A. N. WHITEHEAD'S THEORY OF TIME IN HIS FIRST PHILOSOPHICAL PERIOD: 1919 - 1925

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INTRODUCTION

The aim of this thesis is to investigate Whitehead's philosophy of time in the works which he wrote between 1919 and 1925. These works which belong to what may be called his first philosophical period are: An Enquiry Concerning the Principles of Natural Knowledge, The Concept of Nature, and The Principle of Relativity.[1] Special emphasis will be placed on The Concept of Nature.[2]

The reason for this division of Whitehead's works into periods arises from the different purposes he wished to achieve. In this period Whitehead is mainly concerned with the development of a philosophy of science in which the importance of time is stressed.

It should be kept in mind that philosophy of science for Whitehead should be considered separately from metaphysics and the philosophy of the mind:

> ... any metaphysical interpretation is an illegitimate importation into the philosophy of natural science. By a metaphysical interpretation I mean any discussion

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[1]The works in this first philosophical period complement each other, as Whitehead mentions several times.

[2]The beginning of his second philosophical period is marked by the book, Science and the Modern World (1925).

> of the how (beyond nature) and the why (beyond nature) of thought and sense-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.[3]

In this period Whitehead seeks an empirical understanding of time. But this statement and the above quotation should not be construed as implying that Whitehead is anti-metaphysical; on the contrary, he says, " Science does not diminish the need of metaphysics."[4] What science does is to render "the metaphysical need more urgent."[5] Whitehead discusses the metaphysical issues in his later works;[6] at this stage he is content with showing that such a discussion is imperative. Thus Whitehead avoids in this first period the difficulties and complex problems

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[3]Ibid., p. 28. See Also An Enquiry Concerning the Principles of Natural Knowledge, Cambridge: Cambridge University Press, 1955, the Preface. Further references to this work will be represented by Enquiry.

[4]A. N. Whitehead, The Aims of Education and Other Essays, New York, New York: MacMillan Co., 1959, p. 229. Further references to this work will be represented by Aims of Education.

[5]Ibid., p. 231.

[6]See A. N. Whitehead, Process and Reality, New York, New York: MacMillan Co., 1929 for Whitehead's metaphysics.

of the relations of ideas to the external world.[7]

In this thesis we shall first investigate Whitehead's understanding of nature. This is imperative, for without it one would be unable to understand the significance of time as an attribute of nature. Next, the relationship of space and time to nature will be considered. Thirdly, the perception of time will be discussed in the light of the possible requirements of an a priori judgement. Whitehead's attack on the Kantian concept of time will also be considered. Fourthly, Whitehead's criticism of the instant in the classical (Newtonian) concept of time will be analyzed. Fifthly, Whitehead's method of extensive abstraction, its use for preserving the moment in the physical sciences, will be subject to criticism. Sixthly, Whitehead's departure from the Absolute concept of time and his acceptance of the relativistic concept, along with

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[7]"My argument is that this dragging in of the mind as making additions of its own to the things posited for knowledge by sense-awareness is merely a way of shirking the problem of natural philosophy. That problem is to discuss the relations inter se of things known, abstracted from bare fact that they are known. Natural philosophy should never ask, what is in the mind and what is in nature. To do so is a confusion that it has failed to express those natural relations whose expression is natural philosophy." A. N. Whitehead, The Concept of Nature, Cambridge: Cambridge University Press, 1964, p. 30.

his disagreement with Einstein, will be described. Seventhly, the relationship between motion and time will be investigated. Eigthly, the problem of continuity will be raised. The continuous and discontinuous of Whitehead's time will be discussed. Finally, the influence of Bergson on Whitehead's thoughts will be disclosed.

CHAPTER I

THE MEANING OF NATURE

Before considering Whitehead's notion of nature, the "bifurcation of nature"[1] should be investigated. By bifurcation, Whitehead means the production of two rival accounts of reality.

The bifurcation of nature produces two systems or approaches to reality,[2] thus giving two accounts of what is real.[3] These two realities produce two natures, "one is conjecture and the other real."[4] The awareness of nature is designated a dream. For example, the sky is blue because one sees the sky, and it possesses qualities attributed to the word blue. For some, this reality is a dream. How does one know that the sky as blue is really blue? To prove the blueness of the sky you must go beyond blueness to its cause. The search for a cause is the second system of reality, since it seeks "the nature which is the cause of awareness."[5]

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[1] The Concept of Nature, Chapter II., pp. 26-48. See also Enquiry, Preface.

[2] The Concept of Nature, p. 30.

[3] Ibid.

[4] Ibid.

[5] Ibid., p. 31.

This cause could be conjecture since the rules for confirmation are under attack.[6] How does one confirm the truth or falsity of the cause of appearance?

Now in the first system, that of awareness, man's means of confirming what nature is, is by the authority of the senses only. Awareness "holds within it the greenness of the trees, the song of the birds, the warmth of the sun, the hardness of the chairs, and the feel of velvet."[7] These qualities are not grasped through a theory or model but are presented immediately to the senses. The red glow of a summer sunset is seen, and thus for Whitehead is a part of nature. But the question remains, is our knowledge of nature confined simply to the senses or sense-awareness? Whitehead rejects this approach as the sole interpretation of reality.

The second system, that of the cause of awareness,

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[6]The rules for confirmation of induction have come under criticism by many philosophers and scientists. See W.C. Salmon, The Foundations of Scientific Inference, Pittsburgh: University of Pittsburgh Press, 1966; Also R. Ackerman, Nondeductive Inference, New York City, New York: Dover Publications, 1966.

[7]The Concept of Nature, p. 31.

attacks the first system as unreal.[8] The cause of nature is revealed as "the conjectured system of molecules and electrons which so affects the mind as to produce the awareness of apparent nature."[9] This account to many is the only truly scientific explanation and understanding of reality. For both accounts the fact that a child has blue eyes is acceptable, but for those who pursue the second approach to reality, the cause or explanation, possibly a bio-chemical or genetical one, of why a child has blue eyes is sought.

Whitehead ascribes a special meaning to cause in this bifurcated system:

> Causal nature is the influence on the mind which is the cause of the efflunce of apparent nature from the mind. This concept of causal nature is not to be confused with the distinct conception of one part of nature as being the cause of another part.[10]

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[8] Ibid., p. 27: "There is now reigning in philosophy and in science an apathetic acquiescence in the conclusion that no coherent account can be given of nature as it is disclosed to us in sense-awareness, without dragging in its relations to mind. The modern account of nature is not, as it should be, merely an account of what the mind knows of nature; but is also confused with an account of what nature does to the mind. The result has been disasterous both to science and to philosophy, but chiefly philosophy."

[9] Ibid., p. 31. See also, p. 45: "Another favourite solution, the most attenuated form which bifurcation theory assumes, is to maintain that the molecules and ether of science are purely conceptual. Thus there is but one nature, namely apparent nature, and atoms and ether are merely names for logical terms in conceptual formulae of calculation."

[10] Ibid., p. 31.

When the followers of the second view of nature use the word cause, they necessarily bifurcate nature.

The search for explanations and causes is important, but they must not be considered the sole interpretation of nature.[11] The blue eyes of a child exist, and so do the causes of the blue colour. Possibly the genetical explanation is correct, but two things seem certain, that both the fact and the cause for that fact exist, and a philosophy of nature must account for both.

The hailing of each system's self-importance as the sole interpretation of reality and the rejection of all other approaches produce the bifurcation of nature. It is this exclusiveness that Whitehead rejects:

> For natural philosophy everything perceived is in 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 phenomenon. It is for natural philosophy to analyse how these various elements of nature are connected.[12]

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[11] Ibid., pp. 45-46: "The current answer to these objections is that, though atoms are merely conceptual, yet they are an interesting and picturesque way of something else which is true of nature. But surely if it is something else that you mean, for heavens sake say it. Do away with the elaborate machinery of conceptual nature, which consists of assertions about things which don't exist in order to convey truths about things which do exist. I am maintaining the obvious position that scientific laws; if they are true, are statements about entities which we obtain knowledge of as being in nature; and that if the entities to which these statements refer are not found in nature, the statements about them have no relevance to any purely natural occurrence."

[12] Ibid., p. 29.

What Whitehead desires of natural philosophy is that it should connect the elements of nature and their relations, that it should link perception and its cause.[13]

With this in mind, Whitehead attempts to define nature, in the hope of avoiding the trap of bifurcation. He defines nature as "that which we observe in perception through the senses,"[14] and he further adds: "nature is independent of thought ... I mean ... that we can think about nature without thinking about thought."[15] In this sense, nature is a closed system, and thinking about nature is designated as "homogeneous:"[16]

> There are accordingly two main genera of relations to be distinguished, namely 'homogeneous' relations which relate among themselves natural elements of the same type, and 'heterogeneous' relations which relate natural elements of different types.[17]

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[13] Ibid., p. 46. "The primary task of a philosophy of natural science is to elucidate the concept of nature, considered as one complex fact for knowledge, to exhibit the fundamental entities and the fundamental relations between entities in terms of which all laws of nature have to be stated, and to secure that the entities and relations thus exhibited are adequate for expression of all the relations between entities which occur in nature."

[14] Ibid., p. 3.

[15] Ibid.

[16] Ibid.

[17] Enquiry, p. 60.

He further states that heterogeneous thought is the means by which the scientist considers "nature in conjunction with thought about the fact that nature is thought about."[18] The heterogeneous way of thinking bifurcates nature.

C. D. Broad's reaction to the above statement is that Whitehead has failed to escape the bifurcation which he attacks.[19] Further statements about nature do not help to dispel our first reaction, since what has already been said of nature forces a restriction of the data or confines the realm of the investigation of nature. Thus nature becomes a self-contained or closed entity. Whitehead does not reject this restriction or closure. He says that the 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 the mind, that is, without reference either to sense-awareness or to thought."[20]

A closer examination dispels this impression. First, Whitehead is trying to formulate a philosophy of science which can explain reality as nature without recourse

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[18]The Concept of Nature, pp. 4-5.

[19]C. D. Broad, "Alfred North Whitehead (1861-1947)," Mind, April, vol. 57, 1948, p. 142.

[20]The Concept of Nature, p. 4.

to a metaphysics. Therefore, he welcomes the restriction of the study of nature to sense-perception: "only the object of perceptual knowledge concerns him and the relations of subject qua mental to its objects."[21] Another reason why Whitehead's description does not bifurcate nature is that he does not want to become embroiled in the epistemological controversy which is contained in the formulation: "how do I know what I know?" He accepts without trying to justify the statement that sense-perception is real and does give us an account of nature. To question whether we "really" see red when we perceive red is of no concern here. Nor should we construe from the statement, "nature is without thought," that Whitehead's philosophy of science excludes thought. Only the investigation of what thinking is, the how and the why one thinks, is excluded here. Thus the closure of nature restricts our investigation by making the study of mind unimportant for a philosophy of science.

Nature as revealed through sense-perception is shown to be a "complex of entities," which is brought about by the "diversification of nature." This diversification is a "process of breaking up the subject matter of

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[21]William Hamerschmidt, Whitehead's Philosophy of Time, New York City, New York: Kings Crown Press, 1947, p. 9.

experience into a complex of entities:"[22]

> Our perceptual knowledge of nature consists in the breaking up of a whole which is the subject matter of perceptual experience, or is the given presentation which is experience... . This whole is discriminated as being a complex of related entities, each entity having determinate qualities and relations and being a subject concerning our perceptions, either directly or indirectly, affording definite information.[23]

This diversification is indefinite and depends upon the method of diversification; some of these entities which Whitehead calls attention to are events, percipient objects, sense objects, perceptual objects, and scientific objects.[24] This complex of entities is reducible to change and permanence: "We are aware of nature enduring or - in other words - of the passage of nature."[25] The change revealed in sense-perception is extension, duration, events, and objects as parts of nature. Extension and duration will be dealt with in a subsequent chapter.[26]

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[22] Enquiry, p. 59. See also The Concept of Nature, p. 15.

[23] Enquiry, p. 59.

[24] Ibid., p. 60.

[25] A. N. Whitehead, "Symposium: Time, Space, and Material: Are They, and if so in what Sense the Ultimate Data of Science?" Aristotleian Society, vol. II, supplement, 1919, pp. 44-57. Further references to this work will be represented by Time, Space, and Material. See also The Concept of Nature, pp. 53-54.

[26] See Chapter IV, Whitehead's Concept of Relative Time.

From this endurance of nature, Hamerschmidt concludes that nature can be defined in a spatio-temporal locus:

> The spatio-temporal system of data given in perception exclusive of imagination, ideation, and emotion, including the whole spatio-temporal system of a fact which is connected with our own local space-time region and covering both perceived and unperceived phenomena... .[27]

The permanence of nature is revealed in objects. Now an event occurs "wherever and whenever there is something going on."[28] Whitehead states that an event is "what we discern is the specific character of a place through a period of time."[29] Passage or process is necessary for an event. Thus an event must be extended in a spatio-temporal locus:[30]

> Every event has its own 'substantial unity of being, which is not an abstract derivative from logical construction.' An event is what becomes in nature and can never happen again.[31]

Thus an event is an unique manifestation in nature.

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[27]Hamerschmidt, Op. cit., pp. 101-102.

[28]The Concept of Nature, p. 78.

[29]Ibid., p. 52. Whitehead defines place as the following: "An entity merely known as spatially related to some discerned entity is what we mean by the bare idea of 'place.' The concept of place marks the disclosure in sense-awareness of entities in nature known merely by their spatial relations to discerned entities." The Concept of Nature, p. 51.

[30]Hamerschmidt, Op. cit., p. 10.

[31]Ibid., p. 11.

Yet, while process is necessary, "events never change":[32]

> Nature develops, in the sense that event E becomes 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 other events which were not and which become actual in the creative advance of nature... . Thus we say that events pass but do not change. The passage of an event is its passing into some other event which is not it.[33]

As part of this becoming of nature, an event requires a mutual relationship with other events which surround it. This relationship is one of overlapping; one event contains the other as part:

> Events are the relata of the fundamental homogeneous relation of 'extension.' 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. The externality of nature is the outcome of this extension.[34]

Thus Whitehead will state that events are "the ultimate substance of nature,"[35] and the ultimate fact of sense-awareness.[36] But in order to understand change or an event we must have some fixed point of reference, something which has some permanence. Thus, "sense-awareness also yields

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[32] Enquiry, p. 62.

[33] Ibid.

[34] Ibid., p. 61.

[35] The Concept of Nature, p. 19.

[36] Ibid., p. 15.

to us other factors in nature which are not events. For example, sky-blue is seen as situated in a certain event."[37] Therefore, we must seek an understanding of the notion of an object to help us to understand an event and nature. The "... event is essentially a 'field,' in the sense that without related objects there can be no events."[38]

An object is that aspect of nature which has permanence because it lacks the passage of nature.[39] Lacking the passage of nature, the object by itself is outside a spatio-temporal locus. Objects are those "element(s) in nature which can 'be again.'"[40] Thus the object can give a permanent aspect to some event.[41] The event and the object must have a mutual relationship:

> Returning to the significance of events, we see that there is no such thing as an isolated event. Each event essentially signifies the whole structure. But furthermore, there is no such entity as a bare event. Each event also signifies objects, other than events which are in essential relation to it. In other words the passage of events exhibits objects

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[37] Ibid.

[38] A. N. Whitehead, "The Principle of Relativity," in Northrop and Gross, ed., Alfred North Whitehead: An Anthology, New York City, New York: MacMillan Co., 1966, pp. 297-357.

[39] The Concept of Nature, p. 143.

[40] Ibid., p. 144.

[41] Ibid., p. 143. "An object is an ingredient in the character of some event."

> which do not pass. I have termed the natural factors which are not events but are implicated in events 'objects,' an awareness of an object is what I term recognition. Thus green is an object and so is a blade of grass, and awareness of green or of a blade of grass is recognition. Thus an event signifies objects in mutual relations.[42]

The relationship to be inferred from this passage is not the two-termed logical relationship of an abstract universal and a concrete particular. When the event is characterized as a concrete particular, it changes. The object is characterized as a universal because it lacks change. If we follow this approach of universal and particular, we shall become enmeshed in the ancient problem of the one and the many. This problem can be avoided by refusing to use the two-termed logical relationship. The failure to avoid this type of relationship has also brought about the bifurcation of nature.[43] What is necessary, then, is to see whether this logical relationship exists in nature. If not, then what does nature reveal?

> ... in the apparent world, ... in the world of nature disclosed by sense-awareness, no example of the simple two-termed relationship of a universal signifying its particular is to be found. Green appears to an observer in a situation distinct from that of the observer, but simultaneous with it. Thus there is essential reference to three simultaneous events, the event which is the bodily life of the observer, called the percipient event, and the event which is

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[42] The Principles of Relativity, pp. 313-314.

[43] Ibid., p. 314.

> the so-called situation of green at the time of observation, and to the time of observation which is nothing else than the whole nature at that time. Under the obsession of a logical theory of universals and concrete particulars the percipient event was suppressed, and the relation of green to its situation represented as universal qualifying particular. It was then noted that this relation only holds for the particular observer, and that furthermore account must be taken of contingent circumstances such as the transmission of something, which is not the colour green from an antecedent situation to the percipient event.[44]

Thus nature reveals itself as a patchquilt of interwoven events which are not isolated from other elements nor from objects. Elements are like a magnetical field which has objects situated in it.

Whitehead, therefore, is able to provide a description and definition of nature without bifurcating it. He must go on, however, to discuss problems that are intimately bound with his theory, two of which are time and space.[45] It is to these problems that we now turn.

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[44] Ibid.

[45] The Concept of Nature, p. 31.

CHAPTER II

TIME, SPACE, AND NATURE

The relationship between time, space, and nature is important for Whitehead for the following two reasons: First, the problem of the relativity or absoluteness of time and space must be solved. Those who maintain a bifurcated system of nature, particularly those seeking the cause of awareness, have a tendency to ascribe absolute reality to time and space. Secondly, the problem of the perception of time must be explained. Is time a mental *a priori* as Kant held? Are things perceived *in* time, or *through* time, or *by* time?

In the first chapter of this thesis, Whitehead stated that nature involves a passage or that "nature is a process."[1] It was further shown that this passage of nature must involve time and space, thus establishing a foundation for a relationship between time, space, and nature. A Whiteheadian scholar, A. H. Johnson, broadens this relationship of nature and time by emphasizing duration as part of the 'whole' experience of nature, thus linking

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[1] *The Concept of Nature*, p. 53.

durations with events.

> Whitehead's analysis of our experience of nature indicates to him that our awareness of nature is an awareness of the 'whole' which can be discriminated into parts. The term duration is used in a technical sense to apply to the present totality of nature. The distinguishable parts of a duration are called finite events. Durations are also called events - infinite events. It is Whitehead's claim that events, infinite and finite are the primary physical facts.[2]

By linking events and duration, and by making events "the primary physical facts," Professor Johnson gives nature duration at its core. To better understand this duration, Whitehead defines it as:

> ... 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.[3]

Thus Whitehead claims duration is real because it is

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[2]A. H. Johnson, Whitehead's Theory of Reality, New York City, New York: Dover, 1962, pp. 204-205.

[3]The Concept of Nature, p. 53, (underlining mine). See also: "A duration is 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. 47.

metaphysically described as "a concrete slab of nature." This description gives the reader a pleasant image by which he can claim that he understands duration, but the image does not tell the reader what "concrete" or "slab" means. Whitehead then proceeds to state that sense-awareness posits a present whole of nature which is grasped in a duration. This duration is a natural entity which implies simultaneity.

Whitehead says of simultaneity that it "is an ultimate factor in nature, immediate for sense-awareness."[4] Hamerschmidt interprets Whitehead's simultaneity as "a relation which primarily concerns only events for events are the basic elements generative of space and time. It is the relation between events in virtue which form a duration."[5]

More will be said of duration and simultaneity in further chapters.[6] For now, it is sufficient that these two concepts reveal something about time and space. Duration implies time, and simultaneity implies position and thus space.

A study of Whitehead's attack on absolute time and space will broaden our understanding of what he means by

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[4]The Concept of Nature, p. 56.

[5]Hamerschmidt, Op. cit., p. 52.

[6]See Chapter IV: Whitehead's Concept of Relative Time particularly.

time and space, and how he considers the relationship of time, space, and nature. After revealing the Newtonian position on Absolute time and space, Whitehead's interpretation of Absolute time will be presented

With the advent of Newton, a universal mechanics was formulated which had a limited and special subject matter. The subject matter was time and space. Newton defined space as: "Absolute space, in its own nature, without regard to anything external, remains always similar and unmovable."[7] Of time Newton said: "Absolute, true, and mathematical time, of itself and from its own nature, flows equally without regard to anything external ..."[8]

In discussing the equable flow of Newton's time, Milio Câpek further indicates how this time could flow without a regulator.[9] "Time flows no matter whether something changes or not; in its own nature time is empty and

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[7]Isaac Newton, The Mathematical Principles of Natural Philosophy, tr. A. Motte, F. Cajor, London: Nelson and Sons, Ltd., 1947, p. 6.

[8]Ibid.

[9]"If time were something that flowed then it would itself consist of a series of events in time and this would be meaningless. Moreover it is difficult to accept the statement that time flows 'equally' or uniformly, for this would seem to imply that there is something which controls the rate of flow of time so that it always goes at the same speed." G. J. Whitrow, The Natural Philosophy of Time, London: Thomas Nelson and Sons, Ltd., 1961, p. 33.

is so only in an accessory and contingent way filled by changes. Changes are in time, they are not time itself."[10] Hence time, for Newton, is independent of motion and relies on nothing other than itself. Time has no subject matter since change is not necessary to it. Thus the time, which is the second fundamental concept of classical physics, is static, empty and absolute.

Space, for Newton, is a homogeneous mathematical construct, which has no need of a subject. Absolute space does not rely on anything for its existence. There is no interdependent view of space and time in Newtonian physics, both are autonomous.

Absolute time and space seem to be defined so as to escape the "vulgar" representations of them in everyday time and space revealed by sense-awareness. Newton attempts to transcend sense-awareness, because the time of sense-awareness is unintelligible in a realm of perfect consistency. This perfect consistency is the realm of the Absolutes.

In The Concept of Nature, Whitehead reveals an understanding of how men could be convinced that some absolute time and space lies behind and beyond sense-awareness. Newton was not seeking a bifurcation of nature, but a theory

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[10]Milio Câpek, The Philosophical Impact of Contemporary Physics, New Jersey: Van Nostrand Co., 1961, p. 36.

that could account for sense-awareness in the light of mathematical formulation:

> 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]

The classical concept of time as explained by Newton and then enlarged upon by others has "tacitly crept from books on mathematical physics into general scientific thought as expressive of the ultimate structure (of nature and time)."[12]

It must also be remembered that the advocates of an absolute frame of reference were seeking a way to measure time and space. The sense-perception of relative time and space is impossible to measure unless against an absolute frame of reference.

Whitehead understands the reasons for holding an absolute theory of time and space, and he also understands what is meant by absolute time and space.

> 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

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[11] The Concept of Nature, p. 33.

[12] Time, Space, and Material, p. 44.

> the instants. Namely, the relation and the instants are jointly known to us in our apprehension of time, each implying the other.[13]

Absolute space is defined as points without extension in an ordered relation.[14] This concept of absolute space implies

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[13]The 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 thereupon perceives certain apparent events which occupy certain periods in the absolute time and 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 the causal events. Furthermore, definite causal events produce for the mind 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.

[14]Ibid., p. 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." Enquiry, p. 161.

two necessary relations, a "space-ordering relation, which holds between points,"[15] and a "space-occupation relation between points of space and material objects."[16]

From this brief outline of absolute time and space, it can be seen that Whitehead understands why one can hold an absolute theory of space and time. However, this understanding does not lead to agreement. Newton did not seek a bifurcation of nature. Whitehead shows, to the contrary, that such theories as absolute time and space lead only to the bifurcation of nature.

Whitehead begins his attack on the concepts of absolute time by appealing to the senses.[17] Does sense-awareness convey to us any perception of a pure and subjectless time? Are we aware of events or sense objects without extension? Does time reveal itself as static? These questions are answered by Whitehead in the negative.

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[15] *The Concept of Nature*, p. 36.

[16] *Ibid.*

[17] *Ibid.*, p. 33.

He states that there is no experience of pure time.[18] Nor is anyone aware of things without extension; for things overlap and have a magnitude. He also rejects time as a static entity since he described nature as a passage or a process. Whitehead holds that time is part of nature and thus cannot be a distortion of nature's properties. An example of this distortive property of absolute time follows: Take, for instance, a movie camera filming a diver in the act of diving. The frames of the diver's motion are discrete and static and when projected give the illusion of motion or process. Yet the frame is still, a single unity without extension to the other frames. This single frame corresponds to an ordered succession of durationless instants advocated by the absolute theory of space and time. But the moving picture frames are not the diver's real actions. Something essential is lost in the transfer from the actual diving to its record on film.

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[18] Ibid., p. 34: "I cannot in my knowledge find anything corresponding to the bare time of the absolute theory." See also page 37 where Whitehead uses the same argument against absolute space. See also Time, Space, and Material: "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.

That something is the loss of process or change. Thus, it can be held by Whitehead that time is not static.

Whitehead summarizes his objections as follows:

> 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.[19]

Whitehead further attacks the absolute point of view because it cannot account for velocity, acceleration, momentum, or kinetic energy[20] since all these physical quantities imply extension and change which is only "vulgarly" allowed for in the absolute concept of nature.

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[19] The Concept of Nature, p. 39.

[20] Time, Space, and Material, p. 47. See also: "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 material throughout the same space at another durationless instant of time. The difficulties of this extreme statement are evident ... Some modification is evidently necessary. 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 analyse, 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." Enquiry, pp. 159-160.

Thus Whitehead concludes that classical physics in respect to time and space gives an inadequate explanation.

E. P. Royal sums up Whitehead's analysis of classical physics in these words: "Whitehead's conception of time and causality represent an effort to formulate a philosophical position adequate to the task of replacing that implicit in the physics of Newton."[21]

Let us now deal with the second aim of this chapter, the perception of time. In order to understand this question let us briefly look at what Kant has said about the perception of time.[22]

Kant's notion of time is derived from his study of knowledge in relation to experience. If we regard space and time as real objects outside of our existence, what do we learn of their respective natures? In confronting some object in experience, we realize immediately two aspects, namely, extension and duration - extension insofar as it occupies a continuous position in space; duration in that the object is drawn out in time. But what can be said of these two seeming sense-experiences? One thing is that we

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[21]E. P. Royal, C. S. C., "Becoming, Causality, and Time," The New Scholasticism. Vol. 36, 1965, p. 43.

[22]I realize that a short summary of Kant's view of time is almost impossible, but I think it is necessary since Whitehead was certainly aware of it.

have no sense-organ to perceive time or space, as we do for color - eyes, or sound - ears.

If we say that time and space are external to the viewer of an object, or that the object in-itself is temporal or spatial, we quickly confront difficulties. The first is that we can differentiate between the object and time or space. The object is not time, for we can think away an object in time, but we cannot think away time itself. Another problem with advocating time in nature is that time must be either after or with the experience. Time cannot be after the experience for that would mean that we could not know what the object is doing, presently. For example, if a man were coming to stab me, and if time were after the event, then I would only realize that I had been stabbed after I was actually stabbed. Thus it can be said that our perception of time is not after the experience. Nor would it seem that time is perceived with the experience, for we are able to separate time from the object.

Then it can be argued that time and space are not part of experience nor in the thing-in-itself. They are <u>a priori</u> (meaning that they exist independently of experience and prior to experience). Space is an <u>a priori</u> in the form of external sense, while time is the form of internal

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sense or the intuition of our flow of consciousness.

Time must be before the experience:

> 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 underlies 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.[23]

While Whitehead himself does not fully treat the Kantian dilemma of time perception in this period of writing,[24] he does make some caustic remarks on the subject:

> 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

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[23]Immanual Kant, Critique of Pure Reason, trans. by T. D. Waldon, Oxford: Claredon Press, 1958, pp. 74-75.

[24]Whitehead studies the perception of time more fully in Science and the Modern World and in Process and Reality.

happenings there is nothing.[25]

While Kant would disagree with Whitehead's statement of a priori time as a "metaphysical enigma," since Kant decries metaphysics, he still seems to be trapped in the nothingness of time that Whitehead attacks.

Whitehead makes it clear that even considering time as a total abstraction, it must be an abstraction from nature. Man can distinguish between time and nature, as he does when he uses time as a measure, but even then the basic perception of time is linked with event or happening.

Thus Whitehead, in The Concept of Nature, attacks both the Newtonian concept of Absolute space and time and the Kantian notion of time as an a priori.

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[25]The Concept of Nature, pp. 65-66.

CHAPTER III

THE INSTANT AND EXTENSIVE ABSTRACTION

In chapter two the Newtonian concepts of absolute space and time were sketched. These physical concepts of time and space were considered as ultimate. The idea of the instant, which is unextended and durationless, emerges from the positing of absolute time. The notion of the point, which is unextended, issues forth from absolute space. Thus, the instant and the point were considered as primary structures of reality and became what is truly real in Newton's physics. For classical physics things in nature "are momentary configurations of mass-points, and change is just the fact that at different instants the same mass-points are differently distributed in space."[1]

Whitehead realizes the bifurcating effect of this classical interpretation of nature, for he states:

> The ultimate fact embracing all nature is (in this traditional point of 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 material throughout the same space at another durationless instant of time.[2]

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

[2] Enquiry, p. 159.

In An Enquiry Concerning the Principles of Natural Knowledge, Whitehead attacks these classical structures, the instant and the point. First, he specifies that velocity is destroyed by such structures as the instant and the point, since velocity cannot take place in an instant of unextended place.[3] Velocity must refer to past and future events, as well as to direction to be explained, and these cannot occur in the instant.

Whitehead appeals to biology[4] in attacking the instant and the point. He is justified in his petition to the science of living organisms since the instant and the point should be revealed in the science of life if they are the ultimate factors of nature.

> 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.[5]

Whitehead then investigates the classical theory in relation to contemporary physics, especially relativity,

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[3] Ibid.

[4] Ibid., p. 160.

[5] Ibid.

electromagnetism, and vectors. Whitehead notes:

> that reflections on Maxwell's equations reinforce his 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 literally confine yourself to unextended points; and (c) the differential with respect to time are meaningless if you literally confine yourself to instantaneous configuration.[6]

In The Concept of Nature, Whitehead also attacks the point and the instant as non-observable events of sense-awareness. Sense-awareness only reveals things in extension. It is extension which is the key to observable data. Extension is revealed in the passage of nature. Extension will be dealt with further after an investigation of the notion of extensive abstraction.

While Whitehead denies the evidence of the instant and point in nature, they have been successfully incorporated into mathematics and have a significance in contemporary physics.[7] Yet if we agree with Whitehead that our perception of time is in a duration, which is extensive and continuous, so that there are no individual or discrete units, what would be the function of the instant?

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[6]C. D. Broad, Op. cit., p. 400.

[7]In Quantum Mechanics, "Heinsberg's Uncertainty Principle," takes place in an instant.

Samuel Alexander indicated that while the instant is a logical construction, its function can distinguish individual moments not evidenced in the duration.[8] Thus it seems that what Samuel Alexander is attempting to discover is a relationship between events in duration and events which are discernable from other events.

Now Whitehead agrees with Alexander that the instant is a logical construction,[9] and he seems to agree with Alexander in the need for a discernible element. The question is: can the instant, which is not observable, be explained in terms of natural entities? "Unless we do so, our science, which employs the concept of instantaneous must abandon all claim to be founded upon observation."[10] Thus Whitehead does not eliminate the concept of the instant but rather tries to ground the instant in sense-awareness. The result of this grounding is the method of extensive abstraction. Whitehead claims this method as a justification for the

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[8]S. Alexander, Space, Time, and Deity, New York City, New York: Dover, Vol. 1, 1966, pp. 39-40.

[9]In Enquiry, Whitehead states that "Our perception of time as a duration, and these instants have only been introduced by reason of a supposed necessity of thought. In fact absolute time is just as much a metaphysical monstrocity as absolute space." Enquiry, p. 163.

[10]The Concept of Nature, p. 57.

use of the "moment"[11] in contemporary physics.

Before proceeding with an analysis of "extensive abstraction," Whitehead's conviction of the non-atomic structure of duration[12] must be clarified; for in his later works, particularly Process and Reality, duration is described as atomic. Duration is non-atomic because there are no minimum or maximum durations; thus no immediate distinction of individuals. The duration lacks the "moment." The moment distinguishes individual durations. The moment is postulated by imposing thought on events which are passing in durations. This is necessary if the moment is to be founded on sense-awareness. A method is needed for this postulation of the moment. That method is extensive abstraction.

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[11]Whitehead prefers 'moment' to 'instant.' He defines the moment as "all nature at an instant. A moment ... has no temporal extension ... . A moment is a limit to which we approach as we confine attention to durations of minimum extension." Ibid., p. 59. "We are now prepared to proceed to the definition of a moment of time. 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." Ibid., p. 60.

[12]"... there is no atomic structure of durations ... so as to mark out its individuality and distinguish it from highly analogous durations over which it is passing ... Ibid.

We are now ready to investigate the theory of extensive abstraction. By this method it is hoped that certain natural relations can be discovered between moments and events. "In the Enquiry and other works of the early period, the primitive relations of the theory of extensive abstraction are the relations of 'extension' and 'cogredience'."[13] And it is from these two relations, extension and cogredience that the "... whole metrical theory of time and space can be deduced... ."[14]

Whitehead defines two key relations and their importance before moving on to the abstractive set. It has been briefly mentioned that extension is a natural entity. This is important since Whitehead is attempting to avoid the criticism that the moment is only a logical structure like the instant which is not rooted in sense-awareness. The moment is founded in extension. Extension is defined as:

> ... the relation of whole event to part event, and is a relation which is special to events. For example, all nature within the Senate house during Caesar's death extends over all nature within Pompey's statue during the death.[15]

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[13] W. Hamerschmidt, Op. cit., p. 43.

[14] Time, Space, and Material, p. 50.

[15] Ibid., p. 47. See also The Concept of Nature, p. 58.

Extension is a passing over;[16] from extension continuity arises.[17] The notion of extension allows for measurement. Even if one held the concept of the instant, some form of extension would be needed in attempting to apply one's static ideas or formulae outside of one's own mind. Thus some physicists who claim the instant perpetuate the serial property of number upon time and state that while the instant or the number are not in themselves extensive, they lend themselves to being serialized. Yet Whitehead maintains that this is not his concept of extension since there must be an overlapping in extension. This overlapping is not evidenced in the notion of the serial property of time. Whitehead also adds that to understand extension and to be able to formulate a measurement for time we need to understand cogredience.

Whitehead defines cogredience as:

> ... the preservation of unbroken quality of standpoint within the duration. It is the continuance of identity of station within the whole 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 -

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[16] The Concept of Nature, p. 58.

[17] "The continuity of nature arises from extension. Every event extends over other events, and every event is extended over by other events." Ibid., See also Hamerschmidt, Op. cit., p. 43.

> comprise change in the quality of its peculiar relation to the contained percipient event.[18]

When the meaning of the present for Whitehead is discussed later, the application of cogredience will be further shown.

Now that the two major characteristics of extensive abstraction have been discussed, a third major ingredient, the abstract set, can be considered. In the abstract set the application of extension in Whitehead's method can be seen. An abstractive set refers to events within durations, thus it is an abstract set of events. Two rules govern the abstract set, and these rules define it. They are: "(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."[19] Before continuing let me make a few observations.

It seems to me that Whitehead has incorporated Gino Fano's mathematical representations for geometrical figures or configurations into a philosophical understanding of the abstract concepts. Fano devised a mathematical notation, namely, 7_3, to represent a configuration of seven

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[18] *The Concept of Nature*, p. 110.

[19] *Ibid.*, p. 79. Note also the similarity between the laws that govern the abstract set and the definition of the moment found in footnote eleven of this chapter.

points and seven lines with each line containing exactly three points of the configuration, and with exactly three lines of the configuration passing through each point. Now there is no concrete drawing or real thing existing which corresponds to the 7_3 configuration, just as there is no real instant to conform to sense-awareness. Yet mathematically, and thus abstractly, we can formulate the instant and the 7_3 configuration. This seems to me to be what Whitehead is trying to do with the instant in the abstract set. The mathematical rules for indicating the 7_3 configuration are very similar to Whitehead's two rules for the abstract set. To formulate the mathematical representation of the 7_3 configuration we need the numerals one through seven on a three row, seven column board, and the following two rules: (1) The three numerals in any column must be different, e. g. 4, 4, 6 are not acceptable, but 1, 2, 3 are; and (2) The same pair of numerals must not occur in two different columns, e. g., if the first column contains 1, 2, 3 no other column can contain 1, 2, or 1, 3, or 2 and 3. The mathematical solution to the 7_3 configuration is:

1	2	3	4	5	6	7
1	1	1	2	2	3	3
2	4	6	4	5	4	5
3	5	7	6	7	7	6

Whitehead in his formulation of the abstract set incorporates different characteristics from Fano, since his problem is the instant and not a configuration. The two characteristics of the abstractive are that (1) "... the abstractive class has neither a smallest event nor does it converge to a limiting event which is not a member of the set;"[20] and (2) that there is no convergence to nothing within the set.[21] An illustration of what is meant by the abstract set with its two rules and two limiting characteristics would be concentric circles, without a smallest unit, the point or the void, as being the innermost circle.[22]

Before the digression of Fano's 7_3 configuration, it was mentioned that the abstract set is an application of extension. Extension was characterized as a passing over. The first rule of the abstractive, "that any two members of the set one contains the other as a part,"[23] indicates this

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[20] Ibid.

[21] Ibid.

[22] Whitehead uses the example of "the nest of boxes of a Chinese toy," but he quickly adds a difference between this example and the abstract set; for "the set differs from the toy in this particular: the toy has a smallest box which forms the end box of its series; but the set of durations can have no smallest duration nor can it converge towards a duration as its limit." Ibid., pp. 61 and 79.

[23] Ibid.

passing over, or incorporating quality of extension.

The following questions might be asked at this stage. What is an abstract set, apart from its rules? What is the purpose of the abstract set? The purpose of the abstract set is to arrive at the moment. Whitehead elaborates on this in the following passage:

> It is evident that an abstractive set as we pass along it converges to the ideal of nature with no temporal extension, namely, to the ideal of all nature at an instant. But this ideal is in fact an ideal of nonentity. What the abstractive set is in fact doing is to guide thought to the consideration of the progressive simplicity of natural relations as we progressively diminish the temporal extension of the duration considered ... . Thus an 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.[24]

This is the purpose of the sets, but what are the components of this set? Sets are made up of events in duration. These durations are periods or regions which overlap.

From this operation of the set the moment can be developed and the definitions of surface, line, and point can be deduced. More will be said about surface, lines, and points in the discussion of motion.

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[24] Ibid., p. 61. It should also be remarked that the "non-entity" emerging from the abstract set, is likened to the 7_3 configuration. Neither exist nor can exist; yet with both, you can say to some degree they are derived from sense-awareness, but are both games to be played by the mind.

In summary, it can be stated what Whitehead was trying to accomplish with the formulation of the method of extensive abstraction. In chapter two, Whitehead's disapproval of those theories of nature which bifurcated nature was discussed. Thus, Whitehead sets about trying to present a view of nature that accounted for both sense-awareness and the causes of sense-awareness. From sense-awareness he observes nature in passage and extension. Applying this sense-awareness to time becomes complex. For we are told by Kant and others that we can think away all other things except time and space themselves. Now it has been shown that an attempt to think of pure time or pure space is as impossible as thinking of pure color.

We are told by such men as Newton that the absolute time, incorporating the instant, is the cause of "vulgar" time and is what time truly is. While others, including S. Alexander, claim that because we have no sense-organ for time or space, we grasp time and space by an intuition. Yet others, and I feel Whitehead can be considered in this group, hold that time and space are relations between things or entities. Space and time, then, are the order of co-existence and succession of entities. Add to these views, the physicist's pragmatic success in using the point and instant, and we certainly become immersed in a complicated

study. It is no wonder then that Whitehead concludes his chapter on time in The Concept of Nature by lamenting: "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."[25]

Yet Whitehead does take a stand against the theory of the instant as real time and tries to incorporate the passage of duration with the scientific theory of time but retain velocity and kinetic energy which are denied in absolute time at an instant. To do this he must formulate a method to justify the instant or moment. This method is extensive abstraction. His method is intended to reduce that which is complex into that which is understandable. It is a method of simplification. It is a method which has four main reasons. First, the workability of the instant or moment, given a mental existence, not natural; secondly:

> ... it is an analysis more closely derived from natural fact itself, which is always extended; ... it recognizes the primacy of velocity or

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[25]The Concept of Nature, p. 73.

> movement in nature; ... it defines a straight line without deductive circularity.[26]

In conclusion, then, Hamerschmidt comments on the effectiveness and the results that Whitehead's method of extensive abstraction achieves:

> ... the theory of extensive abstraction offers a geometrical and kinematical continuum which is identical in mathematical structure with that of classical physics. This identity guarantees that any theoretical work in physics based on kinematics or geometry can be based equally on this methodologically sounder theory.[27]

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[26]Hamerschmidt, Op. cit., p. 48. Hamerschmidt states only three reasons for the method of extensive abstraction; yet I think he makes a mistake by not incorporating the validating of the moment as one of these reasons. I feel a reading of the chapter on Time in The Concept of Nature will support my incorporation of the moment.

[27]Ibid., p. 46.

CHAPTER IV

WHITEHEAD'S CONCEPT OF RELATIVE TIME

In the proceeding chapters, Whitehead's rejection of the absolute concepts of space and time was discussed. This development of Whitehead's philosophy came about after his mathematical works. In his early mathematical works, particularly "The Mathematical Concepts of the Material World," he favored the absolute notions of space and time. This position is evidenced by his stress on the characteristic of time as instantaneous: "Time must be composed of instants ... . Instants of time will be found to be included among the ultimate existent of every concept."[1] This statement shows that Whitehead had not yet made up his mind on the relativity theory that was beginning to emerge. Russell had made the same point in an earlier article.[2] It seems as though Whitehead was influenced by this paper.

As a mathematician, Whitehead was satisfied with the classical interpretation of space and time as a unified

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[1]A. N. Whitehead, "On the Mathematical Concepts of the Material World," Philosophical Transactions, Royal Society of London, Series A, Vol. 205, 1906, p. 467.

[2]Bertrand Russell, "Is Position in Time and Space Absolute or Relative," Mind, N.S., Vol. 10, No. 39, July, 1901, pp. 293-317.

explanation of nature. Even in his mathematical period, however, a movement is discernable away from the absolute explanation of space and time. This seems to be brought about by the recent advances of non-Euclidian geometry. This surmise is reinforced by Whitehead's article, "The Axioms of Geometry." He reveals his uncertainty about the absolute notion of time,[3] and he rejects the concept of space as a purely numerical construct.[4] Thus the shift to the relational concept of time and space had begun. This break became pronounced and complete, as has been seen in previous chapters. Whitehead only accepted relational time after careful scrutiny. His own views, however, differ from those of Einstein.

In this chapter an analysis of Whitehead's conception of the relational qualities of time and space will be made.

Whitehead realized the importance of relational time for a philosophy of nature but was skeptical of Einstein's

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

[4]Ibid.

[5]See: "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.

notion of time.[6] Whitehead agrees with most of the main conclusions of the theory of relativity. The following are some points of agreement.

First, relations are spatio-temporal. The classical interpretation of nature was inaccurate in segregating relations into temporal and spatial.[7] This view is confirmed by global

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[6]The skepticism of Whitehead is revealed in a conversation he had 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 Lawin Ltd., 1968, p. 105 from L. Price, Dialogues of Alfred N. Whitehead.

[7]Hamerschmidt, commenting on this spatio-temporal relation, states: "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." Hamerschmidt, Op. cit., p. 4.

perception of space and time, as given by events in extension. "This relation of extension is the common root from which extension in time and extension in space both spring."[8]

Second, there are an infinite set of spatio-temporal series. The classical theory of nature was incorrect in claiming that nature has only a single time-series, one past, one present, and one future for everyone and everything. While Whitehead does not deny the multiple space-time series, this idea will lead to a major disagreement with Einstein over the problem of simultaneity.

Third, nature is actually four-dimensional, three dimensions of space and one dimension of time: "This structure is four-dimensional, so that any event is a four-dimensional hyper-volume in which time is the fourth dimension ... ."[9] This four-dimensional character of nature reinforces the necessity of conceiving relations as spatio-temporal. With respect to time, these are the major points of agreement.[10]

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[8]Time, Space, and Material, p. 47.

[9]Principles of Relativity, p. 316.

[10]With respect to the whole theory of relativity there are many more areas of agreement; for example, gravity.

Before discussing the major areas of difference between Einstein and Whitehead, let us briefly look at sense-awareness and see if the theory of relativity in respect to time and space can be justified, in part.

Relativity is that all motion is relative. This statement attacks the classical definition of motion, that motion is one and an absolute frame of reference. By destroying the classical frame of reference, the absolute motion, Einstein must formulate a new frame of reference to measure velocity. In addition to absolute motion, absolute space, a body at rest, and absolute time must be discarded, leaving no absolutes - since all is relative. Now this is a part of the theory of relativity, but can we correspond relative motion to sense-awareness? To answer this, let us take the following problem.

There are two trains, A and B, in a station. The occupant of train A is looking out his window at train B. All of a sudden the windows of train B flash before the occupant of train A, and he thinks that his train, A, is moving and that train B is at rest. Then he changes his gaze and sees passengers still entering his train. He realizes that it is train B that is in motion and that his train is at rest (in relation to train B).

The reason for the dichotomy of thought by the occupant of train A is that two frames of reference were being employed. The first is the occupant's relation to train B as he gazes out the window of train A. The second is the occupant's change of perspective to the passengers entering his train. From this rather simplified example the conclusion is drawn that motion must be viewed in respect to other frames of reference. The question of the measurement of motion is now raised. This is a question of velocity.

The problem of velocity is evidenced by a similar example as that used for motion. There are two trains, A and B. Train A is moving between points a and b at a constant velocity. Train B is moving between points b and a at a constant velocity. The two trains pass each other at point c, and the occupant of train A concludes that train B is at rest, and that his train is moving. The occupant of train B concludes that train A is at rest, and that his train is moving. Both occupants claim that they are in motion, but how can they prove it?

One solution is the use of certain instruments that reveal the trains' motions and also measure their motion. By the use of these instruments the occupants of trains A and B can measure their own train's motion

without reference to each other. However, the instruments must utilize some frame of reference other than the particular moving object. In the case of a moving object on earth, the object's measurement must be in relation to the earth. Thus when one says the velocity of the train is sixty miles per hour, this measurement is in reference to the earth. Within the near future, Interplanetary or Interstellar flights might use other frames of reference for the measurement of motion.

In the theory of relativity, motion is relative, and it can be said that one is either in motion or at rest, depending on the frame of reference. This conception of motion is based on sense-awareness. Relativity then disavows the classical absolutes of motion, space, and time. Motion and velocity are relative and, therefore, depend upon a frame of reference that can vary. Applying this relativistic notion to the measurement of time, let us briefly take the following example. On earth one form of measuring time is the pendulum clock. Yet given the frame of reference, this measurement will change. On the moon, with the decrease of gravity, the pendulum will measure time differently than on the earth. Thus the frame of reference changes and then the measurement of time changes. Sense-awareness is then the foundation of the relativistic

motion of Einstein's theory.

The acceptance of this multi-series of space and time is not without major problems, however. One of the major difficulties is in the question of the simultaneity of events. This is particularly important in the discussion of time. This question of simultaneity is one of the major disagreements that Whitehead has with the relativity theory. Along with this problem of simultaneity, Whitehead attacks Einstein's theory of the velocity of light. Whitehead attacks this, because while relativity denies all absolute measurement of velocity, Einstein introduces the constant velocity of light (182, 284 in vaco) as a standard for measurement since nothing can go faster than the speed of light.

The disagreement between Whitehead and Einstein is evidenced in the 'Twin Paradox.'[11] In this paradox, there is a set of twins. One twin remains on earth. The other travels close to the speed of light to the spiral nebula in Andromeda. Before he leaves, the two brothers synchronize their watches. According to the Special Theory of Relativity, the "time dilation" between the two brothers' measurement of time can be very large. To better comprehend

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[11]The 'Twin Paradox' is raised in the Special Theory of Relativity and deals with the non-simultaneity between time lived and time measured.

how large this time dilation can be let us look at the mathematical computations made by Edwin M. McMillan, a nuclear physicist:

> An astronaut travels from earth to the spiral nebula in Andromeda. It is about 2 million light-years away. He makes the trip by going half the distance with a constant acceleration of 2 g. then he accelerates negatively at 2 g. until he reaches the nebula. (This is a convenient way, incidentally, of maintaining a steady gravity field inside a space-ship for the entire duration of a long trip, without rotating the ship). The procedure is repeated for the return trip. According to the astronauts own clock, the trip took 29 years. According to earth clocks, about 3 million years have gone by![12]

The problem that must now be discussed is the relationship between the conception of time for the twins. Are their times simultaneous? Now Whitehead agrees with the mathematical formulation and theory, but questions its relationship to experience.[13] It is on this question of experience that Whitehead will ultimately disagree with the 'Twin Paradox':

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[12]Gardner, Relativity for the Millions, New York City, New York: MacMillan Co., 1962, pp. 117-118.

[13]"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." A. N. Whitehead, "The Problem of Simultaneity: A Symposium," Proceedings of Aristotelian Society, Supplementary, Vol. III, July, 1923, p. 35.

Whitehead begins his questioning of the paradox by referring back to one of the principles of General Relativity, that a being can claim to be at motion or at rest, and " ... that either Jack or Jill or the Hill have equal reason to claim the prerogative of being at rest."[14] If this is the case then the earth-brother can claim to be in motion and the astronaut at rest, thus producing the converse experience,[15] and a logical contradiction. The argument of the relativists is that Whitehead's objection is inaccurate because the earth does not move relative to the universe.[16] Yet the universe as an

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[14] Ibid., p. 34.

[15] This is brought out clearly by H. Dingle, an English physicist. Dingle states: "According to the General Theory of Relativity there is no absolute motion of any sort, no 'preferred' frame of reference. It is always possible to choose a moving object as a fixed frame of reference without doing violence to any law. When the earth is chosen as a frame, the astronaut makes the long journey, returns, finds himself younger than his stay-at-home brother. All well and good. But what happens when the space ship is taken as the frame of reference? Now it must be assumed that the earth makes a long journey away from the ship and back again. In this case it is the twin on the ship who is the stay-at-home. When the earth gets back to the space ship, will not the earth rider be the younger? If so, the situation is more than a paradoxical affront to common sense; it is a flat logical contradiction. Clearly each twin cannot be younger than the other." Gardner, Op. cit., pp. 120-121.

[16] Ibid.

"effective physical totality" is denied by the relativists,[17] and thus this objection is arbitrary.

Whitehead's next criticism is that the paradox assumes that astronaut and earth-chronologer are at rest from each point of view. Professor Carr states this as " ... always at the centre of the universe, coordinating it from an unchangeable position."[18] For Whitehead:

> This is true of each of them at each instant. But there is a difference between the traveller and the Earth-chronologer: The Earth-chronologer is at rest during every instant in the same sense of the term. But the traveller changes the sense of the term in which he is at rest. Neglecting the start and the final return, there is an essential change at the star. In other words, there is no difficulty about the explanation if you admit that acceleration and deceleration (as distinct from uniform velocity) express an essential fact of the life history of any body, and is not merely an accidental outcome of the choice of co-ordinates. But this admission as to acceleration is just what the orthodox relativists deny.[19]

What Whitehead seems to be saying is that while the time-measurement might be different, the time-lived is simultaneous. In other words, while the time reckoning will show one younger and the other older or dead, both their bodies will have experienced simultaneous durations.

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[17] Problem of Simultaneity, p. 35.

[18] Ibid., p. 22.

[19] Ibid., p. 40.

This leads into Whitehead's major criticism of this paradox. What is being measured? Is it duration or the measurement of measurement?[20]

Whitehead asks by what means does the traveller calculate time into days. What does the traveller count? "The rotation of the Earth? Certainly not."[21] Whitehead proceeds to show that the Earth-chronologer and the traveller will have different computations of the revolutions made by the earth due to the traveller's "sudden change of space-time systems at the star."[22] And because of this change the traveller's acount of the time measured will be shorter than the Earth-chronologist. "If he had noticed them, he would have counted them; and would then have agreed with the Earth-chronologer on his return."[23]

Another system that might be employed is the transmitting of signals from Earth to the astronaut. Now these transmissions have a finite velocity, so the

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[20]By measurement of measurement I mean the measurement of clock measurement or a mathematical computation.

[21]Problem of Simultaneity, p. 35. For a scientific view of the calculation see: H. Reichenbach, The Rise of Scientific Philosophy, Berkeley: University of California Press, 1968, pp. 150-155.

[22]Ibid.

[23]Ibid., p. 36.

astronaut's reception of the signals will be based upon the astronaut's velocity. If the astronaut's velocity is slower than the signal's velocity, then the astronaut will receive half the signals going and the other half returning. As in the previous case, the astronaut will receive an identical number of signals as have been transmitted.[24]

The transmission of light-signals is the key to the orthodox relativity theoreticians' conception of simultaneity. In fact the velocity of light is needed so that a reliable framework can be used in determining simultaneity at tremendous velocities and great distances. Einstein speaks of simultaneous events as the following. Distant events are simultaneous if light signals from them reach a mid-point between them at observed simultaneous times.[25] The same definition is used to explain unobserved simultaneity.

Whitehead disagrees with making the light-signals the very foundation for simultaneity. He questions the uniform velocity of light:

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[24] Ibid., p. 37.

[25] A. Einstein, Relativity, The Special and General Theory, pp. 26-28.

> ... our only experience of light is as moving through a media, the air, glass, water, etc. We believe that these media 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.[26]

Whitehead must then reformulate a definition of simultaneity that is based on experience. For he claims that the difficulty of the paradox "... arises from the denial of simultaneity as a fundamental fact of awareness."[27]

In Chapter II.,[28] simultaneity was spoken of as "immediate for sense-awareness" and a relationship of events. But can this notion of simultaneity be expanded to encompass events that are beyond an immediate sense-awareness? The answer to this question is yes:

> ... 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.[29]

In this respect, simultaneity can be the foundation of

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[26] Problem of Simultaneity, p. 39.

[27] Ibid., p. 38.

[28] See Chapter II, p. 16.

[29] W. Hamershcmidt, Op. cit., p. 53.

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 immeditely 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.[30]

In respect to the twin paradox, then, Whitehead disagrees with the relative theoreticians because of the following reasons:

1. That the twin paradox does not remain faithful to the General Theory of Relativity by maintaining that one was at rest and the other in motion and by not allowing the converse.

2. That the orthodox relativists' denial of this first position is arbitrary since it is based on a position which they deny themselves. That the universe is an affective totality.

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[30] Problem of Simultaneity, pp. 40-41.

3. That the converse to the twin paradox, as mentioned in the first reason, shows the paradox to be a contradiction. For both positions cannot be true.

4. That the paradox does not take into consideration acceleration and deceleration, which will have an effect on the life history of the body.

5. That the paradox is only measuring clock time and not time-lived or duration. Duration is found upon the passage of nature, and this time will be simultaneous for the man on earth and the man in space, irregardless of time measurement. The difference in time measure is caused because "the real diversity of relations of their bodies to the universe."[31]

6. That the means of determining simultaneity in the theory of relativity are based on light-signals. These light-signals find their bases in the uniform velocity of light which is not evidenced in experience.

7. That the time measurement of the astronaut does not evidence the different frames of reference between himself and the Earth, especially at the star.

These are the major arguments of Whitehead in opposing the twin paradox of Special Relativity. These arguments also evidence some of the major points of difference

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[31] Ibid., p. 35.

between Whitehead and Einstein. Let me present one other important distinction between Whitehead and Einstein with respect to time.

The orthodox relativists hold that the structure of space-time is not uniform, but changes according to its contents. Whitehead rejects this and states that the structure of time is homolaidal:

> (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.[32]

In summary, then, we have seen the major agreements and disagreements between Whitehead and the relativists. We have also seen how Whitehead developed his notion of relative time, and how it modifies Einstein's portrayal of time. We have shown by means of the "Twin Paradox" that the question of simultaneity is one of the major differences between Whitehead and Einstein, and that Whitehead's explanation of the time dilation is consistent with sense-awareness.

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[32] Principles of Relativity, p. 313. See also: Ibid., p. 370.

We are left, however, with several questions with respect to relative time. Is time continuous in relative time? Do we have to redefine continuity since we are dealing with an infinite time series? We have inferred from relative motion to relative time; does this mean that time is motion? It is to these questions that we turn in the next chapter.

CHAPTER V

TIME, MOTION, AND CONTINUITY

The influence of the theory of relativity on Whitehead was discussed earlier. The problems of motion and continuity, however, were left unanswered. We shall attempt to answer these problems in this chapter. They have always been considered important in an investigation of time.[1]

In The Concept of Nature, Whitehead assumes that motion is relative.[2] In classical physics, motion is considered as an absolute frame of reference along with absolute time and space. Newton defined absolute motion as the "translation of a body from one absolute place to another," and place as "a part of space which a body takes up, and is according to space, either absolute or relative ... ."[3]

Absolute motion does not refer to a change of distance. Change of distance is in reference to relative

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[1]See particularly Aristotle, Physics, Book IV, and Henri Bergson, "Perception of Change," in Creative Mind.

[2]The Concept of Nature, p. 105.

[3]Isaac Newton, Op. cit., p. 6.

motion. Absolute motion is a computation used as a frame of reference, and is computed "in the case of any body, by mathematically combining its relative motions on the earth plus the motion of the earth in absolute space."[4] Thus it can be inferred that absolute motion is a mathematical construct without sense verification.

If motion is not a perceived fact of nature then it appears to Whitehead that:

> kinetic energy and momentum and all that depends on these physical concepts evaporates from our list of physical realities.[5]

This statement of Whitehead is directed against the Newtonian physicists. Whitehead is mistaken, however, if he believes that Newton denied motion as a physical fact of nature. Newton believed that relative motion was revealed in sense experience, but, also, a higher order, suggested by relative motion and sense experience. This higher order is the world of the absolute frames of reference - space, time, and motion. These absolute frames of reference are nature for Newton. Newton does not deny motion as a fact in nature; on the contrary, he considers

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[4]E. H. Burtt, The Metaphysical Foundations of Modern Physical Science, London: Routledge and Kegan Paul Ltd., 1967, p. 246.

[5]The Concept of Nature, p. 105.

motion as a part of the foundation of nature. Where Whitehead should disagree with Newton is only on whether or not motion is relative or absolute, and not on whether or not motion is a part of nature. Kinetic energy and momentum are physical realities, and they are denied that status by those holding the notion of absolute motion.

Whitehead also asserts that motion "presupposes rest."[6] This assumption is self-evident from sense-awareness for Whitehead. An illustration of this assumption is found in the following example: When a traveller arrives in Ottawa, he is coming from somewhere else - let us say from Toronto. By the use of the term "coming from" a reference is made to another position. This position will be there even if Toronto as a city is no longer there. Thus a framework for perceiving motion is revealed by sense-awareness. Whitehead's interpretation of rest should not be considered a return to the classical understanding of absolute place. On the contrary, rest is perceived in sense-awareness, which is not true of absolute place.

The assumption of rest being presupposed to motion reveals another difference between Whitehead and Einstein. In the theory of relativity the possibility of absolute position is denied by relative space. Whitehead agrees that

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[6] Ibid.

space is relative but maintains that relative space does not preclude a notion of absolute position.

Rest is consistent with relative time and space, for rest "enters with the admission of alternative time systems,"[7] while absolute place is only consistent with absolute time and space. The multi-space-time series does not lead to the conclusion of a single absolute position. In a multi-time-space series there are absolute positions within each series, but these absolutes are relative with respect to other series. Whitehead explains this concept in the following way:

> Thus the series of spaces in parallel moments of one temporal series may have their own definition of absolute position correlating sets of event-particles, one for each space, all with the same absolute position in that series of space.[8]

Whitehead makes two interesting moves here. The first is his reversal of the classical theory, which progressed from relative place to absolute place, by going from absolute position in a single space-time series to relative position in a multi-time-space series. The second is, by maintaining absolute position, he can introduce the notion of the point into his philosophy. Whitehead defines a

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[7] Ibid., p. 106.

[8] Ibid.

point as "an absolute position in the timeless space of a given time-system."[9] Thus Whitehead is able to incorporate a formulation for comparing the position in one instantaneous space with another position in another instantaneous space.[10] This is denied by Einstein, as seen previously in the discussion of simultaneity. Absolute position allows events to be simultaneous within relative time-series. For, if an event cannot occupy an absolute position within its time-series, then its simultaneity with another event in a different time-series can only be an approximation. With the introduction of absolute position, one has a framework to judge events as simultaneous. Before leaving this topic, let us listen to Whitehead describe "timeless-space":

> There are the spaces of physical science and of any concept of space as external and unchanging. But what we actually perceive is an approximation to the instantaneous space indicated by event-particles[11] which lie within some moment of the

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[9] Ibid.

[10] Whitehead arrives at instantaneous space, as a mathematical construct not perceived by sense-awareness, by extensive abstraction. It should be remembered that it was by extensive abstraction that Whitehead justified the mathematical formulation of the moment, thus allowing a timeless space.

[11] "An instantaneous point is better named an 'event-particle.' Event-particles form a four-dimensional manifold which is divided into three-dimensional inatantaneous spaces which lie within the several moments." Time, Space, and Material, p. 48.

time-system associated with our awareness.[12]

This seems to be all that Whitehead presents about motion in his first philosophical period. I should like, however, to discuss the question raised at the end of chapter four: Is time synonymous with motion since motion and time are relative? In other words, does a space-time series become a motion-space-time series? The answer to this is no. While it is true that we do not perceive time without motion, time is not motion. Motion for Whithead presupposes rest, time does not. Motion implies velocity, faster or slower, time does not. Thus it is clear that time is not motion.

The next problem that should be discussed is whether or not time is continuous. In chapter two Whitehead's concept of extension was described as the relation of durations in the passage of nature. Now "the continuity of nature arises from extension."[13] Extension is only a relation. The subjects of extension are events. Thus Whitehead states that the "continuity of nature is a continuity of events."[14]

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[12] The Concept of Nature, p. 115.

[13] Ibid., p. 59.

[14] Ibid., p. 76.

But what does Whitehead mean by the continuity of nature or events? How does he arrive at continuity? The answers to these questions on the nature of continuity will reveal again how Whitehead has separated himself from the classical physical interpretation of nature. For in the classical interpretation the major doctrine of nature is space at a durationless instant of time in which material is distributed throughout. These durationless instants are disconnected like a point is from a line; for both the instant and the point lack extension. How can one place an extensionless point next to another extensionless point to form a line? It cannot possibly be done; for an extensionless point has no sides or boundaries. It is devoid of magnitude and if one is placed next to another, then they would merge and still be devoid of magnitude, sides, and boundaries. Neither does our sense-experience reveal any extensionless point or instant. All that we see has extension and magnitude. Thus any philosophy of science based on sense-awareness must revel against the primary relationship of nature as material distributed throughout all space at a durationless instant of time. If we reject the classical description, then we must seek an alternative explanation of nature.

Whitehead believes he has done this by claiming sense-awareness as his ultimate court of appeals. Extension is evident in sense-awareness. It is from this doctrine of extension that Whitehead infers continuity.

But what does one infer or observe from continuity? Whitehead states that "junction" is apparent from continuity.[15] This notion is a special relation between events. Whitehead gives two definitions of "junction." The first is that two events have junction when there is a third event of which both events are parts, and which is such that no part of it is separated from both of the two given events. Thus two events with junction make up exactly one event which is in a sense their sum.[16]

The second definition is that two events have junction when there is a third event such that (i) it overlaps both events, and (ii) it has no part which is separated from both given events.[17]

Whitehead points out that these are not logical definitions,[18] but that junction and continuity are

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[15] Ibid.

[16] Ibid.

[17] Ibid.

[18] Ibid., p. 77.

observable in nature. He takes this continuity of nature and junction and applies it to duration:

> Every event extends over other events, and every event is extended over by other events. Thus in the special case of durations ... every duration is part of other durations; and every duration has other durations which are part of it. Accordingly there are no maximum durations and no minimum durations.[19]

William Hamerschmidt offers another aspect of continuity and its importance for Whitehead's philosophy:

> (Whitehead) ... asserts that 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 ... the continuum deduced from extensive abstraction permits the use of usual modern mathematical methods, and the metrical analysis is that of usual metrical geometry. Once the elementary geometrical concepts are defined by the abstractive sets, the new system the conventional modern system will have equivalent analytical properties.[20]

Hamerschmidt's reference to continuity and extensive abstraction reveals another property of continuity, that of "lying-between."[21] This "lying-between" is used to give unity to Whitehead's attempt to explain "the serial relation of temporal order among the moments of a family."[22]

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[19] Ibid., p. 59.

[20] W. Hamerschmidt, Op. cit., p. 48.

[21] The Concept of Nature, p. 64.

[22] Ibid.

This serial relation is not exactly the same as the classical interpretation because the moments lie within duration. Whitehead uses the following example to show this. One has two moments of a family, A and C. A and C are boundary moments.[23] Between A and C is any moment B, which is within the duration. B is said to be "lying-between" A and C. "Thus the three-termed relation of 'lying-between' as relating three moments, A, B, and C is completely defined."[24] Whitehead then alleges, but does not prove, that the passage of nature confirms this distribution.[25]

Whitehead uses continuity to support the serial relation of temporal because of the junction between A, B, C and duration. This allows Whitehead to retain the classical description of time as a series, while also remaining faithful to his test of sense-awareness.

Whitehead also points out that time as a series is "the result of an intellectual process of abstraction."[26]

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[23]Whitehead defines boundary moments as the following: "There are durations of the same family as the given duration which overlap it but are not contained in it." Ibid., p. 63.

[24]Ibid., p. 64.

[25]Ibid.

[26]Ibid., p. 65.

I concur with Whitehead that:

> This serial time is evidently not the very passage of nature itself. It exhibits some of the natural properties which flow from it. The state of nature 'at the moment' has evidently lost this ultimate quality of passage.[27]

Thus Whitehead uses continuity to justify time as a series, allowing himself the use of mathematical methods and metrical analysis, as Hamerschmidt commented.

In summation, Whitehead holds the following:

1. That motion is not absolute as classical physics maintained.

2. That motion is a physical fact in nature.

3. That rest is presupposed by motion.

4. That absolute position is derived from rest. Yet this absolute position exhibits itself as absolute only within its time-series and as relative to other time-series.

5. That absolute position allows us to have simultaneity of events.

6. That continuity is a relation evidenced by the extensive property of the passage of nature.

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[27] Ibid.

7. That continuity reveals certain relationships between events known as junction.

8. That continuity and junction will give a foundation for the intellectual abstraction of time-series.

9. That time is a series and not continuous per se. This lack of continuity in respect to time will be important when the relationship between the past, the present, and the future is discussed in the next chapter.

CHAPTER VI

CONCEPT OF THE PRESENT

What is the present? What is the relationship between the present, the past, and the future? These questions are two of the most difficult problems in the study of time. With respect to the latter question, Aristotle pointed out the difficulty in an explanation of the nature of time: the past no longer exists and the future has not yet come to be.[1] It is also complicated to account adequately for the distinction between the past, the present, and the future.

The present has been the subject of disagreement for many scientists and philosophers seeking an understanding of time. For Newton the present was the instant, a "now," surrounded by other instants. Dr. Whitrow, in The Natural Philosophy of Time, discusses other approaches to the understanding of the present:

> In analysing the idea of the present, Guyau[2] 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,

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[1]Aristotle, The Basic Works of Aristotle, ed. by R. McKeon, New York, New York: Random House, 1947, Physics, Book IV, 217b30.

[2]M. Guyeau, author of La Genèse de l'Idée de Temps, published in 1890.

> that is, one must be aware of producing a certain effort. Janet[3] 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.'[4]

Kant held for a mental or psychic present, while Aristotle held a real and mathematical present. In all this the disagreemetn on the present can be seen. Added to the authorities cited above, the relativistic notion of multiple presents which do not have to be simultaneous makes the issue more confusing. Whitehead admits his confusion and in doing so reveals some important insights into the nature of the present.

In the overall context of Whitehead's time, the present is not an instantaneous point. For if time is a succession of durationless instants, then the present instant is " ... 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 to the instants."[5] Yet I have no awareness or experience of such a phenomena. Furthermore, if the present is only

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[3]P. Janet, L'Evolution de la Mémoire et de la Notion du Temps, Paris, 1928, p. 309.

[4]Whitrow, Op. cit., p. 82.

[5]The Concept of Nature, p. 221.

instantaneous, how does one decide when an event is present and when an event is past? Is the word being read now the present and the word before it the past? How does one arrive at the criterion for dividing things into intervals of successive durationless instants? What is the standard, in this notion, by which we can say that it is in the present?

In answering these questions, Whitehead echoes Bergson's interpretation of the past, present, and future.[6] To understand better Whitehead's notion of the present, it is important to comprehend Bergson's meaning of the terms past, present, and future.

The past, for Bergson, is conceived very differently from previous philosophers, who generally held that the past is that which no longer exists. Yet, a strange phenomenon happens to alter that collective notion of the past. While it is impossible for someone to recapture physically yesterday, one is able to relive yesterday mentally. Several attempts have been made to explain this

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[6]Victor Lowe denies any decisive influence of Bergson on Whitehead. I hope to show in the following few pages that Mr. Lowe is mistaken in this opinion. (See V. Lowe, "The Influence of Bergson, James, and Alexander on Whitehead," The Journal of the History of Ideas, April, 1949, Vol. X, No. 2, pp. 267-298.

phenomenon. The most common is memory.[7] Bergson disclaims this explanation and maintains that the past is preserved in the present. To support his interpretation, he writes on the problem of the past that:

> ... 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 inexistant, 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.[8]

If the past is preserved in the present, as Bergson insists, then the present and the past are co-existent. The present not only exists, but also takes on a psychological connotation in Bergson's attempt to justify his present:

> My present, at this moment is the sentence I am pronouncing. But it is so because I want to limit the field of my attention to this sentence. This

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[7]This explanation is common to such prominent philosophers as Aristotle and Kant.

[8]Henri Bergson, Creative Mind, New York City, New York: Wisdom Library, 1933, pp. 150-151.

> 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 ... .[9]

Bergson further believes that his notion of the present shows the inadequacies of the concept.

> 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.[10]

Bergson illustrates his notion with the aid of the following metaphor. The present is a snowball rolling down a hill continually gathering new experiences as it rolls and becoming larger. Our lives are like the snowball as we

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[9] Ibid., p. 152.

[10] Ibid., p. 151.

become our past.[11]

Bergson also considers the problem of distinguishing between the past and the present:

> 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,

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[11]Bergson 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," Henri Bergson, Creative Evolution, New York, New York: 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, and could I fix this invisible present, this infinitesimal element of the curve of time; it is the direction of the future that it would indicate." Henri Bergson, Matter and Memory, London: MacMillan, 1913, p. 177.

> 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.[12]

Whitehead accepts the Bergsonian framework for evaluating the present, and the rejection of the Newtonian concept:

> As an ultimate fact instantaneous present is a nonentity. What is immediate for sense-awareness is a duration within itself a past and a future; and the temporal breadth of the immediate durations of sense-awareness are very indeterminate and dependent on individual percipient. Accordingly there is no unique factor in nature which for every percipient is preeminently and necessarily the present.[13]

Thus the present can be a unique and highly personalized affair. Bergson dramatized such a present, and Whitehead adds that the individual present is brought by memory, the past, and anticipation. There can be no yardstick to measure these factors of the individual present, in fact, the present is indistinct.

> There is no sharp distinction ... between memory and the present immediacy or between present immediacy and anticipation. The present is a weavering breadth of boundary between the extremes.[14]

This "weavering breadth" is determined by the individual, by what he fixes his attention to, but Whitehead

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[12]Henri Bergson, Creative Mind, p. 152.

[13]The Concept of Nature, p. 72.

[14]Ibid., p. 69.

limits the creative activity of the individual by saying that it is only for "imaginary beings ... that ... all nature shares in the immediacy of ... present duration."[15]

Whitehead poetically describes the present as "the vivid fringe of memory tinged with anticipation."[16] This individual present can occupy one time-series and does not necessarily occupy other time-series.[17] The present of one person does not have to be the same for someone else. The present is "ill-defined" and brought about by the mingling of the past and the future.[18]

The present which Whitehead metaphorically characterizes is a psychological present similar to the one elucidated by Bergson in his example of the sentence. For instance, let us assume that someone was struck by a car last year. In court, his mind searches his memory and the car accident is relived, now. His present is the car accident, and his presence is in the court room. The accident is past, but as the individual takes on a different form, it becomes the present, now.

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[15] Ibid.

[16] Ibid., p. 73.

[17] Ibid.

[18] Ibid.

Both the above example and Bergson's example reveal a plastic interpretation of the present. In the above example, the present is the memory of the accident "tinged" with the anticipation of a court decision, yet this present is distinct from the time that the person was struck by the car. Thus there are boundaries within the present (memory and anticipation) which make it distinct each time.

This individual present is not the same thing as a passage of duration. This is an important point because if Whitehead upholds the individual present, which is a mental present, as identical with duration, then he would have to accept a Kantian framework of time. Whitehead rejects the Kantian idea of time and maintains that one can distinguish the passage of mind from the passage of nature.[19] Although the two passages are closely allied, the

> mind is not in time or in space in the same sense in which the events of nature are in time, but that it is derivatively in time and in space by reason of the peculiar alliance of its passage with the passage of nature.[20]

Hence there are two presents for Whitehead. The first is the individual present. The second is the present of nature. We have already seen that duration has a

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[19] Ibid., p. 69.

[20] Ibid., p. 70.

"temporal thickness," and it has the characteristic of "passing over." Duration is also continuous. This continuous "passing over" evidences prior and antecedent events. From the prior and antecedent we derive a present of duration. This prior and antecedent give us a real past and future. The interrelationship of events is the key to the question of past, present, and future:

> The fact that every event is extended over by other events requires that there is an essential relatedness via extension of all regions of time to any given region of time. There is no such thing as an isolated event. Whitehead holds that each event essentially 'signifies' the whole structure of nature. Events thus signified must include those in the past and in the future. We are aware of them, through the standpoint of the present, as the far off periods of unbounded time. There is an essential involvement of the past and future in the very nature of the present.[21]

An example of this relationship is the day, with sunrise and sunset.

Before concluding this chapter, let me state that the moment, which Whitehead derived from the method of extensive abstraction, should not be confused with the present. The moment is an abstraction from duration. It possesses only mental existence. The duration which has a "temporal thickness" is not derived from the moment. The present, while "ill-defined" and elusive is still a property of

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[21]Hamerschmidt, Op. cit., p. 79.

duration and an abstraction. The moment is used to represent the whole duration at an instant in the mathematical theories. The moment can do this because it is entrenched in nature, while instants and points are fictitious. Thus while the moment might represent the present in certain problems, it is not itself the present.

In summary, then, Whitehead's notion of the present is not fully developed in this first period. We saw his avoidance of the classical interpretation and his way of dealing with supposed non-entities in time. Whitehead uses a psychological interpretation of the present, as well as a present based on sense-awareness.

CONCLUSION

For the most part, in Greek thought, the concept of time did not seem to be of primary importance. The Greek's idea of time seemed to be aligned with the idea of justice or balance, rather than with the idea of progress; and with the theory of primary opposites, rather than a single linear variable. The advent of Newton and his subsequent development of classical physics gave time a primary position in the realm of nature. Time became an absolute concept which explained process as a single variable. By making time a linear variable, Newton achieved two things. First, he freed time from the self-contained circular time of the ancients. Secondly, he utilized the mathematical concept of an infinitely extended straight line in his interpretation of time. Newton then admitted that the order of nature was mathematical.

While the success of Newton was great, his concept of time and his whole theory of nature was successfully challenged by Einstein in his General Theory of Relativity. For Einstein time remained linear but instead of a single linear variable, time became a multi-linear variable. While Newton separated time from space and gave both the

honor of absolute status, Einstein combined space and time. Whereas Newton held for absolute and relative time, Einstein held for relative time only. Yet Einstein still retained the importance of time in his explanation of nature.

Einstein denied the possibility of determining motion absolutely and consequently lead into the idea of the four-dimensional space-time continuum. Since one cannot determine the motions of the factors in the continuum, any pattern of motion must be illusory, and there cannot be any determinable consequences. Thus Einstein denied the possibility of simultaneity.

While Newton and Einstein constructed a mathematical interpretation of nature, Bergson was formulating a poetical and psychological presentation. Nature is a manifestation of the <u>élan vital</u> as the current of consciousness (cummulative and irreversible). The élan is responsible for evolutionary continuity, novelty (the creative leaps into evolution), and complexity (through time in an evolutionary process). This portrayal of nature is grasped in duration. Bergson contrasted two types of time, the mental or thought time, and the duration of experience. This mental or conceptual time is spatio-temporal; that is, time is conceived as a line composed of

points or discrete instants. This type of time is a product of the intellect and falsifies nature for Bergson. Duration or lived time is the stuff of everything, for all is flux or change.[1]

Whitehead's philosophy emerged from these various views of nature. It has been the intention of this thesis to develop Whitehead's philosophy of time and to reveal the agreements and divergencies of his philosophy in relation to the philosophies of time of Newton, Einstein, and Bergson. Whitehead's notion of time is immersed in his whole philosophy of nature. Like Newton, Einstein, and Bergson, Whitehead realizes the importance of time for any unified concept of nature. Yet Whitehead's notion of time fundamentally alters his concept of nature from Newton's, Einstein's, or Bergson's notions of nature. Whitehead agrees with Einstein that time is relative and a multi-linear series, but Whitehead roots time in duration which is continuous and empirically evident while Einstein does not. Bergson roots nature in duration, and Whitehead concurs, but Whitehead maintains that the conceptual linear time-series is valid while Bergson will not. Newton utilizes

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[1]Bergson, Creative Evolution, p. 3; Creative Mind, p. 150.

mathematics to justify his ideas of nature, and Whitehead is in harmony, but Whitehead justifies each employment of mathematics with sense-awareness while Newton does not. What emerges from Whitehead's thought is a unified view of nature which gives a primary importance to time and is markedly different from other philosophers or scientists. Whitehead's philosophy of nature explains both sense-awareness and the causes of sense-awareness.

It is because Whitehead was constructing a total view of nature that this thesis necessarily investigated his concept of nature before seeking his understanding of time. Whitehead's attack on the bifurcation of nature helps set the perimeters for his philosophy. It is because of the bifurcation of nature that Whitehead attacks the Newtonian construct of nature.

After establishing Whitehead's understanding of nature, the role that time plays in nature was sought. In this enquiry, Whitehead's disagreement with the concepts of absolute time and space are established. It was further shown that because nature is a process or passage it must involve space, time, and duration. Whitehead justifies duration in sense-awareness and describes it as a temporal thickness. After confirming duration's grounding in sense-awareness, Whitehead begins his construction of an

abstract concept of time by the method of extensive abstraction.

Whitehead's method of extensive abstraction is intended to reduce that which is complex into that which is understandable. This method of simplification is based on sense-awareness. This method has four major functions. The first intention is to prove the workability of the instant or moment, which has a mental existence, in the understanding of nature outside of the mind. Secondly, this method is based on the extended nature of sense-awareness more than on any other method. The third objective is to recognize motion and velocity as primary functions in nature. Fourthly, this method intends to remove deductive circularity from the definition of a straight line.

From this method of extensive abstraction, an analysis of Whitehead's notion of relative time was made possible. In this discussion of relative time, an attempt was made to reveal the similarities and dissimilarities between Whitehead's and Einstein's views of relative time. This was done by an analysis of Einstein's "Twin Paradox." Einstein revealed six basic attributes of time in this paradox. The first is that time must not be segregated from space as Newton had done. Secondly, time reveals itself as a multi-linear series and not as a uni-linear

series as Newton had advocated. Thirdly, time is a different dimension itself, the fourth dimension, based on the three dimensions of space. Fourthly, time is relative and not absolute as Newton had maintained. Fifthly, time in one linear series is not necessarily simultaneous with time in other linear series. Sixthly, the structure of space-time is not uniform but changes according to its contents.

Whitehead concurs with Einstein's first four pronouncements on time, but the disagreement emerges over the last two statements. Whitehead shows that the time in one linear plane is simultaneous with time in aonther linear plane in respect to duration. Whitehead also rejects the heterogeneous time of Einstein and holds that the structure of time is homolaidal.

After establishing Whitehead's concept of relative time, such problems as continuity, motion, and their relationships to time were discussed. Whitehead states that duration is continuous, but the abstract concept of time is successive. Motion is posited as a physical fact, and Whitehead assumes that rest is presupposed by motion. With this admission as to the nature of rest, Whitehead

is able to assert the existence of absolute position within a single space-time plane and thus reinforce his notion of simultaneity. This assertion of absolute position further estranges Whitehead from the orthodox relativists, who deny any absolute positions. It was also shown that time is not motion, though it depends upon motion.

In the final chapter, Whitehead's understanding of the present, and the present's relationship to the past and to the future is revealed. Whitehead discloses two aspects of the present. The first is an epistomological and psychological present, which is dependent upon memory and anticipation. This view of the present is in close accord with the Bergsonian view of the present. This notion of the present is individual or personal and exists in a single time-series, which is not necessarily simultaneous with other time-series. The second notion of the present is derived from duration and dependent upon the continuity of events and the before and after. This portrayal of the present allows the same present to exist simultaneously in other time-series. This view of the present differs

from the Bergsonian view.

Whitehead as a philosopher brings to philosophy the understanding of a scientist and mathematician equal to Newton and Einstein. He also incorporates a literary and poetical genius similar to Bergson. These attributes congeal into a unified philosophy of nature, which possesses important insights into nature and the nature of time.

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List of Corrections

page 3, line 13, 5th word, should be effluence

page 3, note 8, line 8, 6th word should be disastrous

page 4, note 11, line 9, omit the semi-colon and replace with a comma

page 13, line 21, the word up should be inserted after the word bound

page 17, note 7, line 2, 6th word, should be Cajori

page 17, line 14, 1st word, should be Milie

page 18, note 10, line 1, 1st word, should be Milie

page 26, note 24, should read as follows: Whitehead studies the perception of time more fully in, Science and the Modern World, N.Y: Macmillan, 1925, and in Process and Reality, N.Y.: Macmillan, 1929.

page 30, note 7, line 1, 4th word, should be Heisenberg

page 31, line 6, 2nd word, should be discernible

page 31, note 9, line 5, 1st word, should be monstrosity

page 32, line 5, Process and Reality should be underlined

page 43, line 2, 5th word, should be discernible

page 66, line 9, 9th word, should be deleted and the word to substituted in its place

page 72, note 2, should read as follows: M. Guyau, author of La Genèse de l'Idée du Temps, published in 1890 ...

page 73, line 10, 1st word, should be disagreement

page 88, line 13, 1st word, should be another

List of Corrections

page 93, item 3, should be Milie

page 95, item 1, Journal of Philosophy, should be underlined

page 95, item 9, Journal of Philosophy, should be underlined

page 96, item 7, should be Ushenko

page 96, item 8, Actes du 8 Congres International de Philosophie à Praque, should be underlined