defines the percipient event.

Whitehead concludes that "cogredience is a condition for a percipient event yielding unequivocal meanings to 'here' and 'now' ... (and it) is the relation of absolute position within a duration."¹² Thus cogredience limits and defines the

⁷For an excellent article on Whitehead's conception of mathematical truth see A.P. Lowry, "Whitehead and the Nature of Mathematical Truth," Process Studies, vol. 1, no. 2, 1971, pp. 114-124.

⁸Extension and cogredience are developed in "Time, Space and Material," p. 50; abstractive set in The Concept of Nature, p. 79.

⁹See Chapter II.

¹⁰The Concept of Nature, p. 110.

¹¹An Enquiry Concerning the Principles of Natural Knowledge, p. 70.

¹²Ibid., p. 71.

duration and enables us to distinguish between durations. Motion and rest are defined in terms of cogredience of duration, for motion is a comparison of position in one instantaneous space and position in other instantaneous spaces of the same time system.¹³ "Cogredience yields the simplest outcome of such comparison, namely rest."¹⁴ Palter clearly indicates the importance of cogredience:

In other words, not only are we aware of our own special standpoint at any given time (or better: during any sufficiently short specious present) within the present whole of nature, but we are also aware of the fact that all events are similarly related by cogredience to appropriate durations. For example, consider an observer in a motionless train. The train and the surrounding trees, telegraph posts, etc., are perceived as cogredient to the same duration which is the present whole of nature for that observer. But the train, trees, telegraph posts, etc., assert their own respective relations of cogredience to that duration as facts quite independent of the presence of the observer. When the train is moving, the assertion of cogredience on the part of the trees, telegraph posts, etc., is even more striking, since now these objects are not cogredient to the same duration as the observer himself, who therefore has a double perception of cogredience, namely the cogredience proper to himself and the train and the cogredience proper to the trees, telegraph posts, etc.¹⁵

The other term required to understand the method of extensive abstraction is that of "abstractive set;"¹⁶ Whitehead says that the method of extensive abstraction is "the

¹³Ibid. See also The Concept of Nature.

¹⁴The Concept of Nature, p. 192.

¹⁵Palter, Whitehead's Philosophy of Science, p. 40.

¹⁶In An Enquiry Concerning the Principles of Natural Knowledge "abstractive sets" are called "abstractive classes."

systematic use of these abstractive classes."¹⁷ The abstractive sets are described in terms of the following two rules, namely: "(i) of any two members of the set one contains the other as a part, and (ii) there is no event which is a common part of every member of the set."¹⁸ This definition is almost equivalent to the one Whitehead used when defining "a moment of time":¹⁹

Consider a set of durations all taken from the same family. Let it have the following properties: (i) of any two members of the set one contains the other as a part, and (ii) there is no duration which is a common part of every member of the set.²⁰

Note that the first rule is identical to the first property of the moment. It is only in the second rule that "no event"

¹⁷An Enquiry Concerning the Principles of Natural Knowledge, p. 104.

¹⁸The Concept of Nature, p. 79 (underlining mine). There is a slight difference between the rules and definition given here and those found in the earlier book: "A set of events is called an 'abstractive class' when (i) of any two of its members one extends over the other, and (ii) there is no event which is extended over by every event of the set." An Enquiry Concerning the Principles of Natural Knowledge, p. 104. The difference is not substantial, but indicated Whitehead's earlier emphasis on extension which he subsequently acknowledges in the second edition of the text (p. 202) and which he corrected in The Concept of Nature with the substitution of other words.

¹⁹Whitehead prefers the usage "moment" to "instant". He uses the same characteristics as the instant in explaining the moment: "A moment ... has no temporal extension ... A moment is a limit to which we approach as we confine attention to durations of minimum extension." The Concept of Nature, p. 59.

²⁰The Concept of Nature, p. 60, (underlining mine). Schmidt gives this definition for "abstractive set." I think he should have used the definition on p. 79. See Schmidt, Perception and Cosmology in Whitehead's Philosophy, pp. 73-74.

is replaced by "no duration." It has to be replaced; the set is a set of durations, not just any kind of events, but those known as "durations" in order to provide a meaning for "moment." For example the set diagrammed below cannot serve to yield a "moment."

The abstractive set is "at the heart of ordinary geometrical entities as surfaces, lines, and points."²¹ Hence, the abstractive set is a set of events that will also be used to define the moment, surfaces, lines and points. We may illustrate this with the aid of the following diagram:

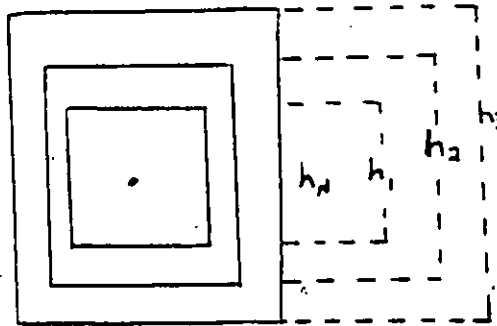


Figure 1²²

Each square represents either events, points, or instants which are limited in space and time; the concentric structure demonstrates the first rule, namely h_3 contains h_2 as a part, h_2 contains h_1 as a part, etc. The concentric squares converge without limit,²³ not to a point or a definite limit,

²¹Hammerschmidt, Whitehead's Philosophy of Time, p. 43; see also The Concept of Nature, p. 61.

²²An Enquiry Concerning the Principles of Natural Knowledge, p. 105.

²³Ibid., p. 104; see also The Concept of Nature, pp. 80-81.

as indicated in Figure 1. This is done by having " h_n tend to zero as N increases indefinitely."²⁴ The unlimitedness of the set demonstrates the second rule, where no event is "a common part of every member of the set."²⁵ In this way Whitehead employs the notion of abstractive set to illustrate his basic philosophical position. From this he is able to maintain that his abstractive set "is effectively the entity meant when we consider an instant of time without temporal extension. It subserves all the necessary purposes of giving a definite meaning to the concept of the properties of nature at an instant."²⁶ Thus the moment is a special kind of abstractive element, one without spatial limits.

Because of the number of abstract entities and the need to develop the concept of the moment more fully, Whitehead designates two characteristics of the abstractive set, prime and anti-prime. A set is prime "in respect to the formative condition ϕ ' (whatever condition ' ϕ ' may be) when (i) it satisfies the condition ϕ , and (ii) it is covered by every other abstractive class satisfying the same condition ϕ ."²⁷ A set is anti-prime: "in respect to the formative condition ϕ ' (whatever condition ' ϕ ' may be) when (i) it satisfies the condition ϕ and (ii) it covers every other ab-

²⁴Ibid., p. 105.

²⁵See N. Lawrence, "Whitehead's Method of Extensive Abstraction," Philosophy of Science, vol. 17, no. 2, 1950, p. 145.

²⁶The Concept of Nature, p. 61.

²⁷An Enquiry Concerning the Principles of Natural Knowledge, p. 106.

stractive class satisfying the same condition σ .²⁸ Given the "formative condition σ " the " σ prime" is the minimum abstractive set, for it is covered by every abstractive set; while the " σ antiprime" is the maximum abstractive set, for it covers every abstractive set.²⁹ The σ prime set will result in Whitehead's definition of events unextended in space and time, the event particles. The σ antiprime set will result in Whitehead's definition of moments. Both prime and antiprime sets will support Whitehead's meanings of simultaneity and continuity.³⁰

In order to implement the notions of prime and antiprime sets, Whitehead first develops the notion of "abstractive element":

An 'abstractive element' is the whole group of abstractive sets which are equal to any one of themselves. Thus all abstractive sets belonging to the same element are equal and converge to the same intrinsic character.³¹

Whitehead arrives at this definition of "abstractive element" from the relation of "covering" between abstractive sets, which produces the equality of abstractive sets. He defines

²⁸ Ibid.

²⁹ For information on the logical status of primes and antiprimes see Palter, Whitehead's Philosophy of Science, pp. 52-53.

³⁰ Hammerschmidt fails to reveal the importance of prime and antiprime in his presentation of either continuity or the method of extensive abstraction. To this author, this is a mistake.

³¹ The Concept of Nature, p. 84. See also An Enquiry Concerning the Principles of Natural Knowledge, pp. 108-109.

"covering" as follows:

An abstractive set p covers an abstractive set q when every member of p contains as its parts some member of q . It is evident that if any event e contains as a part any member of the set q , then owing to the transitive property of extension every succeeding member of the small end of q is part of e . In such a case I will say that the abstractive set q 'inheres in' the event e . Thus when an abstractive set p covers an abstractive set q , the abstractive set q inheres in every member p .³²

Lawrence illustrates this "covering" with the following diagram:

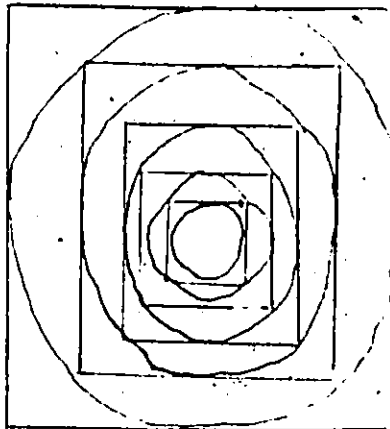


Figure 2³³

Here the circles stand for one set and the squares another. In figure 2, each set covers each other, leading Whitehead to assert "when this is the case I shall call the two sets 'equal in abstractive force.'"³⁴

³²The Concept of Nature; p. 83.

³³Lawrence, "Whitehead's Method of Extensive Abstraction," p. 148.

³⁴The Concept of Nature, p. 83.

It is clear that the importance of abstractive elements lies in the fact that "they enable one to deal simultaneously with all abstractive classes possessed of a given group of convergence - properties, i.e. with complete sets of k - equal abstractive classes."³⁵

Another essential attribute of abstractive elements is that they "form the fundamental elements of space and time."³⁶ It is to this idea that we must now direct our attention: In An Enquiry Concerning the Principles of Natural Knowledge, Whitehead defines duration in terms of absolute antiprimes and moments as abstractive elements in an absolute antiprime. An absolute antiprime is "an abstractive class which covers every abstractive class which covers it."³⁷ Thus, duration is defined as a complete whole of nature,³⁸ which is spatially unbounded and temporally indefinite, and any abstractive class composed of such events can only be covered by classes composed solely of the same events. Thus, "only events of a certain type can be members of an absolute antiprime, namely events which ... have been called dura-

³⁵Palter, Whitehead's Philosophy of Science, p. 53; Palter's use of " k -equal" is the term used by Whitehead in An Enquiry Concerning the Principles of Natural Knowledge and is synonymous with "equal in abstractive force," used in The Concept of Nature.

³⁶The Concept of Nature, p. 85.

³⁷An Enquiry Concerning the Principles of Natural Knowledge, p. 109.

³⁸See Chapter two.

tions."³⁹ If we glance at figure two we see classes of durations converging to an ideal limit. As this limit is approached, the "temporal thickness" of the duration decreases until, theoretically, one reaches the "ideal of no thickness." The "ideal" indicates an extensionless limit. This extensionless limit is the moment. "A moment is a round of approximation to all nature which has lost its (essential) temporal extension."⁴⁰ Thus a moment is the "abstract of all nature at an instant."⁴¹ The moment as an abstract element within the duration can only cover other moments. Broad rephrases Whitehead's meaning of a moment as "a certain abstractive class A of durations, viz., all those durations that belong to any one of a set of abstractive classes which cover an assigned abstractive class of durations."⁴²

In The Concept of Nature, Whitehead appears to be using these definitions of duration and moment,⁴³ but this is merely an appearance. In The Concept of Nature, he begins to depart from his prior position, and although the terminology is roughly the same, there is a definite shift in meaning. This is particularly clear from two passages, namely in the

³⁹ An Enquiry Concerning the Principles of Natural Knowledge, p. 111.

⁴⁰ Ibid., p. 112.

⁴¹ Ibid.

⁴² Broad, "The Principles of Natural Knowledge," Mind, vol. 29, 1920, p. 224.

⁴³ See The Concept of Nature, p. 53.

"Note: On Significance and Infinite Events," which occurs at the end of The Concept of Nature, and in Note IV in the second edition of An Enquiry Concerning the Principles of Natural Knowledge. In the first of these passages Whitehead states that other sets of events also have the qualities of absolute antiprimes and that it is impossible to define duration solely in terms of absolute antiprimes. Palter sums up the import of these notes as follows:

Whitehead expands his doctrine of significance to include the perception, not only of durations, but also of events which are spatially finite but temporally infinite, so that there is a new set of abstractive classes - formed from the new type of infinite events - which also satisfy the definition of absolute antiprimes.⁴⁴

The second passage, in the second edition of An Enquiry Concerning the Principles of Natural Knowledge, makes a similar point. "The attempt to define a duration merely by means of its unlimitedness is a failure."⁴⁵

We have already seen how Whitehead redefines duration,⁴⁶ and we must now add how durations can be discriminated. The Concept of Nature holds what appear to be two conflicting views as to the demarcation of durations. When Whitehead is discussing time he states:

Sense-awareness posits durations as factors in nature but does not clearly enable thought to use it as distinguishing the separate individualities of the enti-

⁴⁴ Palter, Whitehead's Philosophy of Science, p. 56.

⁴⁵ An Enquiry Concerning the Principles of Natural Knowledge, p. 204.

⁴⁶ See Chapter two.

ties of an allied group of slightly differing durations. This is one instance of the indeterminateness of self-awareness. Exactness is an ideal of thought ...⁴⁷

If this were true it would spell the doom of all scientific experiments. Fortunately, Whitehead softens his position later in the same work when he states: "The duration which is the immediate disclosure of our sense-awareness is discriminated into parts."⁴⁸ As Mays points out, durations are discriminated "into an inter-related complex of events having the whole and part relationship, every event extending over other events and being extended over by other events."⁴⁹ Thus, we can discriminate a duration by its parts or limited sets of events.

Whitehead's attempt at defining the moment in terms of absolute anti-prime succeeded no better with moments than it did with durations, for we cannot have one class of absolute anti-primes. The earlier definition was based on the concept of extension. The new definition of the moment adds the new ingredient "totality,"⁵⁰ which stems from the definition of duration. From his analysis of the "moment" Whitehead can also successfully handle the point.

Whitehead's treatment of points is analogous to his

⁴⁷The Concept of Nature, p. 59.

⁴⁸Ibid., p. 74.

⁴⁹W. Mays, "Whitehead's Theory of Abstraction," Aristotelian Society, 1952, p. 110.

⁵⁰The Concept of Nature, p. 89.

treatment of moments. He informs us that "the first thing to do is to get hold of the class of abstractive elements which are in some sense the points of space. Such an abstractive element must in some sense exhibit a convergence to an absolute minimum of intrinsic character."⁵¹ The abstractive element will be "the class of event-particle".

Whitehead arrives at event-particles by establishing an abstractive set devised to yield the totality of event-particles which "will form a four-dimensional manifold."⁵² Here the structure of the abstractive set follows the same rules as were used for the moment.⁵³

Whitehead had hoped to strengthen his meaning and his definition of continuity through the method of extensive abstraction. We see the importance, therefore, of the convergence of parts overlapping parts. "The numerical and analytical aspects of the theory of extensive abstraction can be validly interpreted in terms of the conventional system of points in a real continuum."⁵⁴

Whitehead's justification of continuity by the method of extensive abstraction is important to his philosophy of science; but his emphasis on the convergence to infinity raises difficulties with respect to his meaning of

⁵¹ Ibid., p. 85.

⁵² Ibid., p. 86.

⁵³ Ibid., pp. 86-96.

⁵⁴ Hammerschmidt, Whitehead's Philosophy of Time, p. 48.

events. Since, for Whitehead, there are no minimum or maximum durations, it follows that there are no minimum or maximum events. This would seem to lead Whitehead into an argument which fails to escape the infinite regress. It is only in the next period, when he discusses atomic occasions and the epochal theory of time, that he is able to avoid the problem of infinite regress.

But how can Whitehead reconcile his assertion of an infinite terminus for the abstractive set with sense-awareness? Whitehead repeatedly attacked science for failing to remain faithful to sense-awareness, and yet he argues for infinite convergence when sense-awareness yields surely nothing more than finite convergence. Grünbaum criticizes the method of extensive abstraction for this failing: "How then do Whitehead and the exponents of his Method propose to overcome the difficulty that the infinitudes of regions needed by the Method do not belong to the domain of sense-awareness."⁵⁵ Whitehead, in fact, does not appear to have an answer to this problem.

This failure to answer Grünbaum's criticism reveals that the problem of the instant has not been successfully incorporated into Whitehead's philosophy of nature. The method of extensive abstraction was intended to preserve

⁵⁵ A. Grünbaum, "Whitehead's Method of Extensive Abstraction," British Journal of Philosophy of Science, vol. 71, 1962, p. 223. Other criticisms by Grünbaum will be discussed later in this dissertation; for the moment this is the major one directed at the Method as used in this period.

the functional operations of the instant in a new philosophy based on sense-perception. But the concept of "unlimitedness" so necessary to the method, can in no way be derived from sense-perception.⁵⁶ Thus in this chapter, the lack of cohesion in Whitehead's philosophy of science begins to show itself.

The problem of the instant in a general philosophy of time does not fit into a philosophy which is "closed to mind", because the notions of unlimitedness and the instant, an entity without duration, cannot exist without the creative addition of mind. Yet Whitehead insists that the method of extensive abstraction does not appeal to mind for its justification, but he is unable to offer any sense-perceptions of unlimitedness. If Whitehead wants to utilize the notion of the instant and preserve his method he must abandon the criterion of nature "closed to mind".

This chapter demonstrates that although Whitehead's method of extensive abstraction provides a brilliant alternative to the instant and the point, it ultimately fails. The method bifurcates nature, thereby disproving hypothesis (a). This failure, however, partially verifies my first premise, that the problems of time in this period will force Whitehead to abandon his philosophy of nature.

In the next chapter we will examine Whitehead's alternative philosophy of time. This chapter is also concerned

⁵⁶Ibid.

with the measurement of time and the temporal modes (the past, the present, and the future). But once again these problems will result in the bifurcation of nature and will additionally verify the first premise of my argument.

CHAPTER V

TIME AND THE MODES OF TEMPORALITY

Whitehead's notion of time unfolds from the intricate web of his philosophy as one of the major characteristics of nature. In the preceeding chapters, I have drawn attention to his discussion of nature, duration, passage, events and the moment. I wish in this chapter to discuss more fully Whitehead's philosophy of time during the period we are considering. Let me introduce the topic by briefly surveying the attributes of time that we have already encountered in our study.

a) Time is an attribute of the process of nature. Whitehead arrived at this conclusion from his analysis of the extension and passage of events.¹ Given this characteristic of time, Whitehead is unable to accept Newton's claim that nature is in time or Kant's thesis that time is a priori. He maintains that time can be known without any metaphysical commitment to a philosophy of nature and that it can be discovered directly in and through perception.

¹The Concept of Nature, pp. 53-54, and pg. 142; and An Enquiry Concerning the Principles of Natural Knowledge, p. 75.

b) Time is part of the space-time continuum.²

But while Whitehead claims the fundamental unity of space and time, Whitehead also argues that time can be distinguished from space. As Hammerschmidt indicates, "The distinction between them (space and time) can be expressed by saying that space exhibits the relation of other events within a present, while time exhibits the relation of other events to those in a given present."³ Once again Whitehead appeals to perception as the means of verifying this statement. We only perceive nature in a space-time structure, and to completely separate time from space, making each a separate and unrelated entity is to perform an abstraction.⁴ We can, nonetheless, distinguish time from space without distorting the fabric of nature.

c) Time involves the transition of events and their relationships:

Time is known to me as an abstraction from the passage of events. The fundamental fact which renders this abstraction possible is the passing of nature, its development, its creative advance ...⁵

²"There can be no time apart from space; and no space apart from time..." The Concept of Nature, p. 142; see also p. 80. An Enquiry Concerning the Principles of Natural Knowledge, pp. 163-164.

³Hammerschmidt, Whitehead's Philosophy of Time, p. 4; see also The Concept of Nature, p. 37, pp. 51-52.

⁴Ibid.

⁵The Concept of Nature, p. 34. Note Whitehead's reference to nature's "creative advance." This is one of the few times Whitehead mentions it, and it reveals the embryonic stage of the later theory of time. In later works Whitehead will strengthen the ties between time and creativity - see chapter IX on the epochal theory of time.

The passage of events referred to here is the duration.⁶ Duration involves events that are extended and simultaneous in immediate presents. In Hammerschmidt's words, "time is a succession of extended presents which constitute real extended 'strata' of nature."⁷ This serial property of time is also reflected in the "different families of durations."⁸ Yet, serial time is "not the very passage of nature itself."⁹

d) Time is not composed of a series of instants. The present is extended and any appeal to instants becomes a "metaphysical enigma" without perceptual evidence. Whitehead believes that the concept of the instant plays an important role in the mathematical description of nature, but he attempts to trace the notion of instants back to sense-perception through his method of extensive abstraction. As we have already indicated, the method of extensive abstraction yields an idealized limit, called a "moment," and not an extensionless and durationless entity. The present for Whitehead is extended and is often referred to as a "percipient event," while the "moment" expresses the relation of an abstractive set of durations.¹⁰

⁶Ibid., pp. 54-55.

⁷Hammerschmidt, Whitehead's Philosophy of Time, p. 4.

⁸The Concept of Nature, p. 55.

⁹Ibid., p. 65.

¹⁰See The Concept of Nature, pp. 88-89.

e) Time is one directional. The past is irrevocable because events are unchangeable.¹¹ The unchangeability of events; the irrevocability of the past, and the explanation of passage in terms of extension provide the justification for the uni-directional character of time. Whitehead will later enrich his explanation by using prehension and suppression in order to account more satisfactorily for the irreversible characteristic of time. These attributes of time, according to Whitehead, are its measureability, its characteristic of being beyond nature (as presently described),¹² and its modes of temporality, namely the past, the present, and the future.

One of the major reasons for accepting the mathematical description, either of Newton's absolute time or of Einstein's relative time, was success in measuring and predicting time intervals. The philosophical question arose, however, as to what exactly is being measured when one says that time is being measured. Whitehead contends that any measurement of time is really a measurement of the passage of nature. In other words, the measurement refers to the flow of events and is not simply the measurement of operations.¹³

¹¹An Enquiry Concerning the Principles of Natural Knowledge, p. 62.

¹²In Process and Reality (1929) Whitehead will enlarge his concept of nature to include the mental aspects of time, God and value.

¹³Whitehead, "Einstein's Theory: An Alternative Suggestion," in Alfred North Whitehead: The Interpretation of Science, ed. by A. H. Johnson, N.Y.: Liberal Arts Press, 1961, pp. 132-134.

In order to allow for the measurement of the actual flow of events, Whitehead introduces the notion of "congruence":

Congruence is founded on the notion of repetition, namely in some sense congruent geometric elements repeat each other. Repetition embodies the principle of uniformity.¹⁴

In addition "congruence" is a subset of equality, and the recognition posits memory but excludes "pure memory."¹⁵

After defining congruence Whitehead must show that the practical applications of his views are as viable as the alternative systems he criticizes. Additionally, he must demonstrate that these alternative systems "bifurcate nature," and finally, he must present his meaning and use of congruence without bifurcating nature.

He demonstrates the viability of congruence by developing a set of axioms,¹⁶ "which apply to geometrical elements defined by further applications of the method of extensive abstraction."¹⁷ While these axioms demonstrate the viability of his system for the natural sciences, I am not

¹⁴An Enquiry Concerning the Principles of Natural Knowledge, p. 141.

¹⁵The Concept of Nature, p. 124.

¹⁶The Concept of Nature, pp. 128-130. See also The Principles of Relativity, chapter three; and Palter, Whitehead's Philosophy of Science, pp. 89-90.

¹⁷Lowe, Understanding Whitehead, Baltimore: Johns Hopkins University Press, 1962, p. 74.

going to pursue them because Palter has already covered these axioms quite adequately,¹⁸ and my concern is Whitehead's notion of congruence as it relates to his philosophy of nature. Indeed, as Palter states: "... Whitehead himself never quite ... relates the general doctrines of his natural philosophy to his formal axioms of congruence."¹⁹

Whitehead demonstrates that the alternative measuring systems do bifurcate nature. The Newtonian conception of temporal measurement rested on the assumption of absolute time and absolute space, as well as on his notions of the instant and the point. Both absolute time and absolute space were "conceived as a perfectly definite continuous manifold, existing quite independently of its 'contents' and with perfectly definite metrical characteristics."²⁰ Yet, as Palter indicates, the Newtonian theory failed to provide a suitable model, "for ... time, being a one-dimensional continuum, does not possess any intrinsic metrical characteristic."²¹ Some have tried to maintain the Newtonian notion of the measurement of time by equating the validity of Newton's laws of motion with the congruence of time.²² Palter says: "Those time-lapses are

¹⁸See Palter, Whitehead's Philosophy of Science, pp. 90-95.

¹⁹Ibid., p. 90.

²⁰Ibid., p. 92.

²¹Ibid.

²²The Concept of Nature, pp. 137-140.

congruent which, when they are assigned equal numerical values, are consistent with numerical values for acceleration satisfying the formula $F = ma$.²³

Two things should be noted here. First, to arrive at a congruence of time we must equate time with equal numerical values for acceleration. This might be acceptable if acceleration were either independently derived or independent of time measurement. But to define acceleration one must include time in the mathematical formulation. This would seem to lead to a circular definition for the congruence of time and acceleration. Secondly, asserting the congruence of time and the laws of motion is not satisfactory:

King Alfred the Great was ignorant of the laws of motion, but he knew very well what he meant by the measurement of time, and achieved his purpose by means of burning candles. Also no one in past ages justified the use of sand in hour-glasses by saying that some centuries later interesting laws of motion would be discovered which would give a meaning to the statement that the sand was emptied from the bulbs in equal times.²⁴

In this passage Whitehead is claiming that the measurement of time is not rooted in mathematical formulation or operations but ultimately in perception. The perception of congruence relies on repetition and recognition by comparison of equality. Thus one may devise a unit of time, based on what one hopes is a uniformly repeated process, such

²³Palter, Whitehead's Philosophy of Science, p. 92.

²⁴The Concept of Nature, p. 137.

as the rotation of the sun or earth. Later when clocks were invented, repetition was again sought as the basis for the measurement of time. Clocks were constructed with devices governed by a periodic, oscillatory process such as the swinging of a pendulum or the oscillation of a balance wheel. Recognition by comparison allowed burning candles and sand glasses to be used as effective means of measuring time.²⁵

The contemporary accounts of temporal congruence fare no better than the classical accounts. Palter summarizes Whitehead's contention when he writes, "Modern theories which share with the classical theory the root conception of nature at an instant as an independent fact must also fail to explain congruence adequately."²⁶

Whitehead believed that Einstein was unable to explain adequately the concept of simultaneity, and hence

²⁵"The measurement of time was known to all civilized nations long before the laws (of motion) were thought of - It is this time as thus measured that the laws are concerned with. Also they deal with the space of our daily life. When we approach to an accuracy of measurement beyond that of observation, adjustment is allowable. But within the limits of observation we know what we mean when we speak of measurements of space and measurements of time and uniformity of change. It is for science to give an intellectual account of what is so evident in sense-awareness. It is for me thoroughly incredible that the ultimate fact beyond which there is no deeper explanation is that mankind has been swayed by an unconscious desire to satisfy the mathematical formulae which we call the Laws of Motion, formulae completely unknown till the seventeenth century of our epoch." The Concept of Nature, p 140.

²⁶Palter, Whitehead's Philosophy of Science, p. 92.

unable to explain adequately the measurement of time.

Whitehead defines measurement in such a way that it "pre-supposes for its possibility nature as a simultaneity, and an observed object present then and present now."²⁷

Having provided the reader with Whitehead's theory of congruence and his demonstration of the tautological and/or bifurcating aspects of the alternative explanations of measuring time, I will now evaluate Whitehead's approach to congruence. I believe that Whitehead is correct in basing congruence in nature and basing his measuring system on the passage of nature. However, I believe that his treatment is superficial and results in the 'bifurcation' of nature.

The theory of congruence is superficial despite Whitehead's detailed axioms of congruence because he makes certain assumptions and because he treats time-measurement in diverse time systems simplistically. Whitehead assumes, firstly, that there is no question as to the meaning of "straight line" in the context of the description of physical phenomena. Secondly, he assumes that there is no question as to the role of Euclidean geometry in the structure of physical concepts or as the bases for fundamental axioms about nature, and thirdly, he assumes that there is no question that mathematics is grounded in sense-perception. Every one of these assumptions raises serious philosophical issues that

²⁷The Concept of Nature, p. 196.

Whitehead fails to address. But Taylor in Introductory Mechanics,²⁸ Reichenbach in The Philosophy of Space and Time,²⁹ and Bridgman in The Logic of Modern Physics³⁰ all reveal how the deceptively simple words "straight line" and the relationships between Euclidean geometry and nature conceal a host of subtle philosophical problems. However, Whitehead does not address any of these problems. Thus his axioms are significantly weakened.

Whitehead assumes that mathematics is founded on sense-perception, an assumption which is most difficult to accept given his criterion in this period. That it is an assumption is demonstrated by the fact that each of the axioms depends on mathematics for its understanding and justification. But nowhere in the discussion on congruence or within the works of this period does Whitehead verify this assumption. Even if one were to grant the basis of sense-perception for primary numbers, how would Whitehead account for the notion of " π " as used in the fifth axiom? In addition, what sense-perception provides us with a non-terminating decimal? There is none. Nor is there any sense-perception of irrational numbers.

²⁸See E.F. Taylor, Introductory Mechanics, New York: John Wiley and Sons, 1963, Chapters one and two.

²⁹See H. Reichenbach, The Philosophy of Space and Time, New York: Dover Press, 1951, Chapters one through six.

³⁰See P.W. Bridgman, The Logic of Modern Physics, New York: Macmillan Co., 1927, Chapter one.

Yet without sense-perception as an anchor, Whitehead's axioms can only bifurcate nature, because the axioms are dependent on mind.

Whitehead's axioms five and six deal with the measurement of time in differing time systems. Both of these axioms establish a means of agreement about the congruence between an event located at widely separated points in our frame of reference. These axioms assume symmetry, simultaneity, and the meaning of equality. Whitehead's notions of symmetry and absolute simultaneity have been discussed in chapter three. Thus Whitehead does provide some argumentation for these assumptions, though the justifications are found not in The Concept of Nature (1922), but in a later article, "The Problem of Simultaneity" (1923). Equality is necessary to congruence because congruence is a subset of equality. But Whitehead does not demonstrate how equality emerges from sense-perception; he simply assumes it. But it is not valid to assume that sense-perception provides a basis for equality. Indeed there is considerable disagreement on this point. For instance, Plato argues in the "Phaedo" that our sense-perception cannot provide our idea of equality. This is because our idea of equality admits no inequalities; whereas any perception of equality from sense-perception has inequalities amidst the equalities. According to Plato, sense-perception can spark our remembrance of equality, but it cannot be the source of our idea. My point is not that Plato is correct, but

that Whitehead must answer such arguments by proving that sense-perception is the source of our idea of equality. By not accomplishing this, Whitehead's arguments are weakened.

The difficulties discussed above demonstrate the problems that weaken Whitehead's axioms of congruence, and his dependence upon mathematics in these axioms without basing his mathematics in sense-perception demonstrates the bifurcating characteristic of his axioms.

As I noted earlier, there is a gap between the axioms of congruence and his treatment of congruence in his overall philosophy of nature. Thus I must evaluate Whitehead's notion of congruence within his philosophy of nature. My contention is that Whitehead's theory of congruence fails due to the need for memory to account for repetition, the problem of accounting for the passage of thought and the confusion generated by some of his comments. The problems of memory and the passage of thought lead to the bifurcation of nature. The confusion leads to a weakening of his overall arguments.

In The Concept of Nature, Whitehead briefly attempts to anchor memory in sense-perception. This attempt is superficial and it fails. It is superficial because it does not take into account the psychological evidence of memory as a subjective operation of the mind. There was and is evidence provided by notable psychologists, such as Freud, Jung, and Adler that we remember what we want to remember. In other words, memory is a highly personal and unique aspect of an

individual. While some of the content of memory may be provided by sense-perception, memory itself is separate from sense-perception and can only be accounted for by an analysis of the operations of the mind. The subjectivity of memory is evidenced in such daily examples as the divergent eye witness reports to a police officer at the scene of an accident or the divergent perceptions of what a professor said or did not say at a lecture. This quality of memory introduces mind and therefore taints any analysis claiming to be closed to mind which employs memory. The result is the bifurcation of nature.

Another problem of congruence is the relation of time to the passage of nature and the passage of thought. Whitehead claims that "there is time because there are happenings, and apart from happenings there is nothing."³¹ Then he proceeds to argue that the happenings in the passage of nature are "fundamental" whereas the happenings in the passage of thought are "a logical abstraction representing some of the properties of nature."³² The result of excluding the passage of thought from the passage of nature is a dualism, which invalidates his second hypothesis, interconnection. There is a radical division between thought and nature. There is also a radical division of time. Taking the latter first, measured time becomes a logical abstraction and not a fundamental char-

³¹The Concept of Nature, p. 66.

³²Ibid.

acteristic of nature. Duration is fundamental to nature. Thus time is a multi-faceted entity that can be cleaved like a diamond into two separate pieces. But unlike the two pieces of the gem which remain diamonds, the division of time results in two different kinds of time; one mental and one natural, and they cannot be rejoined. Thus the philosophy of organism that Whitehead is trying to develop becomes fragmented.

If Whitehead attempts to reconcile these positions, he bifurcates nature by introducing the mental component of time into his account.

The dualism between mind and nature is such that a fundamental aspect of nature, time, cannot be accounted for in terms of nature, but only in terms of mind. The result of this dualism is to foster the bifurcation. In addition, the duration, which has had an implied temporal dimension, is now considered a subset of passage and appears to be devoid of its temporal dimensions.

It would seem that in his attempt to explain nature merely in scientific terms Whitehead has succeeded only in doing what he was intent on avoiding, namely bifurcating nature and destroying the interconnection of nature. It is only by integrating mind and nature that this bifurcation can be overcome and connection can occur. Thus the problems with the congruence of time help prove the first premise of my argument.

We see Whitehead's bifurcation of nature in his discussion of the next characteristic of time, the temporal modes of past, present, and future. As we have already indicated, Whitehead attempted to define the present in terms of the percipient event and the past in terms of events no longer existing. Yet, both explanations failed to account for such important features as the existence of memory, the future, or even the perception of the present. In order to account for memory, the future, and the perception of the present Whitehead had to smuggle in the mind and thus bifurcate nature.

Newton considered the present as the instant, the "now." Whitrow, in The Natural Philosophy of Time, considers other approaches to an understanding of the present:

In analysing the idea of the present, Guyau stressed the connection between time and action. Bergson went even further and argued that one must not merely act but must be conscious of acting, that is one must be aware of producing a certain effort. Janet³³ argued that this too is insufficient and that the present must be regarded as an intellectual act uniting narration with action: it should be regarded as 'un récit de l'action que nous nous faisons à nous-même pendant que nous sommes en train d'agir.'³⁴

It is clear that philosophers are not in agreement on the very meaning of the present. Kant held for a mental or psychic present, while Aristotle claimed a real and a mathematical present.

³³Janet, L'Evolution de la Memoire et de la Notion du Temps, Paris, 1928, p. 309.

³⁴Whitrow, The Natural Philosophy of Time, p. 82.

Now we have seen that Whitehead rejected the description of the present as an instantaneous point because he saw this definition of the present would compel him to define time in terms of a succession of durationless instants and would lead to a description of the present "as the relata in the serial relation which is the time-ordering relation..."³⁵ Now Whitehead felt that this definition of time or this description of the present would be misleading. He believed that the absolute theory of the present raised grave difficulties not only because we are unable to perceive the instant but also because we cannot with this view account for the fact that an event is present when it is present and explain why an event is past when it is past. For instance, is the line that the reader is reading now in the present whereas the line that he has just read before in the past? But how does the absolute theory distinguish between past and present? How does it arrive at a criterion for dividing events into intervals of successive durationless instants? The absolute theory fails to provide an answer to these questions and Whitehead felt that one had to have recourse to perception.

It is interesting that Whitehead's concern with the distinction between past and present is similar to the

³⁵The Concept of Nature, p. 33.

one that concerned the French philosopher, Henri Bergson.³⁶ It has been commonly held, throughout the history of Western philosophy, that the past no longer exists. Bergson challenged this notion by formulating a new understanding of both memory and the present. Bergson, of course, does not deny that one is physically incapable of redoing yesterday, but he claims that the past is preserved in the present:

... if change is real and even constitutive of reality, we must envisage the past quite differently from what we have been accustomed to doing through philosophy and language. We are inclined to think of our past as inexistent, and philosophers encourage this natural tendency in us. For them and for us the present alone exists by itself: if something of the past does survive it can only be because of help given it by the present, because of some act of charity on the part of the present, in short ... by the intervention of a certain particular function called memory, whose role is presumed to be to preserve certain parts of the past, for which exception is made, by storing them away in a kind of box. This is a profound mistake.³⁷

Now, if the past is totally preserved in the present, then the present and the past may be said to be co-existent:

My present, at this moment is the sentence I am

³⁶This author is well-aware of the controversy of the supposed influence of Bergson on Whitehead's thought. While Lowe denies any decisive influence by Bergson in his article "The Influence of Bergson, James, and Alexander on Whitehead," other Whiteheadian scholars, notably Stahl, "Bergson's Influence on Whitehead" and deLaguna in a review of "An Enquiry Concerning the Principles of Natural Knowledge" support the influence of Bergson on Whitehead's thought. With respect to the notion of the present, this author believes that a correlation between Whitehead's theory and Bergson's theory can only increase our knowledge of Whitehead's theory.

³⁷H. Bergson, Creative Mind, N.Y.: Wisdom Library, 1933, pp. 150-151.

pronouncing. But it is so because I want to limit the field of my attention to this sentence. This attention is something that can be made longer or shorter ... For the moment, the points are just far enough apart to reach from the beginning to the end of my sentence; but if the fancy took me to spread them further my present would embrace, in addition to my last sentence, the one that proceeded it ...³⁸

In another passage Bergson illustrates his reason for offering an alternative account of the present:

What precisely is the present? If it is a question of the present instant - I mean, of a mathematical instant which would be to time what the mathematical point is to the line - it is clear that such an instant is a pure abstraction, an aspect of the mind; it cannot have real existence. You could never create time out of such instants any more than you can make a line out of mathematical points. Even if it does exist, how could there be an instant anterior to it? The two instants could not be separated by an interval of time since, by hypothesis, you reduce time to a juxtaposition of instants. Therefore, they would not be separated by anything, and consequently they would be only one; two mathematical points which touch are identical... Our consciousness tells us that when we speak of our present we are thinking of a certain interval of duration. What duration? It is impossible to fix it exactly, as it is something rather elusive ... This attention is something that can be made longer or shorter, like the interval between two points of a compass.³⁹

For Bergson the present may be compared to a snowball rolling down a hill and continually gathering new experiences as it rolls and becomes larger.⁴⁰ Bergson addressed himself to the distinction between the past and the present in the

³⁸Ibid.

³⁹Ibid.

⁴⁰Bergson uses other metaphors in explaining this transaction: "Duration is the continuous progress of the past which grows into the future and which swells as it adds."

following manner:

The distinction we make between our present and past is therefore, if not arbitrary, at least relative to the extent of the field which our attention to life can embrace. The 'present' occupies exactly as much space as this effort. As soon as this particular attention drops any part of what it held beneath its gaze, immediately that portion of the present thus dropped becomes ipso facto a part of the past. In a word, our present falls back into the past when we cease to attribute to it an immediate interest ... Consequently, nothing prevents us from carrying back as far as possible the line of separation between our present and our past. An attention to life, sufficiently powerful and sufficiently separated from all practical interests, would thus include in an undivided present the entire past history of the conscious person - not as instantaneity, not like a cluster of simultaneous parts, but as something continually present which would also be continually moving: such I repeat, is the melody which one perceives as indivisible ... What we have is a present which endures.⁴¹

Like Bergson, Whitehead disclaims the Newtonian framework and seeks the present within duration:

As an ultimate fact it [an instantaneous present] is a nonentity. What is immediate for sense-awareness is a duration. Now a duration has within itself a past and a future; and the temporal breadth of the immediate durations of sense-awareness are very indeterminate and dependent on the individual percipient. Accordingly there is no unique factor in nature which for every percipient is preeminently and necessarily the present.⁴²

Bergson, Creative Evolution, N.Y.: Random House, 1944, pp. 6-7. Also: "What I call 'my present' has one foot in my past and another in my future. In my past, first because the moment in which I am speaking is already far from me; in my future, next because this moment is impending over the future: it is to the future that I am tending." Bergson, Matter and Memory, London: Macmillan, 1913, p. 177.

⁴¹Bergson, Creative Mind, p. 152.

⁴²The Concept of Nature, p. 72:

Whitehead seems here to be echoing Bergson's claim that the present is personalized, for Whitehead sees no permanent and universal yardstick in nature that would enable us to establish the meaning of the present. Hence, the present is unique to the individual. We are unable to indicate precisely what the present is, and the distinction between past and present is not free from ambiguity. "There is no sharp distinction ... between memory and the present immediacy or between the present immediacy and anticipation. The present is a wavering breadth of boundary between the two extremes."⁴³

This illustration of a "wavering breadth" is in the individual but Whitehead shows that there are limiting extremes. In other words, there are boundaries although Whitehead never fully states what these boundaries are. All he says is that "our own present has its antecedents and its consequents."⁴⁴

Whitehead speaks of the present as "the vivid fringe of memory tinged with anticipation."⁴⁵ This felicitous metaphor is perhaps not as satisfactory as one would like. The vividness clearly refers to a state of mind and not to a state of nature. The present of one person is not necessarily the same as the one experienced by another person. Memory is

⁴³Ibid., p. 69.

⁴⁴Ibid.

⁴⁵Ibid., p. 73.

what is present to the mind. "In memory the past is present. ... Accordingly memory is a disengagement of the mind from the mere passage of nature; for what has passed for nature has not passed for mind."⁴⁶

It is clear that Whitehead is compelled to move away from his earlier position and to grant that everything cannot be found in nature alone:

Now the distinction between present and past would be obliterated only if 'direct apprehension of the past' meant the holding, in the present moment, of the past with that creative, growing quality of immediacy which it had when it was present. But perishing has intervened. The past has had its chance at becoming; it transfers the opportunity to the next runner. The past is now there to be apprehended, but not to grow and change. The present is creatively active but is not apprehended.⁴⁷

Whitehead's explanation of the future in terms of expectation or "anticipation" allows for freedom and predictability. Freedom is possible since the future is indeterminate, for the individual's anticipation might be wrong. Predictability is insured, for if one knows what another individual anticipates, one can forecast, at least on statistical grounds, important features of an individual's behavior. The present is unique to the person and the boundaries within the present (memory and anticipation) make the present distinct each time. "The past and future meet

⁴⁶Ibid., p. 68.

⁴⁷Lowe, "William James' and Whitehead's Doctrine of Prehension," Journal of Philosophy, vol. XXXVIII, no. 5, 1941, p. 120.

and-mingle in the ill-defined present."⁴⁸

This new approach to the present is substantially different from Whitehead's earlier attempt to define the present in terms of the "percipient event" or the "moment" as derived in the method of extensive abstraction. Those alternatives have failed, and we have seen the difficulties of this new approach. Whitehead does not anchor the present in duration and his inability to do so compels him to bifurcate nature. It is only in his later philosophical period that he will overcome the difficulties of the mental aspect of the temporal modes. At this stage in his philosophical development, it is his failure to account for the instant, the congruence of time, and the past, present and future modes of time solely in the context of nature that forces him to revise his strategy. In the next period (1925-1929), Whitehead abandons the straight-jacket of a philosophy of nature "closed to mind." The abandonment further proves the first premise of my argument. The result is a most creative and refreshing beginning to a philosophy of time. For now Whitehead can only lament:

The theory which I am ~~being~~ admitting admits a greater ultimate mystery and a deeper ignorance ... It is impossible to meditate on time and the mystery of the creative passage of nature without an overwhelming emotion at the limitations of human intelligence.⁴⁹

⁴⁸The Concept of Nature, p. 73.

⁴⁹Ibid.

CHAPTER VI

ACTUAL OCCASIONS

In his second philosophical period (1925-1929) Whitehead will attempt to overcome some of the "limitations of human intelligence." He realized that the closure of nature to mind was faulty, and that some natural entities were imbued with mind. Thus Whitehead failed in his attempt to devise a philosophy of science which unified ordinary sense experience with the scientific realm of nature without bifurcating nature. It failed because the narrow restrictions of sense perception could not account for temporal events without the introduction of mental constructs.

With the advent of Science and the Modern World (1925), Whitehead's philosophy enters a new dimension of thought. The empiricism of the earlier philosophical works is expanded to a radical empiricism, which attempts to harmonize and to account for all human experience¹ - whether

¹"Philosophy, in one of its functions, is the critic of cosmologies. It is its function to harmonise, re-fashion, and justify divergent intuitions as to the nature of things. It has to insist on the scrutiny of the ultimate ideas, and on the whole evidence in shaping our cosmological scheme." A. N. Whitehead, Science and the Modern World, N.Y.: Macmillan Company, 1969, p. vii.

mystical, symbolical, epistemological, metaphysical, scientific, poetic, or religious. While the possibility of a philosophy of science independent of mind is still left open, his philosophy of science is no longer shackled by the narrow empiricism, as it was earlier. This new spirit is witnessed by the shift in Whitehead's view of the philosophic task:

I hold that philosophy is the critic of abstractions. Its function is the double one, first harmonising then by assigning to them their relative status as abstractions, and secondly of completing them by direct comparison with more concrete intuitions of the universe, and thereby promoting the formation of more complete schemes of thought ... Philosophy is not one among the sciences with its own little scheme of abstractions which it works away at perfecting and improving. It is the survey of sciences, with the special objects of their harmony, and of their completion. It brings to this task, not only the evidence of the separate sciences, but also its own appeal to concrete experience. It confronts the sciences with concrete fact.²

Not only does the philosophic task change but Whitehead's approach to his philosophy also changes. As I noted in my comments about the first period (1919-1925), Whitehead's philosophy of time emerged predominately from his criticisms of other philosophies and theories of nature. In fact, one senses that most of Whitehead's philosophy during that period was in response to other theories. However, the writings beginning with Science and the Modern World (1925) and ending with Symbolism Its Meaning and Effect (1927) signal a decisive change in Whitehead's approach to his own philosophizing. While Whitehead still uses the art

²Ibid., p. 87.

of criticism as a means of bringing forth his ideas during this period of 1925 to 1929, here one notes more purpose and direction in his criticisms. The criticisms are intended to provide the support or the rationale or the justification for later positions. But Whitehead's use of criticism is not my main point. The point I wish to make is that Whitehead is more willing to move from the critic at large position to the position of presenting and developing his own creative philosophy in its own right. This is seen with such ideas as prehension (chapter eight of the present study), the epochal theory of time (chapter nine), and causal efficacy and presentational immediacy (chapter ten). This new spirit is also evidenced in Whitehead's expansion of his concrete entities, the actual occasion, to include a mental and a physical pole.

When dealing with this period, it is important to remember that the ideas developed are in a state of emergence and will often indicate the direction that Whitehead's ideas take in his metaphysical writings (1929 to 1947). Indeed this whole period (1925-1929) is one of transition for Whitehead's thoughts. Trial balloons are launched; some explode, while others soar. Yet amidst these transitional problems there is purpose.

Whitehead's hypothesis during this transitional period is that one can integrate the scientific and logical theories of nature with the poetic and aesthetic intuitions

of Wordsworth and the other Romantic poets.³ This hypothesis means that the simplicity, order, logic, and utility of the scientific perceptions of nature are to be harmonized with the intuitive and poetic perceptions of nature as a whole organism with the qualities of change, connectiveness, value, and endurance.⁴ Whitehead's method for establishing this integration is the development of a relational philosophy. The verification of his hypothesis will be dependent upon the success or failure of the harmony in Whitehead's relational philosophy. Whitehead's relational philosophy is embodied in his epochal theory of time and the success or failure of his relational philosophy will be dependent upon the success or failure of his epochal theory of time.

From this hypothesis I have drawn my second premise, that the writings from 1925 to 1929 mark a transition in Whitehead's thoughts in which the epochal theory of time reveals the need for and the direction of his full metaphysics, which is found in the writings from 1929 to 1947. The thrust of chapters six, seven, and eight is to provide the foundation and need for Whitehead's epochal theory of time which is discussed in chapter nine. Chapter ten presents Whitehead's attempt to resolve some of the problems that develop from his epochal theory of time.

²Ibid., p. 18.

³Ibid., p. 88.

As a beginning to the foundation for the epochal theory of time my concern is to discuss now the expanded meaning of Whitehead's fundamental entities, the actual occasion or event.⁵ The expansion of the meaning of actual occasions will show that Whitehead's earlier hypothesis of nature as "closed to mind" is no longer used because actual occasions are integrated entities with mental and physical poles. In addition, the analysis of actual occasions will show the need for a philosophy of time to provide for the interaction and relationships of actual occasions.

In order to comprehend Whitehead's relational philosophy we must understand firstly the fundamental entities of his system, the actual occasions, and to achieve this understanding I will contrast the expanded meaning of the actual occasion against the previous meaning of events as used in the first period (1919-1925). Starting with events we saw that they were characterized as follows:

- a. They are the ultimate substance of nature.⁶
- b. An event is the "ultimate fact for sense-awareness."⁷

⁵Whitehead uses both of these terms synonymously in this period. I will use the term actual occasion to indicate the expanded meaning found in this period and to avoid the possible confusion in meaning that could occur by using the term event.

⁶The Concept of Nature, p. 19; "Time, Space, and Material," p. 47.

⁷The Concept of Nature, p. 15.

- c. They are not atomic,⁸ but have their "own substantial unity of being which is not an abstract derivation from logical construction."⁹
- d. They are unique and are "what does become in nature."¹⁰
- e. They are "the relata of the fundamental homogeneous relation of 'extension'"¹¹ for the externality of nature.
- f. There are no isolated events.¹² Events must have relation to other events. Thus events are not instantaneous points but extensive entities.
- g. There is never any change in events.¹³
- h. They account for the unchangeability of the past.¹⁴
- i. They give rise to past, present, and future.¹⁵ Events involve wholes and parts, and there is no simple way in which they can be divided. An event is spoken

⁸An Enquiry Concerning the Principles of Natural Knowledge, p. 74.

⁹Ibid., p. 77.

¹⁰Ibid., p. 61.

¹¹Ibid.

¹²The Concept of Nature, p. 142.

¹³An Enquiry Concerning the Principles of Natural Knowledge, p. 62.

¹⁴Ibid.

¹⁵Ibid.

of as "the specific character of a place through a period of time." For instance, all that occurred in the Roman Senate on the day of Caesar's murder may be called an event. What was occurring under Pompey's statue during this time interval is another event and is part of the first.¹⁶ Events are what we live through, and what we perceive.¹⁷ They cannot be defined in terms of space and time; rather space and time are defined in terms of events.¹⁸ Hammerschmidt summarizes this notion of an event as "any actual occurrence with an extended spatio-temporal locus."¹⁹

Actual occasions, as they are discussed during the second philosophical period (1925-1929), reveal significant differences. Having introduced mind, it is understandable that Whitehead should have expanded the notion of an actual occasion. Some of the major characteristics of an actual occasion are now:

- a. The actual occasion is not a "substance, supporting qualities, but an individualized feeling, it has no permanence."²⁰

¹⁶"Time, Space, and Material," p. 186.

¹⁷The Concept of Nature, p. 15.

¹⁸An Enquiry Concerning the Principles of Natural Knowledge, p. 62.

¹⁹Hammerschmidt, Whitehead's Philosophy of Time, p. 101.

²⁰D. Emmett, Whitehead's Philosophy of Organism, N.Y.: St. Martin's Press, 1966, p. 181.

- b. The actual occasion transcends simple sense-awareness. Whitehead distinguishes two types of perception, presentational immediacy and causal efficacy. The former deals with the mental world and the latter with the sense world.²¹
- c. Actual occasions are atomic,²² but still retain an internal unity.
- d. Occasions are creative.²³
- e. Actual occasions are unique, and are continually coming to be and perishing. This aspect of the occasion will be used to account for the novelty and process of reality.
- f. Actual occasions are indivisible, simple, and extensive.
- g. Occasions possess prehension and "a prehensive occasion is the most concrete finite entity...."²⁴

²¹A. N. Whitehead, Symbolism Its Meaning and Effect, Cambridge: Cambridge University Press, 1928, p. 25; pp. 51-58.

²²Professor Emmett considers this an unfortunate choice of words, "since it has the connotation of ultimate and enduring particles," Emmett, Whitehead's Philosophy of Organism, pp. 180-181. I do not share her misgivings since even in physics an atom only has a limited span of life.

²³Religion in the Making, pp. 88-89. This idea is presented here for the first time, it is not found in Science and the Modern World where creativity and occasion were distinguished. For an alternative interpretation see A.H. Johnson, Whitehead's Theory of Reality, pp. 69-72.

²⁴Science and the Modern World, p. 71. More will be said about prehensive occasions in the chapter VIII.

Prehension is divided into two spheres, the physical pole and the mental. "The physical pole is the aspect of an actual occasion in which creativity is revealed in its extensive and material character ... (the mental) pole includes an aim at an aesthetical and morally harmonious nature as the result of the self-creation of the actual occasion."²⁵

- h. An actual occasion possesses a spatio-temporal unity by prehension.²⁶
- i. "Every actual occasion is a member of some set of actual occasions. Whitehead calls such a set a nexus."²⁷

The term actual occasion of the period 1925 to 1929 and the term event of the earlier period 1919 to 1925 have a number of similarities but their differences are striking, since the occasion is atomic, creative, and prehensive, and displays features that go well beyond physical perception. Hammerschmidt put it this way:

The concept of an 'actual occasion' is the analogue of Whitehead's earlier notion of an 'event.' It is the most concrete fact, unique and particular, connected with all other actual occasions, with becoming as its essence,

²⁵Hammerschmidt, Whitehead's Philosophy of Time, p. 16.

²⁶Science and the Modern World, p. 72.

²⁷Hammerschmidt, Whitehead's Philosophy of Time, p. 17.

incapable of recurrence, perpetually perishing, extended, atomic, and with a mental pole and physical pole." For a theory of time, its significant difference from an event lies in its last two properties - it is atomic, and it has a mental pole and a physical pole.²⁸

As Hammerschmidt's statement indicates, the nature of actual occasions will have an impact on Whitehead's philosophy of time. The mental pole of the occasion will provide Whitehead with the means of accounting more satisfactorily for the temporal modes that troubled him earlier (see chapter five). The atomicity of occasions will necessitate an atomic notion of time and will force Whitehead to abandon his notion of the continuity of time as held in the first period. But while occasions impact on the philosophy of time that Whitehead will have to develop, the nature of occasions also reveals a need for a theory of time to account for the temporal matrix between occasions and to explain the becoming of occasions. In other words, Whitehead must develop a relational philosophy in which actual occasions will be assimilated.

Finally, the atomic nature of actual occasions should not be interpreted as a movement towards the discreteness advocated by materialistic atomism. Whitehead is opposed to such a view of reality. The actual occasions are intended to provide the basis for a new philosophy. This philosophy requires a qualitative atomism, and the inclusion of creativity, novelty, and the mental pole as characteristics

²⁸Ibid., p. 16; Underlining is mine.

of the fundamental entity makes the actual occasion the foundation for Whitehead's new relational philosophy.

~~Whitehead's~~ opposition to the quantitative atomisms of science and the importance of his actual occasions to his philosophy will be seen more fully in the next chapter, which discusses the denial of simple location. This chapter seven will further demonstrate the need for a relational philosophy.

CHAPTER VII

SIMPLE LOCATION

Whitehead no longer wishes to speak of the "bifurcation of nature" in his criticism of science. He now speaks of the denial of simple location. The expression, simple location, first appears in Science and the Modern World,¹ and refers to the position of matter in space and time.² The argument of simple location is that for each bit of matter, there is a perfectly definite specification in space and time, where it is located. In other words, the only way to differ-

¹Science and the Modern World, p. 49. While Whitehead coined the term "simple location," the conceptual origin of this idea can be traced to The Concept of Nature, pp. 145-146. Unfortunately, in Whitehead's writings from 1915 up to 1925, he did not develop this line of reasoning. The most probable reason is that he was confident about the criteria of "bifurcation of nature." Yet the fact that the embryonic origins of the denial of simple location are in The Concept of Nature supports the developmental thesis that Whitehead was using the denial of simple location as a means to retain his criticisms of Newton's and Einstein's theories after the collapse of the criteria of "bifurcation of nature."

²"By simple location I mean one major characteristic which refers equally both to space and to time, and other minor characteristics which are diverse as between space and time. The characteristic common both to space and time is that material can be said to be here in space and here in time, or here in space-time, in a perfectly definite sense which does not require for its explanation any reference to other regions of space-time." Science and the Modern World, p. 49.

entiate one bit of matter from all the other bits of matter is its spatial location at a particular instant.

Essential to the meaning of simple location is that matter by definition is isolated and can be accounted for and differentiated by geometrical explanations. This view of matter allows us to say that each unit of matter is non-relational, impenetrable, and homogeneous. Matter is non-relational because each bit of matter can be situated in one "finite region of space" and in one "finite duration of time," without having any relations to the surrounding space or time or space-time regions.³ This is what allows a scientist to point to a graph and say the atom is there in that place, at that time. The result is that each bit of matter is disconnected from every other bit of matter. Matter is impenetrable because one and only one bit of matter can occupy a particular point in space at the same time and with the same respect. Matter is homogeneous in terms of quality because the only way to differentiate one bit of matter from another bit of matter is by its geometrical location.

Whitehead speaks of simple location as a fundamental precept and identifies important consequential axioms as arising from simple location. Some of the more important

³"To say that a bit of matter has a simple location means that, in expressing its spatio-temporal relations, it is adequate to state that it is where it is, in a definite finite region of space, and throughout a definite finite duration of time, apart from any essential reference of the relations of that bit of matter to other regions of space and to other durations of time." Ibid., p. 58.

resulting axioms are:

a. It answers the question asked by the Ionian philosophers and modern scientists: what is nature made of? The answer, nature is composed of bits of matter (atoms). How else can we account for non-relational, qualitatively homogeneous bits of matter which are impenetrable in-themselves and dependent on their geometrical location for differentiation? Only by holding a corpuscular view of reality is this possible.

b. Nature is to be explained in terms of materialism and mechanism. This follows from (a) above.

c. Time is an accidental property of nature.

Whitehead demonstrates this in the following passage:

First, as regards time, if material has existed during any period, it has equally been in existence during any portion of that period. In other words, dividing the time does not divide the material. Secondly, in respect to space, dividing the volume does divide the material. Accordingly, if material exists throughout a volume, there will be less of that material distributed through any definite half of that volume. It is from this property that there arises our notion of density at a point of space. Anyone who talks about density is not assimilating time and space to the extent that some extremists of the modern school of relativists very rashly desire. For the division of time functions, in respect to material, quite differently from the division of space.

Furthermore, this fact that the material is indifferent to the division of time leads to the conclusion that the lapse of time is an accident, rather than of the essence, of the material. The material is fully itself in any sub-period however short. Thus the transition of time has nothing to do with the character of the material. The material is equally itself at an instant of time. Here an instant of time is conceived as in itself without transition, since the temporal transition is the succession of instants.⁴

⁴Ibid., pp. 49-50.

d. Because time is accidental to nature and space is primary to nature, space and time are treated as distinct entities.

e. The point and the instant are necessary ingredients of nature. This is necessitated by the coupling of the non-relatedness and impenetrability of matter.

f. The dynamics of nature are to be accounted for in terms of successiveness or serialization of matter in space and time. Time can only proceed successively since it cannot possibly be continuous.

g. The emphasis on the atomicity, isolation and impenetrability of each bit of matter in nature results in there being no dynamic connection between any individual bit of matter and the rest of nature.

h. There are no qualitative attributes in nature. Quality exists only in the mind. Since extension is the only true attribute of matter, the qualities cannot be in nature.

These axioms, which Whitehead sees as arising from simple location, have often been viewed in science and philosophy as the fundamental principles themselves.⁵ The importance of Whitehead's analysis is that he shows that these are dependent axioms and not independent axioms.⁶ I believe that

⁵See Chapter III and the discussion of Newton and Einstein.

⁶The relativists who deny that their theory holds to simple location miss this point.

this point is crucial to an understanding of Whitehead's philosophical development because he failed to make the distinction himself in the first period. Indeed the issues that he examined under the light of "bifurcation of nature" were only consequential axioms of the doctrine of simple location. He did not develop the fundamental principle of these axioms, as he does here. Thus I believe that the analysis of simple location and its subsequent denial are a much more powerful and more meaningful approach than the approach of "bifurcation of nature," even if the latter were still viable.

Whitehead states that the doctrine of simple location lies at the heart of Western science's approach to nature. Let me illustrate this claim by briefly examining classical mechanics and relativity. Both theories by Whitehead's contention maintain the doctrine of simple location.⁷

Only one instance, from classical kinematics, is needed to demonstrate classical mechanics' acceptance of simple location:

Space is assumed to be three dimensional and Euclidean. In such a space, points can be conveniently described by

⁷"Curiously enough this character of simple location holds whether we look on a region of space-time as determined absolutely or relatively." *Science and the Modern World*, p. 49. "... this concept of simple location is independent of the controversy between the absolutists and the relativist views of space or of time. So long as any theory of space, or of time, can give a meaning, either absolute or relative, to the idea of a definite region of space, and of a definite duration of time, the idea of simple location has a perfectly definite meaning." *Ibid.*, p. 58.

means of rectangular Cartesian coordinates, i.e., by three numbers representing the respective distances of any point from the three mutually perpendicular coordinate axes. In classical mechanics time constitutes a one-dimensional continuum entirely independent of space; it is therefore quite arbitrary how we decide to orient the time-axis in our geometrical diagrams for describing motion.⁸

Given this view of space and time, matter can only be located in space and time graphically as a point and an instant without primary reference to surrounding regions of space or time, as suggested by Palter in the following diagram:⁹

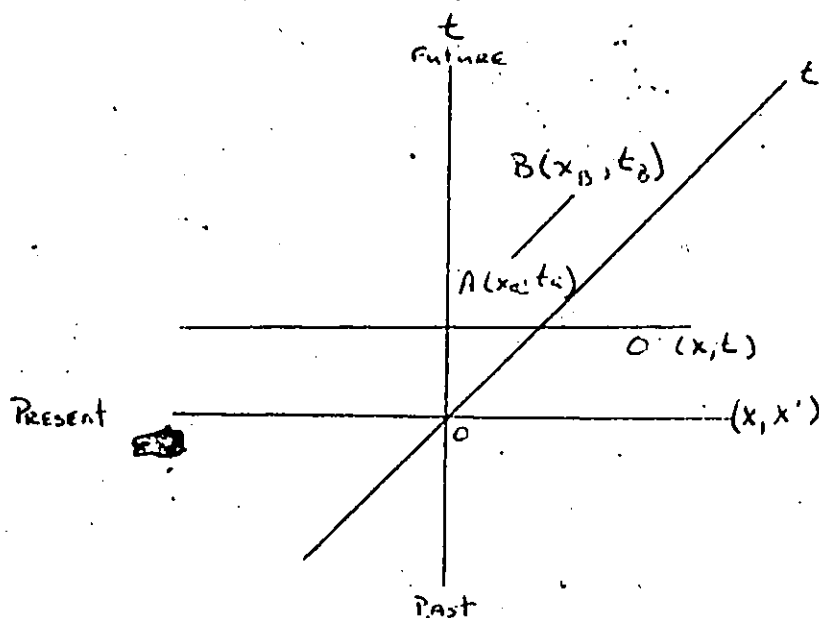


Figure I.

⁸R. M. Palter, Whitehead's Philosophy of Science, p. 14.

⁹Ibid., p. 15. Professor Palter explains the figure as follows: "In Figure 1 the time-axis is taken, for convenience, as perpendicular to the space-axis, also for convenience, and without real loss of generality, two space-axes have been omitted. A point in Figure 1 represents an instantaneous and spatially infinitesimal occurrence, sometimes referred to as a 'point-event'... Ibid., p. 14.

In the figure, a "bit of matter" can be located in terms of an instant and a point solely by its position. Thus it seems that Whitehead is correct in applying the doctrine of simple location as a part of classical physics.

The relationship of simple location to those adhering to the relativity theory is less obvious. In fact, relativists would claim that they deny simple location by holding the relativistic theory. This view is even shared by some Whiteheadian scholars. As McGilvary remarks:

Since the relativist theory of space and time maintains that no region of space (or duration of time) has any meaning apart from its spatial relations of distance and direction to other regions (or apart from its relation of before and after to other durations), I find it hard to distinguish the denial of 'simple location' from the relativist doctrine...¹⁰

Needless to say, McGilvary is puzzled since the theory of relativity does not seem to accept simple location, as Whitehead claims. McGilvary's only explanation is to refer to Whitehead's statement on simple location,¹¹ to isolate the phrase, "a bit of matter," and to connect it with the following words of Whitehead:

There will be some fundamental assumptions which adherents of all the variant systems within the epoch unconsciously

¹⁰E.B. McGilvary, "Space-Time, Simple Location and Prehension," The Philosophy of Alfred North Whitehead, ed. by P. Schlipp, Evanston: Northwestern University Press, 1941, p. 229. Alston advances a similar argument in his article, "Whitehead's Denial of Simple Location," The Journal of Philosophy, XLVIII, 1951, pp. 715-716.

¹¹See footnote 7 of this chapter.

presuppose ... One such assumption underlies the whole philosophy of nature during the modern period. It is embodied in the conception which is supposed to express the most concrete aspect of nature. The Ionian philosophers asked, What is nature made of? The answer is couched in terms of a stuff, or matter, or material ... which has the property of simple location in space and time, or if you adopt the more modern ideas, in space-time.¹²

What the relativists and McGilvary fail to grasp from Whitehead's words is that Whitehead is talking about the underlying axiom not the consequential axioms. It is true that relativity does away with absolute space and absolute time and joins them into space-time regions. It is also true that relativists would hold time as an essential attribute of nature. But we must not confuse the modification or abandonment of some of the consequential axioms of the doctrine as a rejection of the doctrine itself. Einstein himself seems to favor the acceptance of the doctrine of simple location, for he writes:

According to the general theory of relativity the metrical character (curvature) of the four-dimensional space-time continuum is defined at every point by the matter at that point, and the state of that matter.¹³

We notice here the absence of relations between the "bits of matter" at the various points in the space-time continuum. Einstein, in fact, allows the isolated point and a single finite region of space to define the "metrical character of the four-dimensional space-time continuum."

¹²Science and the Modern World, p. 48.

¹³A. Einstein, The Principles of Relativity, London: Methuen and Company, 1923, p. 183.

Professor Northrop also shows that the relatedness advocated by relativity theory is at the abstract level and not at the level of actual occasions or events occurring in nature:

... the relational theory of space, necessitated by Einstein's rejection of Newton's absolute space, must be conceived not as relating physical objects, or events, defined in terms of physical objects or propagations as Einstein maintains; but as relating immediately sensed non-physically defined phenomenal events.¹⁴

After stating that the doctrine of simple location is embodied in Western science, Whitehead proceeds to deny the doctrine. He declares: "in our immediate experience there is no element whatever which possesses this character of simple location."¹⁵ He supports this declaration in four ways. First, he demonstrates that the concept of matter as isolated and qualitatively homogeneous is in error. Secondly, he shows that while matter can be conceptually isolated, we must not forget that the units of nature are dynamically connected and interdependent with the rest of the universe. Thirdly, he claims that the advocates of the doctrine of simple location fall into the epistemological mistake of making the abstract concrete. Finally, he shows that the doctrine of simple location destroys induction.

The first position is not to be interpreted as a denial of atomism. On the contrary, atomism will play a

¹⁴F.S.C. Northrop, "Whitehead's Philosophy of Science," p. 192.

¹⁵Science and the Modern World, p. 58.

significant role in Whitehead's philosophy but he is objecting to the classical atomism that dominates science and philosophy, the atomism which strips qualities from matter in the fashion of Descartes' "res extensa" and Locke's natural entities. Actual occasions are indivisible and to break them up into entities with extended properties plus imposed subjective qualities is a failure to grasp the unity of the occasion. To allow for the qualitative properties of occasions (as we have seen in Chapter VI) Whitehead claims that each actual occasion is organically unified with dual poles, a mental and a physical. There is no evidence in this period that Whitehead abandons the position first articulated in The Concept of Nature when he said: "For natural philosophy everything perceived is nature. We may not pick and choose. For us the red glow of the sunset should be as much a part of nature as are the molecules and electric waves by which men of science would explain the phenomena."¹⁶ The result is a qualitative atomism that will differ sharply from the atomism inherent in simple location, for not only will it span the divide which separates science and sense-perception, but it will also account for qualities in things. Thus this qualitative atomism avoids the empiricists' problem of why we should perceive qualities in nature if they do not exist in nature.

The second argument is probably the most important

¹⁶The Concept of Nature, p. 29.

though it is often overshadowed by the third argument.

In this second argument Whitehead reaffirms the Leibnizian pluralistic position and adds to it the notions of the unity and dynamics of nature. The result is that each occasion is fundamentally and dynamically connected with the other occasions in nature and reality.¹⁷ This point is often lost by the proponents of Western science. Reality cannot be interpreted simply by the static conditions of Euclidian geometry used by Newton or by the Riemannian geometry employed by Einstein because reality is dynamic and involves a matrix among occasions, space and time. This matrix transcends the simplicity of mathematical descriptions alone. The reality of change or flux makes simple location untenable. In addition, the isolation of matter is only one aspect of nature. What Whitehead adds is a dynamic unification of nature. By doing so he enhances our perspective of reality.

The third argument rests on the fact that the advocates of simple location commit the fundamental error of assigning an abstraction to the level of concrete being. By doing this, they allow all matter to be reduced to locations in points and instances. This mistake involves not only the concretion of the abstractions of the points and the instants, but also total reduction. "Accordingly, the real error is an example of what I have termed: The Fallacy of Misplaced

¹⁷Science and the Modern World, p. 90-92.

Concreteness.¹⁸ This fallacy is "... the accidental error of mistaking the abstract for the concrete."¹⁹ Whitehead does not deny that abstractions such as simple location are natural to the human mind, he merely wishes to stress that we should not forget that they are abstractions:

Of course, substance and quality, as well as simple location are the most natural ideas for the human mind. It is the way in which we think of things, and without these ways of thinking we could not get our ideas straight for daily use. There is no doubt about this. The only question is, How concretely are we thinking when we consider nature under these conceptions? My point will be, that we are presenting ourselves with simplified editions of immediate matters of fact. When we examine the primary elements of these simplified editions, we shall find that they are in truth only to be justified as being elaborate logical constructions of a high degree of abstraction. Of course ... we get at the ideas by the rough and ready method of suppressing what appear to be irrelevant details. But when we attempt to justify this suppression of irrelevance, we find that, though there are entities left corresponding to the entities we talk about, yet these entities are of a high degree of abstraction.²⁰

The final argument against the doctrine of simple location is to reveal that the acceptance of the doctrine destroys induction because nature can play no role in verification and memory is severely limited. Whitehead states:

It is at once evident that the concept of simple location is going to make great difficulties for induction. For, if in the location of configurations of matter throughout a stretch of time there is no inherent reference to any other times, past or future, it immediately follows that

¹⁸ Ibid., p. 58.

¹⁹ Ibid., p. 51.

²⁰ Ibid., p. 52.

nature within any period does not refer to nature at any other period. Accordingly, induction is not based on anything which can be observed as inherent in nature. Thus we cannot look to nature for the justification of our beliefs in any laws such as the laws of gravitation. In other words, the order of nature cannot be justified by the mere observation of nature. For there is nothing in the present fact which inherently refers either to the past or to the future. It looks, therefore, as though memory, as well as induction, would fail to find any justification within nature itself.²¹

Whitehead has provided the philosophic and scientific community with four strong arguments against the doctrine of simple location. However, if this is all he does, then his philosophy is nothing more than an interesting footnote. He must develop an alternative philosophy which is relational. His alternatives are limited. Classical mechanics is so imbued with the doctrine of simple location that it is not a viable possibility. While relativity tries to break with the doctrine of simple location, relativity is still tainted with the doctrine. Thus relativity offers Whitehead only limited help. Bergsonian philosophy, while avoiding the doctrine of simple location, is too anti-rational and too dependent upon the duality of reality (the élan vital and matter) to offer Whitehead a viable alternative. Only quantum mechanics offers Whitehead a possible avenue, but the doctrine's total

²¹Ibid., p. 51. Whitehead places a great deal of emphasis on induction since we acquire our first knowledge by it. See Whitehead, "Technical Education and It's Relation to Science and Literature," N.Y.: Macmillan, 1959, pp. 79-81.

atomicity makes it unacceptable.²² The result is that Whitehead must develop a relational philosophy independent of the major physical theories. His denial of simple location provides the direction. The immediate results of his denial provide some of the substance.

One of the initial results of the denial is that Whitehead is able to retain his earlier criticism of classical mechanics and of relativity without the "bifurcation of nature." This provides Whitehead with some powerful arguments, as we have seen, particularly against the point and the instant. These previous arguments, coupled with the denial of simple location, demonstrate that the point and the instant are abstractions which cannot be said to be in nature.²³ Thus one of the first necessary steps for the development of a relational philosophy of nature has been taken by Whitehead. Nature is not composed of isolated non-extensional and non-durational entities. The denial of the point and the instant allow Whitehead to

²²See Chapter X.

²³The point and the instant provide Whitehead with a serious problem. He has to explain how a system based on abstractions, such as points and instants, can be philosophically wrong and yet physically useful and significant. His answer is that these abstractions have a real place in science but that they were misunderstood. Whitehead believes that his method of extensive abstraction can explain the role of the point and the instant by basing them on concrete entities. (The method of extensive abstraction is the same as that in the first period, see chapter IV). No major modifications are made to the method until he arrives at his metaphysics with Process and Reality.

develop a second result.

Since time is not composed of isolated instants, the thesis of time as "pure succession" is false. By falsifying this theory of time Whitehead can then argue for some type of interconnection between entities and deny that things simply happen. Indeed by denying simple location Whitehead is able to reject Hume's and Kant's notions of "simple occurrence."

I directly deny this doctrine of 'simple occurrence.' There is nothing which 'simply happens.' Such a belief is the baseless doctrine of time as 'pure succession'.... The fallacy of 'misplaced concreteness' abstracts from time this specific character, and leaves time with the mere generic character of pure succession.²⁴

Since time cannot be defined in terms of pure succession and nothing "simply happens," then the view of the present as an isolated instant is false. The present is composed of related occurrences. Whitehead gives us some clues about the nature of these related occurrences in the next result.

In denying the instant, the point, and the definition of time in terms of pure succession and by affirming the existence of extension and duration for occasions and relatedness between occurrences, Whitehead is trying to establish a unification between the entities of nature which was lost by the acceptance of simple location. This unification is stressed

²⁴Symbolism Its Meaning and Effect, pp. 45-46.

in the next two results.

First, Whitehead denies the Lockean dualism between nature and mind with respect to primary and secondary qualities. The subjectivistic interpretation advanced by the British empiricists is rooted in the doctrine of simple location.²⁵ This dualism of nature and mind is destroyed when Whitehead includes "the secondary qualities in the common world."²⁶ The result is a qualitative, as well as, a quantitative world.

Secondly, Whitehead argues for the unification of space and time. The Newtonian need for a separate and absolute notion of space and a corresponding notion of time is no longer necessary once simple location and its inherent isolationism are rejected.²⁷ The unification of space and time also allows Whitehead to reaffirm his previously held position that time is an essential to nature.

Whitehead's arguments against the doctrine of simple location and the steps taken to develop a relational philosophy are still in jeopardy unless he can account for those "bits of matter" and explain their interrelationship. Whitehead attempts to do this with his notion of prehension. For the "bits of matter" he substitutes those qualitative and atomic

²⁵Science and the Modern World, p. 91.

²⁶Ibid.

²⁷This argument is similar to the one found in The Concept of Nature, pp. 34-37, where he talks about absolute space and time. It should be noted also that Whitehead does not attribute this characteristic to the relativity theory.

"actual occasions."²⁸

These actual occasions are not unlike Leibniz's "monads mirroring perspectives of the universe."²⁹ It is this statement on monads that Whitehead takes from Leibniz and not the statement that "monads have no windows." Whitehead's actual occasions are open to the entire world, both giving and taking. The beauty of having every occasion as a "mirror of the universe" is that the mirroring takes time and thus the temporal process is essential to prehension. Whitehead further transforms Leibniz's monads by introducing the notion of prehension, which he derived from Berkeley's doctrine.³⁰

We can substitute the concept, that the realization is a gathering of things into the unity of prehension; and that what is thereby realized is the prehension, and not the things. This unity - of a prehension defines itself as a here and a now and the things so gathered into the grasped unity have essential reference to other places and other times. For Berkeley's mind, I substitute a process of prehensive unification ... note that the idea of simple location is gone. The things which are grasped into a realised unity, here and now, are not the castle, the cloud, and the planet simply in themselves; but they are the castle, the cloud, and the planet from the standpoint, in space and time, of the prehensive unification. In other words, it is the perspective of the castle over there from the standpoint of the unification here. It is, therefore, aspects of the castle, the cloud, the planet which are grasped into unity here.³¹

²⁸"Now, Mr. Whitehead's answers substitute 'actual occasions' for stuff or matter, or material..." McGilvary, "Space-Time, Simple Location, and Prehension," The Philosophy of Alfred North Whitehead, ed. by P. Schlipp, N.Y.: Tudor Publishing Co., 1951, p. 230.

²⁹Science and the Modern World, p. 70.

³⁰Ibid., p. 69.

³¹Ibid., pp. 69-70; underlining mine.

Whitehead reiterates this position later in Science and the Modern World:

....my theory involves the entire abandonment of the notion that simple location is the primary way in which things are involved in space-time. In a certain sense, everything is everywhere at all times. For every location involves an aspect of itself in every other location... Thus every spatio-temporal standpoint mirrors the world.³²

Whitehead gives an example to illustrate prehensive unity within an organism.³³

...an electron within a living body is different from an electron outside it...The electron blindly runs either within or without the body: but it runs within the body in accordance with its character within the body.³⁴

An electron, no longer in isolation, mirrors its world of "here" and "now" by conforming to the unity of the body. If the electron were disconnected, as the theory of simple location claims, then it would not operate in radically different ways in different media, namely in different heres and nows. But the electron does operate differently in new media.

Professor Alston makes the following useful comment on the notion of prehension:

Thus, if we accept this view of nature as made up of unities of prehension, we give up simple location. The components of such a prehensive unity are not simply located at their region of origin; but, qua involved in that prehension, they are at both places. They are at their point of origin, from the standpoint of the prehensive

³²Ibid., p. 91.

³³While this example is not used in the same sense as Whitehead used it, I think its use is consistent to Whitehead's meaning.

³⁴Science and the Modern World, p. 91.

region; or they are at the prehensive region with the mode of location at their place of origin. Hence they are, in a somewhat different sense, at both places, and at neither exclusively. And if any entity is involved as components in many prehensive unifications, it will correspondingly have many locations.³⁵

And McGilvary states: "Thus we find that Mr. Whitehead's doctrine of the denial of 'simple location' is intimately connected with his view of 'prehension' and that this is likewise intimately connected with his view of 'perspectives.'"³⁶

It should be noted, however, that Whitehead does not accept Leibniz's version of pre-established harmony.³⁷ We should also make clear that the process of unification on relations given by and through prehension does not destroy the individuality of the event, since individuality in Whitehead's perspective does not mean independence:

Thus, concrete fact is process. Its primary analysis is into underlying activity of prehension, and into realised prehensive events. Each event is an individual matter of fact issuing from an individualisation of the substrate activity. But individualisation does not mean substantial independence.³⁸

The denial of simple location also allows Whitehead to argue even more radically for the immortality of actual occasions. In subsequent works he states that the actual

³⁵Alston, "Whitehead's Denial of Simple Location," Journal of Philosophy, vol. 48, 1951, p. 717.

³⁶McGilvary, "Space-Time, Simple Location, and Prehension," p. 231.

³⁷A.H. Johnson, "Leibniz and Whitehead," Philosophy and Phenomenological Research, vol. 19, 1958-59, pp. 293-294.

³⁸Science and the Modern World, p. 51.

occasion is immortal since it is prehended by other actual occasions.³⁹

The fact of prehension will be part of Whitehead's new relational philosophy. This concept will be developed in the next chapter, but the point here is that prehension and the necessity for developing a relational philosophy rests upon Whitehead's denial of simple location.

It seems to me that several scholars have failed to recognize the importance of Whitehead's denial of simple location. Lovejoy in his Revolt Against Dualism unfairly attacks Whitehead by claiming that he is contradicting himself in different versions.⁴⁰ Emmet maintains that simple location refers only to space and time in the absolute position:

...the initial statement of the meaning of 'simple location,' shows that the 'fallacy' lay in the ascription of an absolute position in Space and Time to a bit of matter without reference to other regions of Space and Time.⁴¹

³⁹See Whitehead's article, "Time."

⁴⁰A.O. Lovejoy, The Revolt Against Dualism, N.Y.: Norton, 1930, p. 159. Alston criticizes Lovejoy's position by pointing out the following weakness: It is not difficult to see that Lovejoy is playing Whitehead's imprecision for a little more than its worth...This is indicated by the fact that he supports only two of his seven senses by direct quotations from Whitehead in which the phrase in question is used. What he has done is to take seven different theories, some of which are actually maintained by Whitehead, and lump them all together, without any apparent warrant for doing so, under the title 'denial of simple location.' Alston, "Whitehead's Denial of Simple Location," p. 714, footnote 6.

⁴¹D. Emmet, The Philosophy of Organism, p. 177, footnote 3.

While Emmet is correct in the statement that the concepts of absolute time and absolute space are dependent on the doctrine of simple location, she has not seen that the history of Western science is imbued with the doctrine. Nor has she realized the significance of Whitehead's denial. In addition, her comment on simple location is contained in a footnote, which seems to indicate the lack of importance she attributes to it.

Braithwaite maintains that Whitehead assigns simple location to universals and not to concrete particulars.⁴² I believe that this position is not supported, and it must be said that Braithwaite does not adduce any direct quotation to indicate on what grounds he bases his analysis.

Alston argues that the idea of prehension compels Whitehead to deny simple location.⁴³ He concludes that "... the denial of simple location ... is simply this Principle of Mutual Immanence applied to actualities insofar as they occupy space-time."⁴⁴ But Alston has it backwards. The denial of simple location compels Whitehead to develop the theory of prehension. If Whitehead accepted the doctrine of simple location, then he would have accepted the isolated atomism

⁴²R. Braithwaite, "Review of 'Science and the Modern World,'" Mind, N.S. XXXV, p. 493.

⁴³Alston, "Whitehead's Denial of Simple Location," p. 717.

⁴⁴Ibid., p. 718.

inherent in the doctrine and would not need to explain the relatedness between occasions because there was none. Only by denying simple location and accepting a dynamic atomism, that is inherently related, does the necessity for developing the idea of prehension occur. Thus Alston is mistaken in his notion of the importance of simple location and fails to grasp the reasoning underpinning prehension. In addition, Alston seems to agree with Braithwaite, but this does not seem entirely consistent with his general analysis of Whitehead's philosophy.⁴⁵

Johnson's treatment of simple location is also misdirected. In his work, Whitehead's Theory of Reality, he discusses the denial of simple location under the heading: the fallacy of misplaced concreteness.⁴⁶ But the denial of simple location precedes the fallacy of misplaced concreteness. Only by developing the doctrine of simple location and then denying it is it possible to understand Whitehead's meaning of misplaced concreteness. By having it backwards Johnson misses the relationships between simple location and the criticisms. Thus it is little wonder that Johnson does not show the relationship between the denial of simple location and other key concepts, such as prehension.

⁴⁵Ibid., p. 713.

⁴⁶A. H. Johnson, Whitehead's Theory of Relativity, N.Y.: Dover, 1962, pp. 150-151.

In addition, Johnson refers to the denial of "simple location as the "sub-fallacy of Simple Location."⁴⁷ In Science and the Modern World, Whitehead never uses the phrase, "the fallacy of simple location." Only once does he mistakenly use the phrase and then it is in Process and Reality.⁴⁸ Finally, Johnson's only other reference to simple location occurs in a lengthy footnote⁴⁹ where he very effectively takes Lovejoy's criticism apart. But it is unfortunate that Johnson did not perceive the importance of the denial of simple location in any greater fashion than Lovejoy. It is possible that Johnson might have overlooked the denial of simple location due to the larger scope of Whitehead's thoughts that he was trying to cover, but no such defense can be made for Hammerschmidt and Palter. Neither Hammerschmidt, in Whitehead's Philosophy of Time, nor Palter, in Whitehead's Philosophy of Science, mention simple location and Whitehead's denial of it. Their omissions are quite baffling. It is Whitehead who claims that Western science embraced the doctrine of simple location. It is Whitehead who shows that this

⁴⁷ Ibid., p. 150.

⁴⁸ Process and Reality, p. 160. Lawrence explains why Whitehead does not use the term fallacy with simple location in his article, "Single Location, Simple Location and Misplaced Concreteness," Review of Metaphysics, vol. 7, 1953, p. 231.

⁴⁹ A. H. Johnson, Whitehead's Theory of Reality, pp. 249-250, footnote 192.

doctrine destroys the meaningfulness of time in nature. It is Whitehead who shows that the acceptance of the doctrine is the acceptance of misplaced concreteness and nature as composed of isolated "bits of matter." These are all themes that Hammerschmidt and Palter deal with, but they never mention simple location. This I believe is a glaring oversight in two otherwise excellent works.

Thus a set of common elements can be detected in these commentarial views on Whitehead. Uniformly, they fail to see the significance of the doctrine of simple location and the role it has played in science, as well as the importance and boldness of Whitehead's denial. As a result some have misunderstood the relationship between the denial of simple location and other key Whiteheadian concepts. Some have failed to grasp that without the denial of simple location Whitehead's criticisms of Newtonian and Einsteinian theories would not make sense. Others have missed the link between the denial and the necessity to form a relational philosophy because of the denial of simple location. Most have failed to grasp the link between the denial and its importance to Whitehead's philosophy of time. Most have failed to understand Whitehead's denial of simple location.

Because of his desire for a relational philosophy, Whitehead must develop the notion of prehension and a theory of time which allows for the unity of occasions. The next chapter will deal with Whitehead's notion of prehension. Chapter nine develops Whitehead's relational philosophy of time, the epochal theory of time.

CHAPTER VIII

PREHENSION

In Science and the Modern World, Whitehead introduces a new concept, that of prehension. Previously, he had used the terms extension¹ and apprehension² to convey his views about the relationship between events. These terms, however, proved to be too narrow for his broadened purposes. Whitehead had argued against the doctrine of simple location, but neither extension nor apprehension captured the full impact of his new position.

Whitehead still uses, of course, the term apprehension,³ in Science and the Modern World, but its meaning is that provided by the context "uncognitive apprehension."⁴ Hence,

¹"Time, Space, And Material," p. 47.

²See A. N. Whitehead, An Enquiry Concerning the Principles of Natural Knowledge, Chapter VI.

³Science and the Modern World, pp. 84-85.

⁴Whitehead reveals the link between apprehension and prehension in Science and the Modern World by claiming that prehension will substitute for "incognitive apprehensions" - meaning by this any apprehension whether cognitive or not. (Science and the Modern World, p. 69). This meaning of prehension will have major significance in Process and Reality when prehension will include feelings.

when Whitehead discusses Wordsworth's apprehensions and sees in them a criticism of scientific materialism,⁵ he interprets "the concrete facts of our apprehension" as expressing "... entwined prehensive unities, each suffused with a modal presence of others."⁶

Whitehead has another use for prehension. He realized that if relations were only based on extensive relations, he might be forced into a Cartesian doctrine concerning secondary qualities. Descartes argued that all we know of the constitution of bodies must be expressed in terms of extension and local motion.⁷ Sense perceptions or qualities, such as color and taste, are subjective. The only primary qualities are extension and motion. All changes depend on local motion, for there are, strictly speaking, no qualitative changes, since qualities are not said to be clear and distinct ideas unless they pertain to the soul.⁸ Whitehead does not wish to be forced into this epistemological framework, but extension, as it is found in his earlier works, hints at a dualism between mind and matter since it does not refer to a perceiving subject. But with the introduction of prehension, this possibility is removed for the union of actual occasions

⁵Ibid., p. 84.

⁶Ibid.

⁷See R. Descartes, Principles, IV and IX, Part II.

⁸See R. Descartes, Meditations, IV, V, and VI.

grasped in the here and now.⁹

In a sense, prehension redefines perception:

"Perception is simply the cognition of prehensive unification: or more shortly, perception is cognition of prehension."¹⁰

The definition of perception in terms of prehension provides three advantages from Whitehead's point of view. First, it enables him to expand the meaning of perception beyond simple awareness of events grasped in sense-awareness as Whitehead had done in his earlier philosophical writings.¹¹ Secondly, perception can now be seen to deal with entities in the here and now. Finally, a direct link is supplied for the relationship between prehension, causal efficacy, and presentational immediacy. This is accomplished since, according to Whitehead, the two modes of perception that we have of the external world are causal efficacy and presentational immediacy.¹²

Prehension becomes a tool in Whitehead's attack on the problem of simple location. McGilvary and Alston infer from this that the denial of simple location depends on the

⁹Science and the Modern World, pp. 69-70.

¹⁰Ibid., p. 71.

¹¹"Perception is an awareness of events or happenings ..." An Enquiry Concerning the Principles of Natural Knowledge, p. 68; see also The Concept of Nature and The Principles of Relativity.

¹²Symbolism Its Meaning and Effect, p. 15.

primacy of prehension.¹³ I would like to suggest the inverse: for if Whitehead had upheld the doctrine of matter in simple location, then there would have been no need for the doctrine of prehension. I submit that Whitehead means this when he writes: "Now that we have cleared space and time from the taint of simple location, we may partially abandon the awkward term prehension."¹⁴ Despite its appearance, this statement is not intended to dismiss the doctrine of prehension but to reveal two important factors in his philosophy. First, Whitehead recalls that prehension was introduced to avoid the fallacy of simple location; and secondly, that the concept of prehension in Science and the Modern World is not sufficiently developed to stand by itself.

In Science and the Modern World and in the article, "Time," Whitehead used prehension in a number of cases with apparently different intentions, for he gives five meanings of prehension:

- a. It is the process of unifying.¹⁵
- b. It expresses how the "world is a system of organisms."¹⁶

¹³See McGilvary, "Space-Time, Simple Location, and Prehension," pp. 231-232, and Alston, "Whitehead's Denial of Simple Location," p. 717.

¹⁴Science and the Modern World, p. 72.

¹⁵Ibid.

¹⁶"The category of Prehension expresses how the world is a system of organism." "Time," p. 60.

c. It is a "prehensive occasion."¹⁷

d. It is one of the foundations for nature as process.¹⁸

e. It defines events as "the thing prehended."¹⁹

It would seem, therefore, that Whitehead had not fully reconciled himself to one meaning or one term, since "events," "prehensive occasions," and "organism" are all synonyms of prehension.

The first meaning of prehension¹ as a "process of unifying" is considered by Lawrence to be the most important meaning of prehension, namely, it "refers to the relation between events, albeit the relation as a process of unifying is itself treated as an event."²⁰ Now this particular use of prehension is important since it allows Whitehead to collect entities and to escape the bifurcation of perceiver and perceived as isolated units. This use of the term, however, compels Whitehead to accept a new meaning of the term "event." Although Whitehead does provide a new definition, an event as a thing prehended, it does not solve the problem. For if an event is only to be understood as a thing prehended through the process of unification, then the very process itself is

¹⁷Science and the Modern World, p. 71.

¹⁸Ibid., p. 72.

¹⁹Ibid.

²⁰N. M. Lawrence, Whitehead's Philosophical Development, N.Y.: Greenwood Press, 1968, p. 290. See also Science and the Modern World, p. 72.

the external world viewed by the perceiver, and it is indeed supplied by the perceiving subject. Whitehead does not wish to be driven to this conclusion since he maintains that atoms can prehend atoms. Thus, while this meaning of the term is interesting and instructive, it is not adequate to his general task. We can ask, indeed, what relation is being unified: the relation, of course is time. The events or occasions are in a temporal relationship of "now." Without this temporal structure no unification would be possible, and Whitehead is thereby forced to explain how two entities can grasp each other directly for he ultimately wishes to explain how entities grasp past and future occurrences. The temporal "now" is of capital importance for Whitehead's concept of prehension.

The second meaning of prehension is "how the world is a system of organisms." Lowe, in discussing the meaning of organism in Whitehead, states: "By 'organism,' Whitehead generally means a temporally bounded process which organizes a variety of given elements into a new fact."²¹ There is, of course, a striking similarity between Whitehead's use of the term organism and the first meaning of prehension. Again the temporal aspect is stressed. Yet this second meaning is in some respects more felicitous than the first, for prehension is here the method, the way that entities

²¹Lowe, "The Development of Whitehead's Philosophy," p. 95.

enter into the process of temporal unification, and the resulting organisms. Prehension is given the global status of a fundamental category.²² Its process of organization is explained as: "The definite way in which A includes other occasions in its concretion is here called 'Prehension.'"²³ This concretion is the "growing together of diverse elements"²⁴ of an occasion. The diverse elements are other occasions and eternal objects. Prehension determines the way by which this concretion takes place, for instance, the concretion of atoms to other atoms, or of the perceiver to the perceived.

It seems to me that the other meaning of prehension are related to the first two meanings. By claiming that prehension is one of the foundations for the process of nature, Whitehead is preparing us for this move in his article, "Time," where prehension becomes a fundamental category.²⁵ The problem is that Whitehead simply offers this definition but does not develop it: In his other definition, he identifies prehension with the prehensive occasion. This seems to me to be telling, since Whitehead probably had not decided in Science and the Modern World whether prehension is simply a method or a process

²²"Time," p. 60.

²³Ibid.

²⁴Ibid.

²⁵Prehension as a fundamental category is continued in Process and Reality where it is part of the "Categories of Existence."

between concrete finite events. He overcomes this difficulty to a certain extent, in the second definition, but the problem remains until prehension is redefined and expounded more systematically in Process and Reality (1929). The final meaning of prehension, as a definition of activities in events as the things prehended, contains some of the problems already mentioned in connection with prehensive occasion. As Lowe indicated:

This conception of natural events is applied to the problem of mechanism and freedom: Since every event arises as a prehension of its environment, the characters of the events in the human body are not entirely determined by any absolute properties of the components of bodies in general (molecules) but are modified by the fact that the molecules are in a particular human body (the theory of organic mechanism).²⁶

In other words, "the molecules differ in their intrinsic characters according to the general organic plans of the situations in which they find themselves."²⁷ The cause of the differences is the method by which things become prehensive occasions.

We must stress here that the meaning of prehension is still in a state of transition, and I consider that the most adequate meaning to be the one given in the second definition. A pictorial model of prehension that can help our understanding of Whitehead's meaning of prehension is found in electro-

²⁶Lowe, "The Development of Whitehead's Philosophy," p. 96; see also Science and the Modern World, p. 80.

²⁷Science and the Modern World, p. 80.

magnetism, where there are no individual particles, but a unified field with a temporal framework that produces concrete finite events.

We must now investigate how the doctrine of prehension influenced Whitehead's doctrine of time. As we have seen in the first two definitions, prehension has a temporal structure. "The concept of time is complex, and arises from the interplay of three fundamental categories, namely, Supersession, Prehension, and Incompleteness."²⁸

Supersession involves a unification of occasions. It allows for an orderly sequence by which we can understand the relationship between occasions. In the article, "Time," supersession is referred to the succession of phases within a concrescence, as well as to the transition from one occasion to another. The process of supersession is three-fold:

Each occasion supersedes other occasions, it is superseded by occasions, and it is internally a process of supersession, in part potential and in part actual.²⁹

Supersession will in part explain the atomicity of time and delineate the parameters of the past. For concrescence, which is the growing together of the many in the unity of a one, needs a temporal dimension.

Lowe has suggested that Whitehead arrived "at the

²⁸"Time," p. 60.

²⁹Ibid., p. 59.

causal character of physical prehension through an analysis of time."³⁰ Prehension is indeed a unifying relation between two actual occasions, "whereby the actual occasion brings other beings into a synthesis with itself."³¹ The adjective physical limits the scope of the prehension and excludes eternal objects.³²

Johnson provides us with an excellent explanation of the relationship between prehension and a prehending entity:

In the case of a physical prehension of actual entity B by actual entity A, data for prehension into A are available only after the internal existence of actual entity B has 'evaporated, worn out and satisfied.' ... This theory is summarized in the statement that actual entities 'perpetually perish' subjectively (they are no longer living, concrete, active subjects), but are immortal objectively.³³

An illustration of what Whitehead means can be found in the heart transplants. An individual person B can give up his heart to another person A, thereby allowing A to exist. For A to continue to exist and the transplant to occur, B must die before that transplant. Thus A's existence is dependent upon B's death. Another example, though not as graphic as the first example, can be found in the moments of time. An event occurs while you are reading this page, and the event endures.

³⁰Lowe, "The Development of Whitehead's Philosophy," p. 99.

³¹Lawrence, Whitehead's Philosophical Development, p. 291.

³²See "Time," p. 60. The influence of eternal objects is in mental prehension.

³³Johnson, Whitehead's Theory of Reality, p. 28.

The continuation of the event's existence is dependent upon the demise of the first moment and the suppression of this moment into the next. We should note here that the unification by physical prehension does not include cognitive elements for Whitehead. In fact, some of the entities that are treated by the theory of physical prehension are what some of the scientific communities refer to as matter, i.e. atoms and molecules. These entities cannot be secured in an instant but require both extension and duration.

The relationship between occasions in physical prehension is quite definite. To quote Johnson again: "A very important implication of this situation is that direct relationship between actual entities only occurs when they are in a serial order one in the past of the other."³⁴

This does not mean that the past occasion is always completely or identically absorbed by the present occasion as in the case of the heart transplant. Take, for instance, the sensation of pain as it occurs in a headache. The headache may well begin as a dull feeling of unpleasantness with a minimum of pain, but as it continues in the next moment, the pain endures not as a dull throbbing but as something that grows into more or less excruciating pain. The occasion of pain when first felt is not completely identical with the occasion of pain in the next moment, yet there is a continuity between

³⁴Ibid.

the initial pain and its subsequent development. In Whitehead's own words:

The definite way in which A includes other occasions in concretion is here called 'Prehension.' By this term, blind physical perceptivity is meant. We recall concepts are blind. The physical world exhibits itself as a system of organisms arising out of concretions of blind intuitions.³⁵

Whitehead is able to show the relationship between discrete occasions through the use of the doctrine of prehension and prehensive unity. This will be invaluable in dealing with the notion of becoming. Whitehead's epochal theory of time is his theory of becoming, and is the subject of the next chapter.

³⁵"Time," p. 60.

CHAPTER IX

EPOCHAL THEORY OF TIME

In the period of transition which we have been considering Whitehead initiates a philosophy of time which he will continue to develop throughout his philosophical writings, but the full doctrine will not be formulated until Process and Reality. There are four important factors to be considered here. The first is that his philosophy of time was to become significantly different from the one that was hinted at in the early philosophical period. Secondly, through his epochal theory, Whitehead tried to restore time as an explanation of reality. Thirdly, this new doctrine of time was intended to unify his theories of actual occasions and prehension. Finally, the doctrine aims at establishing the primary claims of process and creativity.

The epochal theory of time is the foundation of Whitehead's theory of becoming. An actual occasion perishes and becomes another actual occasion. How one occasion ceases to be and becomes another is of vital concern in any philosophy of organism. Hence, Whitehead must explain becoming, and this he attempts to do through what he terms the epochal theory of time. To understand this notion, his doctrines of supersession

and prehension are required for becoming is not continuous, it is atomic, or a special version of atomic, namely, without spatial extension.

Whitehead rejects the notion that supersession is a continuous process. He argues that supersession and continuity lead to an "infinite regress." He reasons as follows:

For if B supersedes A, then the continuity of B requires that some earlier portion of B has superseded A antecedently to the latter 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.¹

Whitehead seems to believe that Zeno's paradox is related to this problem, and he believes that his move will avoid the traditional paradox.

Whitehead is abandoning the notion of continuity. He presupposes here that actual occasions are indivisible. These are the rock bottom elements of reality, and since they are indivisible, there are no smaller units of reality. Whitehead sees in some scientific theories, especially Newton's, the danger of an infinite regress since it could be argued that intervals of time which divide parts are themselves composed of parts, and one could proceed ad infinitum.

The problem Whitehead addresses is discussed by the "realist philosophers," Aristotle and his follower, Aquinas, in their attempt to explain coming to be and ceasing to be

¹"Time," p. 63.

in terms of continuity. Whitehead believed that their attempted solution to the problem deserved consideration for it revealed a well-thought attempt to avoid the problems of becoming and cessation by using the principle of continuity. The failure of their attempt is enlightening since it can help us avoid unnecessary philosophical work.

Aristotle and Aquinas considered becoming and cessation to be part of the general problem of substantial change. The problem, as they saw it, was, since substantial change occurs, then we must have in the case of cessation, or corruption as they put it, a change or passage from being to non-being. If this corruption were to take place in a strict continuous manner, then the principle of contradiction is in jeopardy. For instance, a man who is dying cannot at the same time be both dead and alive, or he cannot be both a corpse and a man at the same time. Their quandary rested on their belief that time is continuous.² Now, one move would be to consider substantial change as not occurring in time, but the strangeness here is that a physical occurrence is now considered not to have occurred in time. The alternative would be to say that corruption occurs in an instant or "now." Corruption of an entity occurs in an instant and its becoming or "generation" as they would have said, occurs in another

²See Aristotle, "Physics," in Basic Works of Aristotle, trans. by R. McKean, N.Y.: Random House, 1941, 22/a 9-13; and Aquinas, Commentary on the Physics, trans. by Kecourek, St. Paul, 1951, IV, 1, 17, N. 7.

instant. But this solution is also open to serious difficulties. Plato would argue that there is an intermediate time between two instants of time. Aquinas, working in the footsteps of Aristotle, argued that substantial change occurred in the instant and that a substantial change occurred in a continuous time. Here is how Aquinas argues:

However, it seems that this conclusion indicates that generation and corruption occur in an instant and that there is no intermediary between the termini of generation and corruption. For if between the 'now' when the body is in the terminus to which there is an intermediate time, it would then follow that there is an intermediary between being and non-being. For in that intermediate time that which is changed is neither being nor non-being...But...this does not mean that there is an ultimate instant in which that which is being generated is non-being. Rather this means that there is a first instant in which it is being, such that in the whole time which precedes that instant it terminates the motion there is no intermediary. Thus it is not necessary that there be an intermediary between being and non-being. Rather, since the time which precedes the instant in which the body was first generated measures some motion, it follows that just as that instant in which the body was first generated is the terminus of the preceding time which measures the motion, likewise 'to begin to be' is the terminus of the preceding motion.³

This passage indicates that since this generation of one substance implies the corruption of another, both take place in an instant. It is impossible to allow an intermediate time because the prime matter does not exist independently.

To quote Aquinas once again:

First he sets for a problem which is usually raised in regard to generation and corruption. That which is generated ceases to not-be and begins to be. Some time

³Aquinas, Commentary on the Physics, Bk. VI, 834.

must be assigned, therefore, to the existence of that which is generated or corrupted, and a different time to its non-existence. For example, if fire is generated from air, in the whole time AB it was not fire but air. But in the whole time BC it is fire. Since, then, this point of time B is common to both times, it seems that in that common instant the same thing simultaneously is and is not fire.⁴

It is also plain that unless we hold that the point of

time that divides earlier from later always belongs only to the later so far as the thing is concerned, we shall be involved in the consequence that the same thing is at the same moment existent and not existent, and that a thing is not existent at the moment when it has become. It is true that the point is common to both times, the earlier as well as the later, and that, while numerically one and the same, it is theoretically not so, being the finishing-point of the one and the starting-point of the other: But so far as the thing is concerned it belongs to the later stage of what happens to it. Let us suppose a time ABC and a thing D, D being white in the time A and not-white in the time B. Then D is at the moment C white and not-white: for if we were right in saying that it is white during the whole time A, it is true to call it white at any moment of A, and not-white in B, and C is in both A and B. We must not allow therefore, that it is white in the whole of A, but must say that it is so in all of it except the last moment of C. C belongs already to the later period, and if in the whole of A not-white was in process of becoming and white of perishing, at C the process is complete. And so C is the first moment at which it is true to call the thing white or not-white respectively. Otherwise a thing may be non-existent at the moment when it has perished: or else it must be possible for a thing at the same time to be white and not-white and in fact to be existent and non-existent.⁵

Substantial change occurs in a continuous time according to Aquinas and the medieval followers of Aristotle because they believed they could transcend the physical change and time

⁴Ibid., Bk. VII, 119.

⁵Ibid.

and make the apparent instant of substantial change on earth become a part either of the continuous time and motion of the sun, as in the case of Aristotle, or of the continuous time of God, as Aquinas chose to do. The point here is that in order to explain becoming as continuous they had to transcend the time of man to reach some "higher" concept or level of time.

This is only one of several attempts to explain becoming in terms of continuity. A more contemporary attempt can be found in the physics of relativity and in Maxwell's theory of electromagnetism which clearly presupposes the concept of continuity.

Maxwell's theory concerning the electromagnetic field incorporated in one elegant system all that was known concerning light, electricity, and magnetism on the macroscopic scale of ordinary experience. In 1864, in his final version of his theory, Maxwell states:

I have preferred to seek an explanation (of electric and magnetic phenomena) by supposing them to be produced by actions which go on in the surrounding medium as well as in the excited bodies, and endeavoring to explain the action between distant bodies without assuming the existence of forces capable of acting directly at sensible distances.

The theory I propose may therefore be called a theory of the 'Electromagnetic Field' because it has to do with the space in the neighborhood of the electric and magnetic bodies, and it may be called 'Dynamical' theory because it assumes that in that space there is matter in motion, by which the observed electromagnetic phenomena are produced ... (The space) may be filled with any kind of matter, or we may endeavor to render

it empty of all gross matter as in the case of Geissler (electrical discharge) tubes and other so-called vacua.⁶

In this paper and in the Treatise on Electricity and Magnetism published in 1873, the elaborate heuristic device of fluid cells and vortices, and the models of lines of forces are no longer used. What is left is a network of mathematical equations and the concept of "field" as the condition or state of the medium. Strongly influenced by previous work in the field and inspired by Faraday's intuitive speculations about lines of force and the role of an intervening medium in electromagnetic phenomena, Maxwell proceeded to reinterpret his mathematical assertions.

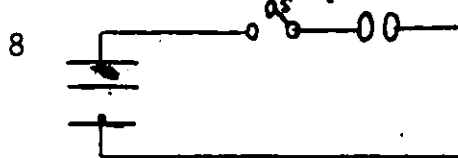
Faraday's law of induction ($\mathcal{E} = -N \frac{d\Phi}{dt}$) was based on measurements of current induced within a conductor when the total magnetic flux was changed through the conducting loop. Maxwell conceived the idea that an electrical field might always be induced around a region of varying magnetic flux (in accordance with the left-hand rule, indicated by the minus sign), even in a vacuum and regardless of whether or not a loop of wire happened to be present. The conducting loop, he held, simply acted as a detector and revealed the presence of a circulating electrical field because the charge was free to move within the conductor.

⁶James Maxwell, "A Dynamical Theory of the Electromagnetic Field," in The Scientific Papers of James Clerk Maxwell, ed. by D.W. Niven, N.Y.: Dover, 1965, vol. 1, p. 527.

According to Maxwell's conjecture, $(\oint \mathbf{E} \cdot d\mathbf{s} = \frac{d\Phi}{dt})$ would be applicable in any region in empty space. The integral on the left-hand side is to be taken around any arbitrarily chosen closed loop in empty space, and the symbol on the right-hand side refers to the total magnetic flux passing through this loop.

Given the conjecture that a varying magnetic flux is always surrounded by an induced electrical field, one might be led to wonder about the inverse effect. Is a varying electrical flux surrounded by an induced magnetic field? In answering this question it should be kept in mind that Maxwell already knew of Oersted's work that a current-carrying conductor is surrounded by a magnetic field. The question then is: What must happen in the vicinity of a capacitor as it is being charged by a battery?⁸ In raising this question and proposing an answer, Maxwell was motivated by problems of the continuity of the electrical system. His answer supports the continuity of the system.

⁷N is taken as equal to 1.



When switch S is closed, the pulse of current flows through the circuit as the capacitor is charged. Wires are surrounded by a magnetic field, while the current is flowing. The question then is: Is the region between the capacitor plates similarly surrounded by a magnetic field? If so, can this field be related to an equivalent current between the capacitor plates as the magnetic field around a wire is related to current in the wire?

As the capacitor is charged, the electrical field between the plates increases from zero to $E = \frac{4\pi k_E q}{A}$. The expression k_E denotes the constant which appears in Coulomb's law. The subscript E emphasizes that this is the constant associated with the electrical force and to distinguish it from the magnetic constant k_M .

Maxwell suggested that, while the electrical field is charging, the capacitor is surrounded by a magnetic field just as are the wires carrying the pulse of current, and he then extended this idea to the broader conjecture that a varying electrical field will always be surrounded by an induced magnetic field, even in a vacuum, in regions far removed from the immediate influence of moving charges.

The import of Maxwell's theory is that electro-magnetism can be mathematically interpreted in terms of a field theory. This field theory is continuous in a medium and could be incorporated in other levels of physical description. Maxwell showed how to bring together in one set of field equations electrical phenomena and magnetic phenomena, but the equations involved presumed and required the continuous propagation of energy.

Relativity also supports the Maxwellian argument for continuity. In a paper, "Concerning an Heuristic Point of View Toward the Emission and Transformation of Light" (1905), Einstein points out:

...the total energy of a ponderable body must, according to the present conceptions of physicists, be represented as a sum carried over the energies of the atoms and electrons (that make up the body). The energy of a ponderable body cannot be subdivided into arbitrarily

many or arbitrarily small parts, while the energy of a beam of light from a point source (according to the Maxwellian theory of light or, more generally, according to any wave theory) is continuously spread over an ever-increasing volume.

The wave theory of light, which operates with continuous spatial functions, has worked well in the representation of purely optical phenomena and will probably never be replaced by another theory.⁹

Although Einstein examines experimental difficulties against the continuum theory, he did not think that it should be abandoned. However, according to Whitehead, the continuum theory as advocated by both Maxwell and Einstein suffers from four serious difficulties.

First, their types of continuum must have points and instants, and we have seen that Whitehead rejected these concepts as being concrete.¹⁰ Secondly, Whitehead believed that a divisible continuum led to an infinite regress. He recognized that it was a special kind of infinite regress since nowhere in the continuum could one discern the true beginning of becoming. In an infinite regress, becoming would have to begin in "what should be the infinite end of the regress. But there is no infinite end."¹¹ Thirdly, in the words of Hammerschmidt:

He (Whitehead) asserts that all becoming must begin in an extended locus. But any assigned extended locus must be abandoned as the locus of the beginning of becoming,

⁹A. Einstein, "Concerning an Heuristic Point of View Toward the Emission and Transformation of Light," Underlining is mine.

¹⁰See Chapter on Simple Location.

¹¹"Time," p. 63. This argument can also be used against Aristotle's and Aquinas' position.

in favor of a part of the locus. This allows no extended locus to define the true beginning of the becoming. Unextended loci are impossible. Therefore the becoming can have no true beginning and cannot rationally be said to become.¹²

Fourthly, the continuum theory advocated by Maxwell and Einstein did not seem capable of explaining the structure of the atom, blackbody radiation, and the photoelectric effect. The explanation in quantum mechanics of these phenomena indicated a serious theoretical flaw in the continuum argument. Whitehead stresses the seriousness of this problem in Science and the Modern World:

This discontinuous existence in space, thus assigned to electrons, is very unlike the continuous existence of material entities which we habitually assume as obvious. The electron seems to be borrowing the character which some people have assigned to the Mahatmas of Tibet. These electrons, with the correlative protons, are now conceived as being the fundamental entities out of which the material bodies of ordinary experience are composed. Accordingly if this explanation is allowed, we have to revise all our notions of the ultimate existence. For when we penetrate to these final entities, this startling discontinuity of spatial existence discloses itself.¹³

The sentence that is underlined at the end of this quotation reveals Whitehead's acceptance of at least some of the theory of quantum mechanics. He wrote: "The epochal theory of time is the foundation of the theory of atomic organisms and of the modern physical quantum theory."¹⁴

¹²Hammerschmidt, Whitehead's Philosophy of Time, p. 23.

¹³Science and the Modern World, p. 35; underlining mine.

¹⁴"Time," p. 64.

Atomism had been an influential philosophical position since the time of Leucippus and Democritus, but it was not until the late eighteenth century that it became a scientific theory. It was only in the twentieth century with Rutherford and Bohr that atomism began to achieve the status of a confirmed physical theory. Matter was viewed as discrete, as "quantized" in the form of atomic or molecular particles with distinct electrical and mechanical properties.

To accept the view that matter was quantized entailed abandoning the continuum field models of heat and electricity. By the end of the nineteenth century, heat was being considered as associated with the energy of random thermal motion of discrete atomic or molecular bodies, and the total thermal energy of a body was considered to be the sum of individual discrete parts. These views received strong empirical verification in experiments that revealed that an electrical charge was also "corpuscular" or quantized.

In Atomic Physics, Max Born indicates the problem of the wave-particle duality in the following way:

The ultimate origin of the difficulty lies in the fact (or philosophical principle) that we are compelled to use the words of common language when we wish to describe a phenomenon, not by logical or mathematical analysis, but by a picture appealing to the imagination. Common language has grown by everyday experience and can never surpass these limits. Classical physics has restricted itself to the use of concepts of this kind; by analyzing visible motions it has developed two ways of representing them by elementary processes: viewing particles and waves. There is no other way of giving a pictorial description of motions - we have to apply it even in the region of atomic processes, where classical physics breaks down. Every process can be interpreted

either in terms of corpuscles or in terms of waves, but on the other hand it is beyond our power to produce proof that it is actually corpuscles or waves with which we are dealing, for we cannot simultaneously determine all the other properties which are distinctive of a corpuscle or of a wave, as the case may be. We can therefore say that the wave and corpuscle descriptions are only to be regarded as complementary ways of viewing one and the same objective process, a process which only in definite limiting cases admits of complete pictorial interpretation.¹⁵

Whitehead does not accept the quantum theory entirely,¹⁶ but he is struck by its importance in discussing the problem of a continuous or a discontinuous model of physical reality:

The discontinuities introduced by the quantum theory require revision of physical concepts in order to meet them. In particular ... some theory of discontinuous 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.¹⁷

Whitehead felt that quantum mechanics was unable to give a full explanation of the discontinuous world, for it still remained wedded to "scientific materialism."¹⁸ Whitehead wished to devise a theory that would account for both discontinuity and continuity and yet allow for value and purpose. As Lawrence states:

Whitehead attempts to use the philosophy of organism to provide a foundation on which various conflicting

¹⁵M. Born, Atomic Physics, N.Y.: Hagner Publishing Co., 1962, 7th. edition, p. 99.

¹⁶See Science and the Modern World, chapter VIII.

¹⁷Ibid., p. 135; underlining mine.

¹⁸Ibid., p. 17.

needs of contemporary scientific theory may find common ground. The problem Whitehead faces is one of continuity versus atomicity. Maxwell's equations for electromagnetic phenomena presuppose a set of continuous processes in a medium ... At the same time the planetary theory of the construction of the atom, in a single-minded focus, yields us protons and electrons with 'space' in between.¹⁹

Whitehead takes the meaning of epochal from its Greek root, *Εποχή*, which means arrest. This arrest is applied to durations "as the field of the pattern realised in the actualisation of one of its contained events."²⁰

Whitehead's analogy to a "field of the pattern" is not as powerful as "a vibratory ebb or flow of an underlying energy, or activity."²¹

Accordingly there will be a definite period associated with each element, and within that period the stream-system will sway from one stationary maximum to another stationary maximum - or taking a metaphor from the ocean tides, the system will sway from one high tide to another high tide. This system, forming the primordial element, is nothing at an instant. It requires its whole period in which to manifest itself. In an analogous way, a note of music is nothing at an instant, but it also requires its whole period in which to manifest itself.²²

In this quotation Whitehead focuses our attention on the two major characteristics of the epochal theory of time, namely temporal extensiveness and successiveness.

¹⁹Lawrence, Whitehead's Philosophical Development, p. 294; underlining mine.

²⁰Science and the Modern World, p. 125.

²¹Ibid., p. 35.

²²Ibid.

This temporal extensiveness is without spatial extension. The actual occasion, like the electron, is an indivisible entity but in its functioning it vibrates in a pattern within a period by which it realizes itself. The occasion can be abstracted from the pattern but it is not an entity in itself for it needs the whole pattern, not only to be intelligible, but to exist. The pattern it establishes is a totality, and the occasion is unified with its vibrations just as the electron is unified with its oscillations. "That is to say, the event is a unity, but one in which earlier and later incomplete phases may be distinguished, so that it is said to involve a duration."²³ Now, according to Chappell, the unity of the event or occasion is not extensive.²⁴ What Chappell fails to realize is that the extensiveness of the event or occasion comes from its external relationships to other events, simultaneous with this or that in a causal relationship with other events, or in a relationship of events in a past, present, or future sequence. The internal unity of the event is not non-extensive; it is temporal extensiveness without spatial extension. The extensive character of an event can only come about by endurance.

²³Emmet, Whitehead's Philosophy of Organism, p. 178.

²⁴It is here that Whitehead's theory comes under attack, see V. C. Chappell's article: "Whitehead's Theory of Becoming," Journal of Philosophy, vol. 58, 1961, pp. 516-518. More will be said about Chappell's criticism later in this chapter.

This, for Whitehead, is "a pattern which is exhibited in the prehension of one event is also exhibited in the prehension of its parts ... In other words, the meaning of endurance presupposes a meaning for the lapse of time within the spatio-temporal continuum."²⁵ Time is that in respect to which patterns repeat themselves. Temporal repetition yields the enduring object, a series of events exhibiting a certain kind of unity. Spatial repetition would yield multiplicity.²⁶

An illustration of Whitehead's meaning of endurance is found in music. The pattern of a musical score is exhibited in the unity of a piece, which is in turn exhibited in the interrelationship of the notes. No one note is the musical score for only the relationship of the notes to each other gives rise to the score. This is what is meant by endurance. Each note is discrete but its extension is only perceived in the whole pattern.

Time is also free from the spatial extension found in the spatio-temporal continuum. In other words, time can be differentiated, to some degree, from space.²⁷ This is an interesting move for one of the cardinal principles of the theory of relativity is the intrinsic unity of space and time.

It is in this endurance of pattern that time differentiates itself from space. The pattern is spatially now; and

²⁵Science and the Modern World, p. 120; underlining mine.

²⁶Ibid., pp. 119-120.

²⁷Ibid.; p. 125.

this temporal determination constitutes its relation to each partial event ... Enduring objects are significant of a differentiation of space from time in respect to the patterns ingredient with events; and conversely the differentiation of space from time in the patterns ingredient within events expresses the patience of the community of events for enduring objects.²⁸

Having noted this difference Whitehead speaks of time separated from extension. Now Whitehead is not claiming that time is instantaneous or lacks relations, as Chappell assumes.²⁹ He is merely freeing time from the shackles of spatial extension.

The second major characteristic of becoming is successiveness: "Time is sheer succession of epochal durations."³⁰ An example of successive time is:

... it (electron) appears at a series of discrete positions in space which it occupies for successive durations of time. It is as though an automobile, moving at the average rate of thirty miles an hour along a road, did not transverse the road continuously; but appeared successively at the successive milestones, remaining for two minutes at each milestone.³¹

Or to use an example which is even more familiar, an individual who is watching a motion picture perceives continuous motion when in reality the picture is a movement of discrete frames. The successiveness is there, only it is

²⁸Ibid., p. 119.

²⁹Chappell, "Whitehead's Theory of Becoming." A similar point to mine is also made by D.A. Sipfile, in his article countering Chappell's; "On the Intelligibility of the Epochal Theory of Time," The Monist, vol. 53, no. 3, 1969, pp. 505-51.

³⁰Science and the Modern World, p. 125.

³¹Ibid., p. 34.

transformed into continuity by our act of perception. In his chapter on "The Quantum Theory," Whitehead writes:

... the continuity of the complex of events arises from the realization in a subject-event of a pattern which requires for its display that the whole of a duration be spatialized (i.e. arrested), as given by its aspects in the event.³²

Thus the epochal theory of time is wedded with the data of quantum mechanics and is seen to imply discreteness and successiveness.

In his first philosophical period, Whitehead tried to explain nature without reference to the act of cognition. This empiricism failed when Whitehead attempted to explain the nature of time. This compelled Whitehead to revise his philosophical approach³³ and to incorporate the cognitive level in his explanation of the philosophy of time. This he did by introducing supersession and prehension.

Now in his early period Whitehead did not claim that all events are atomic:

His (Whitehead's) acceptance of uniform objects proves this. He admits that an object can be 'uniform'; that is, capable of exhibition without regard to the extension of the event in which it is situated. Such an event is capable of infinite subdivision into smaller events like itself through which it must become. Clearly, in these passages Whitehead does not recognize the difficulty of an infinite regress of becoming, ...³⁴

³²Ibid., p. 135.

³³Lawrence in Whitehead's Philosophical Development disagrees with this observation for he states: "The theory of time as given in the early period is repeated, without a noticeable advance, in the transition period (1925-1928)." p: 300.

³⁴Hammerschmidt, Whitehead's Philosophy of Time, p. 26.

Without the notion of atomic events Whitehead cannot adequately argue for succession, and he has great difficulties defending his position against infinite regress. The epochal theory was intended to avoid this difficulty.

A second function of the epochal theory of time was to recover time as an explanatory principle of reality. Because of the principle of simple location, the notion of time was hollow; but by developing a philosophy of time which avoided the fallacy of misplaced concreteness and structured time around the fundamental principle of nature, the actual occasion, Whitehead made time a major principle of interpretation. As we have seen, the epochal theory also integrated the notions of prehension and actual occasion. Finally, the philosophy of time allowed Whitehead to show the relationship between creativity and process. In Religion in the Making, he emphasizes these relationships:

The epochal occasion has two sides. On one side it is a mode of creativity bringing together the universe. This side is the occasion as the cause of itself, its own creative act ... on the other side the occasion is the creature. This creature is that one emergent fact ... But there are not two actual entities, the creativity and the creature. There is only one entity which is the self-creating creature.³⁵

35A. Whitehead, Religion in the Making, pp. 88-89. Whitehead defined the "epochal occasion" as follows: "The actual temporal world can be analyzed into a multiplicity of occasions of actualization. These are the primary actual units of which the temporal world is composed. Call each such occasion as 'epochal occasion.'" Ibid., p. 86.

These epochal occasions are not prone to the danger of the infinite regress, for they are unified by "self-enjoyment:"

Thus there is also a continuity in time ... This continuity is an instance of the potentiality which is an essential element in the actual world. The epochs in the past are what they have been. But if we abstract from the realized self-enjoyment which is the individual residuum of each epochal occasion, that occasion, considered with the abstractions of physics, might have been subdivided into epochal occasions which together complete that one occasion ... Thus there is no continuity of becoming, but there is a becoming of continuity.³⁶

In Science and the Modern World, Whitehead first developed his theory of becoming and fluctuated between the physical and the non-physical world, claiming atomism in both, to avoid infinite regress. Now is creativity atomistic? What is the relationship between events and creativity? Or again, how does creativity relate to temporality? These questions are important and interdependent, and the answers given account for some of the confusion of the epochal theory as it is presented in Science and the Modern World. Whitehead claims that creativity is not atomic. But if creativity is not atomic, then it can be continuous and thus susceptible to an infinite regress. This, of course, Whitehead wishes to avoid. As Hammerschmidt says:

In this context of creativity, events, and patterns, the problem of becoming concerns the manner in which creativity fits into the temporal continuum without yielding an infinite regress ... There appear to be only four alternatives, either creativity is prior in time to its product, the event, or it is in the same

³⁶"Time," p. 64; underlining mine.

duration with it - that is, simultaneous with it, or it is not in time but generates time in successive and contiguous epochal intervals, or it is unreal.³⁷

Hammerschmidt claims that all these alternatives are unacceptable and that the arguments are not entirely satisfactory. The only move that is left is the one taken in Religion in the Making and "Time." For after completing Science and the Modern World, Whitehead seems to have realized the incompatibility between creativity and becoming. In Religion in the Making, he integrates the event and creativity, and creativity becomes an aspect of a creature in time. In "Time" the infinite regress is avoided by unification of the occasion through "self-enjoyment." This allows Whitehead to claim: "the creativity whereby the actual world has its character of temporal passage to novelty."³⁸

Hammerschmidt is correct when he claims that while no solution is found to the problem of becoming in Science and the Modern World, we find an indication of the direction Whitehead will later take.³⁹

The duration is that which is required for the realization of a pattern in the given event. Thus the divisibility and extensiveness is within the given duration. The epochal duration is not realized via its successive divisible parts, but is given with its parts.⁴⁰

³⁷Hammerschmidt, Whitehead's Philosophy of Time, p. 27.

³⁸Religion in the Making, p. 85.

³⁹Hammerschmidt, Whitehead's Philosophy of Time, p. 28.

⁴⁰Science and the Modern World, p. 125.

Given this direction, Whitehead can make statements in "Time" to the effect that there is no continuity of becoming, but that there is a becoming of continuity.⁴¹ This is achieved by the unity of the occasion and the divisibility given within its parts. Thus in Religion in the Making and in "Time," Whitehead is able to relate time and creativity.

Whitehead's theory of becoming or epochal time leaves a number of issues unresolved. Some of these issues Whitehead fails to address, while others are due to the incoherence of his writings.

When Whitehead claims that time is "sheer succession of epochal duration"⁴² and that natural process requires a "duration involving a definite lapse of time, and not merely an instantaneous moment,"⁴³ he is failing to address the question of becoming and existence. What temporal explanation can be given for the coming into being of something?

Whitehead should have dealt with this question, but he avoids it in this period of his philosophical development. His theory will not allow him to accept the answers offered by such philosophers as Plato, Newton, Aquinas, or Aristotle. Plato seems to have maintained an explanation of the "sudden," which is

⁴¹"Time," p. 64; see also quote of footnote 36.

⁴²Science and the Modern World; p. 125.

⁴³Ibid., p. 124.

outside of time.⁴⁴ Whitehead cannot accept this move due to the need for a temporal framework for "epochal occasions" and the natural process. Nor does the succession of time allow for temporal holes, as is the case in Plato's theory. Newton's theory of time as instantaneous appears more unacceptable to Whitehead. Newton's position seems to lead to one or two conclusions about the nature of becoming; either two instants are involved, one for the becoming of the thing and one for the existence of the thing with a gap in between or the whole process occurs in an instant. This second alternative is, of course, rejected by Whitehead who does not entertain the notion of the instant. The solutions offered by Aristotle and Aquinas are not more attractive for if they were embraced they would clearly involve a completely different account of time, occasions, and creativity. Hence, Whitehead is left with the problem: Does an apple exist in the blossom of the apple tree? When does day become night and night become day? When does the man become a corpse, and when does the past become the present or the present become the past? These questions are crucial since Whitehead is trying to construct a philosophy of organism which would maintain constant novelty and emergence. If the problems of becoming and existence are not resolved, there appears to be no way of explaining the emergence of a novel event.

⁴⁴Plato maintains this doctrine in the "Parmenides."

The problem has further ramifications, for how can Whitehead proceed to justify his doctrine of causal efficacy? In Symbolism Its Meaning and Effect, he states that the relation of cause and effect is "the conformation of the present with the immediate past."⁴⁵ But how can the past, which no longer exists, cause the present, which does exist? The answer, unfortunately, is not readily available. The past cannot be co-present with the present for they would then be simultaneous, and such a strange doctrine of the past and present cannot be entertained. Whitehead unambiguously rejects the idea that cause and effect are simultaneous in this sense. The doctrine of prehension does not help either since for the past occasion to have prehended the present and thereby cause it, we would be compelled to return to the simultaneity of past and present, for when the past prehends the present, then the present is obviously simultaneous with the past. The converse would avoid the problem of simultaneity but would not be much more successful, for if the present occasion prehends the past as its cause and as its effect, then the present occurred after the past but how the present came to be is in no way explained. This problem will surface again at other points in Whitehead's philosophy, but he does try to address it with the doctrines of causal efficacy and presentational immediacy, which are the subjects of the ensuing chapter.

⁴⁵Symbolism Its Meaning and Effect, p. 46.

CHAPTER X

CAUSAL EFFICACY AND PRESENTATIONAL IMMEDIACY

In the last chapter we have seen how Whitehead considers time to be atomic, discrete, and successive.¹ His epochal theory of time, while adequate to explain becoming, does not really explain time since it fails to account for continuity. Hence, Whitehead was driven to develop his theories of causal efficacy and presentational immediacy.² These views not only help to explain continuity as distinguished and opposed to pure succession but provide a framework for a better understanding of the past, the present, and the future.

In order to deal with continuity, Whitehead advances two modes of perception, presentational immediacy and causal efficacy. While Whitehead maintains the notion of succession, he argues for continuity. Are we involved here

¹Time or becoming "is not another continuous process but is atomic succession," Science and the Modern World, p. 126. See also "Time," p. 64.

²It should be noted that Chappell is attacking Whitehead's epochal theory of time because it is discontinuous and Chappell fails to mention or even consider these two modes of perception. If he had, I believe he would have realized how Whitehead was able to keep atomic time and still account for continuity.

in a flagrant contradiction?³ No, for when Whitehead deals with the atomic aspect of time, he refers to what for him is the rock bottom element of things, the actual occasion, which is discrete, unique, indivisible, and one. When he deals with continuity, however, he refers to the relationships between actual occasions, and these relationships can be successive as well as continuous. An actual occasion does not exist in isolation for it needs to form a nexus,⁴ and one way that nexūs are formed is by prehension. Prehension, as we have already seen,⁵ involves an interpenetration of one occasion by another. Hence, it is possible to claim that time is in one sense continuous and in another sense discontinuous as long as we are careful to separate and to distinguish various aspects of time.

The context in which Whitehead presents his theories of presentational immediacy and causal efficacy is the general problem of perception, in particular, the problem of the meaning of symbolism and its effect on the human mind and nature. Whitehead investigates this problem with an eye to the philosophies of David Hume and Immanuel Kant.

³Lee finds the doctrine of discontinuity in the epochal theory of time incompatible with the doctrine of continuity in the theory of causal efficacy. See H. Lee, "Causal Efficacy and Continuity," Tulane Studies in Philosophy, vol. X, The Hague: Martinus Nijhoff, 1961, p. 63. This author will attempt to demonstrate that the epochal theory and causal efficacy are compatible.

⁴See Chapter on Actual Occasions.

⁵See Chapter on Prehension.

The empiricists believed that what was presented to the mind was something simple, whether it be impressions or sense-perception.⁶ Whitehead found the empiricists' view naive, for the verified data presented to consciousness is to be found in presentational immediacy, which is:

... our immediate perception of the contemporary external world, appearing as an element constitutive of our experience. In this appearance the world discloses itself to be a community of actual things, which are actual in the same sense as we are.⁷

The knowledge provided by this mode of perception is spatial,⁸ relational, and independent,⁹ solid, "vivid, precise, and barren. It is also to a large extent controllable at will."¹⁰ Presentational immediacy is only important to a "few high-grade organisms."¹¹

⁶See D. Hume, An Enquiry Concerning the Human Understanding, Chicago: Britannica, Great Books, vol. 35, pp. 455-457.

⁷Symbolism Its Meaning and Effect, p. 25.

⁸"The main facts about presentational immediacy are: (i) that the sense-data involved depend on the percipient organism and its spatial relations to the perceived organism; (ii) that the contemporary world is exhibited as extended and as a plenum of organisms; (iii) that presentational immediacy is an important factor in the experience of only a few high-grade organisms and that for the others it is embryonic or entirely negligible." Symbolism Its Meaning and Effect, p. 27.

⁹"It (presentational immediacy) expresses how contemporary events are relevant to each other, and yet preserve a mutual independence." Ibid., p. 19; see also p. 16.

¹⁰Ibid., p. 27.

¹¹Ibid.

Presentational immediacy, thus, presents us with immediate knowledge of spatial extension, for when we perceive, for instance a colored wall, we do not perceive a disembodied color or wall but we grasp a spatial extension. Spatial relations are considered a "generic abstraction" provided by the sense-data.¹² Hence, "These qualities are the source of our notions of extensiveness and of perspectivity. In their relatedness they provide a complete scheme of spatial extension."¹³ These qualities are the sense-data of colors, sounds, taste, etc.

The importance of knowing spatially extended things cannot be over-emphasized, for without an awareness of extension any move to incorporate continuity into Whitehead's philosophy of organism is bound to fail. Yet the immediate perception of extension is not in itself satisfactory or sufficient to account for continuity. Whitehead also needs to complement presentational immediacy with another mode of perception which he calls causal efficacy.

Causal efficacy is "nothing else than a way of

¹²"Thus the sense-data, such as colours, etc., or bodily feelings, introduce the extended physical entities into our experience under perspectives provided by this spatial scheme. The spatial relations by themselves are generic abstractions. But the perspectives of the sense-data provided by the spatial relations are the specific relations whereby the external contemporary things are to this extent part of our experience." Ibid., p. 26.

¹³Bright, Whitehead's Philosophy of Physics, p. 15.

thinking about sense-data, given in presentational immediacy."¹⁴ But the "way of thinking" while dependent on presentational immediacy can be distinguished from it. This way involves a distinct relationship of the past reaching out into the present. "Causal efficacy is the hand of the settled past in the formation of the present."¹⁵ This penetration of the past into the present is experienced by all organisms,¹⁶ in contrast to presentational immediacy. Whitehead is not referring to an experience that exists only in the mind of the beholder, for the knowledge acquired through causal efficacy is "analyzable into actual things of the actual world and into abstract attributes ... which express how those other actual things contribute themselves as components to our individual experience."¹⁷

The theory of causal efficacy is Whitehead's answer to Hume's attack on our perception of the relation between actual things and his substitution of the "presupposition of 'simple occurrence.'"¹⁸ As we know, this led Hume to the

¹⁴Symbolism Its Meaning and Effect, p. 47.

¹⁵Ibid., p. 59.

¹⁶"... all organisms have experience of causal efficacy whereby their functioning is conditioned by their environment." Ibid., p. 15.

¹⁷Ibid., p. 20.

¹⁸Ibid., p. 45.

theory that time is pure succession,¹⁹ an assumption according to Whitehead that is also embraced by Kant.²⁰ Whitehead, on the other hand, believes that if time is pure succession and if things simply happen then we are faced once again with the doctrine of simple location.

Bright sees the thrust of Whitehead's critique of Hume as follows:

Whitehead begins his discussion of causal efficacy with a criticism of Hume ... Presentational immediacy ... is only a part of our total sense experience, but it is so much the more obvious and vivid part that Hume could mistake it for the whole. Hence he denied any genuine causal connection between things, since such a connection cannot be justified when you consider sense-data alone. For Whitehead this was an example of philosophy's failing in its task of showing that an abstraction is an abstraction, or of drawing attention to the elements which have been overlooked. Instead of allowing that we have a direct perception of causal efficacy prior to reflection on our experience, both Hume and Kant considered causal efficacy to be importation into the data of a way of thinking about those data.²¹

The doctrine of causal efficacy is also important for Whitehead's philosophy of organism since Whitehead "maintains that his cosmology is realistic. He also declares that his philosophical outlook is basically empirical. The perception of causal efficacy is the factor that holds these two things together."²² In other words, "the hands of

¹⁹Ibid., p. 40.

²⁰Ibid., p. 45.

²¹Bright, Whitehead's Philosophy of Physics, pp. 15-16.

²²Lee, "Causal Efficacy and Continuity in Whitehead's Philosophy," p. 59.

causal efficacy arise from without us."²³

In order to understand Whitehead's understanding of the relationship between past and present, we must consider for a moment his category of incompleteness.²⁴

Physical memory is another exemplification of the category of incompleteness. In occasion B there is a physical memory of each antecedent occasion, such as A. Since A is antecedent, B prehends A into itself as contributing a measure of determinate completion ... Thus physical memory is causation ...²⁵

Hence, Whitehead sees physical memory as causation but his understanding of physical memory is not to be confused with conscious or present memory. For instance, if one has the memory of his fifth birthday right now, it "is not the memory of the image of the past"²⁶ but an image in the present. The physical memory relies on prehension, incompleteness, causation, and objectification. The last of these, objectification, accounts for the immortality of the past occasion,²⁷ and this leads Whitehead to assert the "irreversibility of time." Hence, a past occasion is completed by the prehension of the present occasion, which causes some determination of the present and is objectified into an immortal occasion which

²³Symbolism Its Meaning and Effect, p. 68.

²⁴Incompleteness was touched upon in the chapter on prehension in this section.

²⁵"Time," pp. 61-62.

²⁶Ibid., p. 62.

²⁷Ibid., pp. 61-62.

gives time its irreversible character.

Since the past is to some extent the cause of the present occasion, we must inquire into what way and how it is the cause of this occasion. Whitehead's evidence to demonstrate the causal connection between past and present is perhaps seen more clearly in lower organisms:

A flower turns to the light with much greater certainty than does a human being, and a stone conforms to the conditions set by its external environment with much greater certainty than does a flower. A dog anticipates the conformation of the immediate future to his present activity with the same certainty as a human being. ... But the dog never acts as though the immediate future were irrelevant to the present. ...

Most living creatures, of daytime habits, are more nervous in the dark, in the absence of the familiar sense-data. But according to Hume, it is the very familiarity of the sense-data which is required for causal inference. Thus the sense of unseen effective presences in the dark is the opposite of what should happen.²⁸

Further illustrations could be supplied by the psychologists but the point is that an explanation of the primacy of immediate sensation as presentational immediacy in Whitehead, or "impression" in Hume are barren for explaining the behavior of organisms. As Whitehead says:

In practice we never doubt the fact of the conformation of the present to the immediate past. It belongs to the ultimate texture of experience, with the same evidence as does presentational immediacy. The present fact is

²⁸Symbolism Its Meaning and Effect, pp. 49-51. The reasoning Whitehead is using in the first part of this quotation is the same as when he deals with the past and the present. Here he is claiming that the present influences the future, and if this can be shown, it adds further credence to the argument that the past influences the present.

luminously the outcome from its predecessors, one quarter of a second ago.²⁹

Whitehead seems to be arguing that if one accepts common-sense experiences to validate one type of perception, one cannot reject it to justify another mode of perception, namely causal efficacy.³⁰ Whitehead is really arguing against Hume's understanding of causal efficacy as a "habit of thought." He is also somewhat more indirectly arguing against Kant's advocacy of causal efficacy as a "category of understanding." Whitehead believes that both Kant and Hume naively presuppose that time is purely successive.³¹

...the pure succession (of time) is an abstraction from the irreversible relationship of settled past to derivative present. The notion of pure succession is analogous to the notion of colour. There is no mere colour, but always some particular colour such as red or blue: analogously there is no pure succession, but always some particular relational ground to which the terms succeed each other ... we find that pure succession is an abstraction of the second order, a generic abstraction omitting the temporal character of time ...³²

Note here that Whitehead is not claiming that time is in no

²⁹Ibid., p. 54.

³⁰"Hume and Kant were ... wrong to suppose that causal connections were due to conscious thought on the part of the higher organisms. Causal experience is really extremely primitive, to be found at all levels of nature. They failed to see this because they considered only long-range predictions that do demand complex reasoning for the discovery of remote causes; but if attention is restricted to very short period of time, it is not easy to deny that all present fact is 'luminously the outcome' of the situations a fraction of a second before and this is equally true for plants, animals and men." Bright, Whitehead's Philosophy of Physics, pp. 17-18.

³¹Symbolism Its Meaning and Effect, pp. 50 and 45.

³²Ibid., pp. 41-42.

way successive but merely that time cannot be characterized as purely successive. Occasions or events are successive one upon another.³³ "Time in the concrete is the conformation of state to state."³⁴ To abstract merely the successive aspect and to forget about the acts of experience is a failure to understand the real nature of time. Time has a successive characteristic but the past successive moments "establish the conditions to which that act must conform"³⁵ in the present.

Hence the continuity of time is not denied by the theories of presentational immediacy and causal efficacy. Whitehead is struggling to develop a "becoming of continuity." His notion of continuity, however, with respect to time, is still in an embryonic stage and is incomplete. The continuity of time is fulfilled in the potentiality of the past occasion completing the present occasion through causal efficacy. Or in the case of the future, it is the anticipation of the present occasion towards the future. Thus Whitehead's theory of prehension and supersession allows for this type of continuity. The emphasis here is on the potentiality and

³³It is interesting to note that while Lee in his article, "Causal Efficacy and Continuity in Whitehead's Philosophy," presents Whitehead's disclaimer against time as pure succession, he fails to note that Whitehead does describe time as successive but not pure succession. This could, in part, explain Lee's confusion about Whitehead's meaning of time.

³⁴Symbolism Its Meaning and Effect, p. 41.

³⁵Ibid., p. 42.

then the realization through prehension, supersession, and causal efficacy.

Whitehead's doctrine is unusual to say the least for he is attempting to blend succession and continuity. The occasions concerned are fundamentally successive in their relationships to other occasions, since even when there is a conformation of the past in the present each occasion is still discrete and, in point of fact, the past is objectified and made immortal, thereby distinguishing it from the present. The stress on potentiality is also unusual for the potentiality of one occasion to conform to another occasion might not arise thereby leaving each occasion successive.

The difficulties with this theory are numerous. The first obvious one is whether there is any real continuity or merely the appearance of continuity. If the continuity is merely apparent, Whitehead would be compelled to transform the very basis of his theories of prehension, causal efficacy, and supersession. Whitehead would probably have none of this. But, if the answer is that continuity is genuine and real, then Whitehead should articulate more fully what is meant by succession, and should address himself to the problem of an extended continuum.

It is obvious that for Whitehead each occasion is discrete by itself but can also become part of a new occasion,

either by being subsumed totally or in part. The new occasion is totally integrated, indivisible, and discrete, and from a linear perspective, is successive to the other occasion, but in a developing sense it is discontinuous. Whitehead will clearly have to offer a new definition of succession just as he attempted to develop a new understanding of continuity. Unfortunately, Whitehead does not make this move. He does not consider the problem of the extended continuum, and he does not do so until the development of his theory of extensive connection in Process and Reality.

A second major problem with Whitehead's theory of continuity is his failure to explain how it can be recognized as such. Finally, the language that Whitehead employs during this period leads to confusion as to what is being said.

Before leaving this chapter an understanding of what Whitehead means by the future is in order, since we have already seen his meaning of past and present. The future is treated by Whitehead in a similar fashion as the past, only the reverse. Instead of the present being a completion as in the case of its relationship to the past, the present with respect to the future is incomplete and needs to be superseded.

The incompleteness of an actual occasion A means that A prehends in its concretion objectification of occasions

X, Y, Z ... which must supersede A but, as in A, have not the actuality or determinate concretions. Thus the objectification of its own supersession belongs to the real essence of A. A calendar of next year, and a railway time-table, render this truth ... Thus the category of incompleteness means that every occasion holds in itself its own future...³⁶

Hammerschmidt, in commenting on Whitehead's meaning of the future, observes correctly:

... the development of the future of an actual occasion M is the becoming complete of M itself, for part of the essence of M is M's future.³⁷

Thus the doctrine of presentational immediacy and causal efficacy provide us with the direction for formulating a principle of continuity which accounts for succession and allows us to formulate an understanding of past, present, and future. This direction is developed further in Process and Reality (1929).

³⁶"Time," p. 61.

³⁷Hammerschmidt, Whitehead's Philosophy of Time, p. 84.

CHAPTER XI

CONCLUSION

As is readily apparent, this dissertation has supported the acceptance of the following argument.. Premise one: The lack of a definite philosophy of time explains why Whitehead had to abandon his initial philosophy of nature (found in the writings from 1915 to 1925). Premise two: The writings from 1925 to 1929 mark a transition in Whitehead's thoughts in which the epochal theory of time revealed the need for and the direction of his metaphysics (found in the writings from 1929 to 1947). Conclusion: Whitehead's struggle with the perceptions, concepts, and problems of time had a significant impact on and gave direction to his philosophical development.

In providing support for the argument, chapters two through five provided the proof for premise one. Chapter two explained Whitehead's major hypotheses during this period (1919-1925). They were: (a) To develop a philosophy of nature which is closed to mind; and (b) To develop a philosophy of nature which is based on the connectiveness and the inter-relationship of the fundamental entities in nature, events.

By hypothesis (a) Whitehead means that mind does not make any important contributions to the content of nature. To do otherwise Whitehead calls the "bifurcation of nature." Hypothesis (b) is intended as a replacement to the atomistic and disconnected view of reality presented in classical mechanics and latent in relativity.

Chapter three demonstrated how classical mechanics and relativity bifurcate nature and lead to a disconnected account of reality. Whitehead attacked the claimed experiential reality of the instant, which is so necessary to both of these theories. He showed that the instant is non-experiential and abstract. In addition, chapter three provided us with some of the properties of time which Whitehead accepted. This occurred inferentially from his attacks on the other theories. The characteristics of time which Whitehead held are: time is part of nature; it is dynamic; it is in union with space but not identical to space; it involves the transition of events and their relationships; it is one directional; it is not a product of our measuring systems; it is continuous; and there is real simultaneity.

In chapters four and five I have shown that Whitehead's attempt to develop a philosophy of nature anchored in his two hypotheses failed because he could not explain time without mind. The method of extensive abstraction dealt with in chapter four is a further attempt by Whitehead to avoid

the bifurcation of nature and to incorporate the practical utility of the point and the instant into his philosophy. While the method of extensive abstraction incorporates the utility of the point and the instant into his philosophy, it also opened nature to mind. The bifurcation of nature occurred because the method of extensive abstraction required the idea of temporal unlimitedness. Yet sense-perception only reveals finite regions of durations. There is no sense-perception of temporal unlimitedness. Without the sense-perception of temporal unlimitedness, it can only be accounted for by mind. Thus Whitehead contradicts his hypothesis by bifurcating nature.

The measurement of time and the temporal modes, (the past, the present, and the future) dealt with in chapter five provided further evidence of the collapse of Whitehead's hypotheses. Whitehead's approach to the congruence of time is to base temporal measurement on the passage of nature. This approach seems consistent with his hypotheses. However, two serious difficulties emerge. First, he must depend on memory to account for the past passage of nature. The second difficulty rests on the distinction between the meaning of the passage of nature and the passage of thought. The introduction of memory is a problem because Whitehead's account of memory is brief and fails to account for sense-perception. Indeed, there is a great deal of evidence to support the claim that

memory is a subjective operation of the mind. This claim and evidence coupled with Whitehead's failure to account for memory in terms of sense-perception make the explanation of nature open to mind. The problem of distinguishing between the passage of nature and the passage of thought is troublesome because Whitehead's position is not very distinct. He seems to be arguing that there is a distinction. Yet, if he excludes the passage of thought from the passage of nature, then there is a radical dualism between mind and nature. The result is the dualism that he is trying to overcome, and his interconnected philosophy is doomed. If Whitehead accepts the passage of thought as part of the passage of nature, which he seems to do, there are two problems. First, the temporal passage of thought is quite distinct from the temporal passage of nature in that the passage of thought is without any spatial extension while the passage of nature involves spatial extension. He cannot account for the complete absence of spatial extension in the temporal passage of thought. Secondly, the temporal awareness of thoughts (images, ideas and concepts) seems to be quite different from our perceptions in nature. In our daydreams we can experience the unlimitedness of time, and yet the natural passage is very finite. In dreams the mental perception of days occurs in seconds. When one is bored, the psychological perception is different from when one is enjoying oneself. Our temporal perceptions when dealing with the passage of thought mark them as part of mind not nature.

Thus to put the passage of thought into the passage of nature results in the bifurcation of nature.

Whitehead's analysis of the past, the present, and the future also indicated the bifurcation of nature within his philosophy. Having rejected the possibility of an instantaneous present, Whitehead describes the present in terms reminiscent of Bergson: "The present is a wavering breadth of boundary between the two extremes."¹ While poetically satisfying, this statement's content is unconvincing.

The extremes referred to are the past and the future. Each present is individual for each of us. The present, in one respect, is the whole life of an organism with the past being a sub-set of the present when the mind chooses. If this is true, then the present is highly subjective and dependent upon the mind. The result is a bifurcating of nature. Whitehead's description of the future as "anticipation" also brings in mind because it requires recognition of the present and the desire or feeling for either the continuance of the phenomena or a change. Either way nature becomes open to mind. To account for the temporal modes Whitehead must and does make mind a partner in our understanding of nature.

The overall result in this period is that Whitehead failed to account for time within the confines of the limits of nature closed to mind. This results in Whitehead's abandon-

¹The Concept of Nature, p. 69.

ment of the criterion of bifurcation of nature and necessitates the development of a metaphysical philosophy that accounts for both nature and mind. To study Whitehead's metaphysical roots we examined the writings from 1925 to 1929.

Premise two is that the writings from 1925 to 1929 mark a transition in Whitehead's thoughts in which the epochal theory of time reveals the need for and the direction of his metaphysics. Chapters six through ten provided the proof for premise two. Chapter six contained Whitehead's major hypothesis during this period. This hypothesis is to integrate the logico-mathematical position presented in the Principia Mathematica with the aesthetic and poetic intuitions, so beautifully represented in the poetry of Wordsworth and the other Romantic poets. Chapter six also showed how Whitehead expanded the meaning of his concrete entities, the actual occasion or event, to include the mental pole along with the physical pole. In addition, the chapter shows how the actual occasions need a temporal matrix to allow for the interconnection of the atomic occasions. As I have shown, Whitehead's emphasis on the atomic nature of the actual occasion is not an abandonment of his criticism of materialistic atomism. Instead he is offering a new relational philosophy of qualitative atomism based on the epochal theory of time (chapter nine) and prehension of occasions (chapter eight) that replaces the discrete atomisms of materialism.

The rejection of the materialistic atomism is only one of the important aspects contained in chapter seven, the denial of simple location. As I have shown, this chapter is crucial for an understanding of Whitehead's philosophy during this 1925-1929 period because he demonstrates the need for an alternative relational philosophy, of which the epochal theory of time (chapter nine) and prehension (chapter eight) are the focus. In addition, this chapter shows how Whitehead maintains and sharpens his criticism of Newton, Einstein and Kant, which was developed in the earlier 1915 to 1925 period, without the constraints of "bifurcation of nature." The denial of simple location effectively criticizes the concept of the instant and the definition of time in terms of pure succession. This chapter also demonstrates that induction is a viable source of knowledge by showing that the doctrine of simple location destroys induction, thus preserving sense-perception as a legitimate source for philosophical investigation. While this chapter is effective in its criticism, Whitehead must still develop a relational philosophy. He does this by accounting for the interconnection of atomic occasions by prehensive unity.

It is by prehension (chapter eight) and the epochal theory of time (chapter nine) that Whitehead hoped to verify his hypothesis. Prehension reveals Whitehead's attempt to provide a method and a process by which atomic occasions become unified. As I have shown, prehension is a direct result of the denial of simple location. Whitehead's presentation of

prehension is obfuscated by his terminology. However, I have shown that it is also incomplete due to the lack of a philosophy of time to provide the temporal matrix for the unity of occasions. Whitehead's philosophy of time which is his analysis of the dynamics of becoming is the subject matter of the next chapter, the epochal theory of time and is intended to provide the temporal matrix for prehension.

The doctrine of prehension and the denial of simple location point the way for Whitehead's epochal theory of time, which is the substance of his relational philosophy. Not only does the epochal theory of time represent Whitehead's alternative relational philosophy, but it also demonstrates the major difficulties in Whitehead's philosophy of time during this period. The epochal theory of time is the foundation of Whitehead's theory of becoming. How one occasion ceases to be, or how an occasion comes to be, or how occasions come to be unified with other occasions are crucial questions for any relational philosophy. Indeed, Whitehead should be applauded for addressing these issues because he is one of only a few philosophers who have dealt directly with these questions.

The striking aspect of the epochal theory of time is its advocacy of discontinuity, in contrast to the continuity argued for in the first period of writings (1915-1925). Time is the "sheer succession of epochal durations," and that natural process requires a "duration involving a definite lapse of

time, and not merely an instantaneous moment."² As I have shown, it was the problem of explaining the process of becoming in terms of continuity and Whitehead's claim that occasions are unique and novel that forced a discontinuous mode of explanation. The continuum theories of Aristotle, Aquinas, Maxwell, and Einstein all lead to an infinite regress in accounting for becoming. The continuum theory is so dependent upon the interpenetration of occasions that the uniqueness of an entity is explained in terms of the entity and the penetrating entities, and not in terms of the uniqueness and novelty of the entity itself. To avoid these aspects of continuity, Whitehead claims that the process of becoming is discontinuous. This claim is not an abandonment of the interconnectedness of reality but a means for preserving the identity of the occasion and the process of becoming within a relational philosophy. The theory Whitehead uses to account for discontinuity is modeled after quantum mechanics. Whitehead's epochs of duration are not instants but fields, patterns or "a vibratory ebb and flow of an underlying energy, or activity."³ Quantum mechanics explains the pattern in terms of electrons and other sub-atomic entities. Whitehead explains the pattern in terms of occasions and adds the quality of endurance, by which he means the repetition of the patterns

²Science and the Modern World, p. 125.

³Ibid., p. 35.

of successive occasions. Thus time is the succession of these patterns or epochs in duration. The theory preserves the uniqueness of occasions and places time as an essential ingredient in reality, but it failed to explain becoming. It merely described it, and it failed to explain the interconnectiveness in reality and our perception of continuity. The failure to account for the becoming of occasions is significant because Whitehead was presenting a theory of becoming. His theory does not account for the situation when a human being ceases to be a human being and becomes a corpse. What the epochal theory of time does do is reveal the necessity for a metaphysics of becoming, a metaphysics which Whitehead does develop in Process and Reality. This verifies part of premise two that the epochal theory of time provides the direction to his metaphysics. The problem of interconnectiveness is very serious. Whitehead's hypothesis is to provide a philosophy that is integrated, yet the epochal theory of time only provides the appearance of interconnectiveness and not its reality. The interconnectiveness that emerges from the epochal theory of time is similar to what occurs when one watches a movie. The picture on the screen appears continuous and interconnected, but in reality, the picture is a movement of successive discrete frames. The continuity is imposed by either the process or by the mind. Neither answer is satisfactory for preserving the real interconnectiveness because Whitehead

does not have a process in which to anchor the successiveness. The appeal to mind is completely unsatisfactory because the sense-perception of continuity becomes an illusion. The result is that once again Whitehead must develop an answer within the context of a full-fledged metaphysics. He does and this is part of the verification of premise two. A further ramification of the problem of continuity is the relationship between the past and the present. The epochal theory of time fails to explain when the present becomes the past. Thus the problems of continuity versus discontinuity remain unresolved in the epochal theory of time though Whitehead tries to resolve some of these problems with his notions of causal efficacy and presentational immediacy (chapter ten).

Causal efficacy and presentational immediacy failed to resolve the problems of continuity but they do provide the direction that Whitehead will use in his metaphysics. This direction is that the continuity of time is fulfilled in the potentiality of the past occasion through causal efficacy; or in the case of the future, it is the anticipation of the present occasion towards the future. Thus the theory of prehension and the epochal theory of time will be wedded to a view of potentiality. Potentiality plus modifications in prehension and the epochal theory of time are presented in Process and Reality (1929) and will help to resolve this problem. Thus the failure is one of degrees and must wait for its resolution within the context of a metaphysics. This problem also demon-

strates the validity of premise two.

The result of this dissertation is the conclusion that Whitehead's struggle with the perceptions, concepts, and problems of time had a significant impact on and gave direction to his philosophical development.

This dissertation demonstrated the importance of time in the development of Whitehead's philosophy. In addition, the dissertation revealed that Whitehead's philosophy of time was distinctly different from the two major views of time, notably the mathematical view and the Bergsonian view. It is my contention that Whitehead's philosophy of time is a viable alternative to the other philosophies of time; in part because Whitehead's view is a synthesis of the two major views, and in part because his philosophy can explain aspects of time that the other views cannot.

Whitehead's philosophy of time is a synthesis of the two major theories in the following ways. In contrast to the mathematical account, Whitehead has shown that time is more than a quantitative term. Indeed, he has shown that time is qualitative and part of the very fabric of reality itself. For Whitehead the meaning and process of time is not spatially oriented; nor is time to be wedded to a particular measuring system based on the utility of the time measurement, as the physicists seem to claim. In contrast to Bergson's views of time, Whitehead has demonstrated that many of the rational, conceptual and scientific statements on time can be part of a

philosophy based on process, creativity, and novelty.

Whitehead's philosophy of time can also account for temporal phenomena and experiences that the mathematical account cannot. This point is crucial to a demonstration of the viability of Whitehead's time in contrast to the mathematical notion of time. Thus I will detail those experiences and accounts that the mathematical theory cannot explain but Whitehead can. These are: the psychological perceptions of time (both subjective and objective); the temporal perceptions of animals; the cross-cultural accounts of time; and the becoming and ceasing to be of an entity.

Our psychological perceptions of time are indeed important. The diverse usages of time in our language systems and the fact that the history of Western thought is replete with as many concepts of time as there are great thinkers, who have dealt with time, are negative aspects of the importance of the psychological perception of time. However, there are numerous positive approaches. Psychologists, such as Piaget,⁴ in their studies on children's perception of time, present strong and convincing arguments that children perceive and experience "lived time," and that they learn the precepts of mathematical time. The perception of lived time is demonstrated

⁴J. Piaget, Le Developpement de la notion de temps chez l'enfant, Paris: Presses Universitaires de France, 1946. See also J. Piaget, Traite de Psychologie Experimentale, vol. 1, Paris: Presses Universitaires de France, 1963, pp. 148-149.

by the child's experiences of waiting shorter or longer periods for the fulfillment of their desires. This is seen even in an infant's impatience for a bottle when it is hungry as opposed to the infant's behavior when it is contented. The measured time is the same but the child's behavior reveals that it is taking too long. Adults experience and evidence similar phenomenal behavior. We all experience the phenomena of an enjoyable weekend which passes too quickly while a boring or anxious experience passes very slowly. We also experience the unlimitedness of time in daydreams, or dreams which can cover hours, days, weeks or years in only a few measured minutes on our clocks. Piaget has shown that our conceptual perceptions of time are bound to a developmental process which indicates that our perceptions of time vary according to the physical and psychological development of the individual. The mathematical account cannot explain "lived time." Yet if the mathematicians deny it, then they are rejecting at least one very important aspect of time. Indeed, if the song writer of "Young at Heart" is correct, you are as young as you feel. Because time is an integral part of the process of nature Whitehead can account for "lived time."

The psychological perception of time also reveals the "physically" impossible perception of timelessness. This perception was studied by Jung⁵ and experienced, according to

⁵C. Jung, "Introduction," The Tibetan Book of the Great Liberation, by W.Y. Evans-Wentz, Oxford: Oxford University Press, 1954, see pp. xlvi, lix.

the claimed reports, of mystics such as John of the Cross. In these cases the mathematical account of time is meaningless. Yet an empiricist or metaphysician must account for this phenomenon or call them lies.

The temporal perception of animals is also revealing. There is no empirical evidence that animals quantitatively measure time. Yet there is evidence of temporal perception in animals. This perception seems to be based on the rhythm or process of nature in accordance with the biological rhythm of the individual organism. Indeed, it appears that some animals' temporal perceptions are unrelated to environmental impact. According to Willowby,⁶ barn owls which have been subjected to abnormal patterns of light and darkness do not return to their original patterns at the conclusion of the experimental period. While not conclusive, the inference Willowby drew was that while the owls usually respond to the environmental stimulus (lightness and darkness), there are also individual rhythms that appear to be environmentally unrelated. The conclusion is that animals experience time. The mathematical perception of time cannot account for this.

The mathematical account of time seems to be a peculiarly European concept. The Indians have a static

⁶Ernest Willowby, unpublished research on barn owls.

notion of time; the Australian aborigines hold time to be timeless; the Sioux viewed time as a being; the Japanese view time as a process, a process in nature; and the Chinese view time as a real phenomena involving the feeling of continuous durations. These views on time should not and cannot be dismissed. They must and should be accounted for.

Finally the mathematical perception fails to account for time in the process of an entity coming into being and ceasing to be. Both of these processes are real and should be accounted for in terms of time. When does a human being become non-human? At what time does something come into being? These and similar questions are not discussed in the mathematical account of time. If the mathematical account is the only true account then do these other activities occur outside of time?

The extreme alternative theory to the mathematical notion of time is the Bergsonian theory. Bergson's philosophy would have little difficulty with most of the problems discussed above. Indeed, both Piaget and Jung studied and used Bergson's thoughts in their theories. Mao Tse Tung claimed that Bergson expressed his civilization's perceptions on time. But Bergson's philosophy is anti-rational and becomes anti-scientific. Intellect is only good for the practical world. The result is that Bergson fails to understand the creativity,

novelty, and beauty of the mathematical alternative.

The worth of Whitehead's approach is that he is willing to synthesize both extremes and chart a course between them. Indeed, a complete philosophy of time must account for the mathematical account and the psychological account of time. I believe that Whitehead's relational philosophy is a viable and important contribution to our knowledge of time. Also, I believe that time is essential to our understanding of Whitehead's philosophical development.

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THE DEVELOPMENT AND THE IMPACT OF ALFRED NORTH WHITEHEAD'S
PHILOSOPHY OF TIME, 1915 to 1929

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The purpose of this dissertation is to prove the following argument. Premise one is that the lack of a definite philosophy of time explained why Whitehead had to abandon his initial philosophy of nature which is found in the writings from 1919 to 1925. Premise two is that the writings from 1925 to 1929 mark a transition in Whitehead's thoughts in which the epochal theory of time reveals the need for and the direction of his metaphysics, which is found in the writings from 1929 to 1947. The conclusion is that Whitehead's struggle with the perceptions, concepts and problems of time had a significant impact on and gave direction to his philosophical development.

By examining the problems, the tentative solutions, and the process which Whitehead followed in attempting to integrate time into his philosophy, I plan to prove my argument and to show Whitehead's conceptual triumphs, shortcomings, and the necessity for Process and Reality in 1929. To this end, chapters two through five deal with the writings from 1915 to 1925 and are structured to support the truth of the first premise of my argument. This is done by showing that Whitehead's method of extensive abstraction, his congruence of time, and his account of the temporal modes (the past, the present, and the future)

bifurcate nature. Thus Whitehead's original fundamental premise was destroyed, and he was forced to develop a new approach. Chapters six through ten analyze this new approach as presented in the writings from 1925 through 1929 and demonstrate the truth of the second premise of my argument. This is accomplished by showing the necessity for the epochal theory of time, and the problems the theory has without a complete metaphysical system to support it. My conclusion integrates the chapters and premises to provide the proof of my argument and support my contention that Whitehead's philosophy of time offers a viable alternative to today's dominant constructs of time.