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# Direct Perception and Whiteheadian Natural Philosophy

Dhanaraaj Raghuveer[a] and Dominik Endres[a]

[a]Theoretical Cognitive Science Lab, Department of Psychology, Philipps Universität Marburg, Germany.

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**ABSTRACT**
In this theoretical paper, our primary focus is on Alfred North Whitehead's natural philosophy. While the term 'natural philosophy' may be misleading, it is nothing but *general* natural science 'before it is convenient to split it up into various [*special*] branches' of physics, biology, and psychology. In the paper's first section, we warrant and contextualize such a study as contributing to the spirit of thinking together the physical, biological, and psychological science. In the second section, we look at Whitehead's *general* natural science, partly expressible as 'mathematical theory of a hypothetical substructure of the universe.' Specifically, we focus on two such theories, mechanistic materialism and Whitehead's ether of events, state their formal properties in intuitive terms, and draw out the corresponding implications it has for physics (Space, Time, Mass, Charge) and psychology (Sense Objects, Perceptual Objects). We concretize the dispersed insights on perceptual psychology in this section in a subsequent section - Direct Perception - and highlight the senses in which perception might be conceptualized as direct. Two are of notable importance, the first of which concerns the rejection of 'Bifurcation of Nature,' and the second with acceptance of the 'Solidarity Thesis.' We end with a brief conclusion.

**Abbreviations:**

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| UA | A Treatise on Universal Algebra |
| MCMW | On Mathematical Concepts of the Material World |
| PM | Principia Mathematica |
| IM | Introduction to Mathematics |
| PNK | Principles of Natural Knowledge |
| CN | The Concept of Nature |
| R | The Principle of Relativity |
| UC | Uniformity and Contingency |
| PR | Process and Reality |
| MT | Modes of Thought |
| ESP | Essays on Science and Philosophy |

**KEYWORDS**
Alfred North Whitehead; Indirect and Direct Perception; Material ether and Ether of events; Philosophy of Nature and Science.

Correspondence: Dhanaraaj Raghuveer. Email: dhanaraaj.raghuveer@uni-marburg.de

> "We shall term the traditional ether an 'ether of material' or a 'material ether,' and shall employ the term 'ether of events' to express the assumption of this enquiry, which may be loosely stated as being 'that something is going on everywhere and always.' It is our purpose to express accurately the relations between these events so far as they are disclosed by our perceptual experience, and in particular to consider those relations from which the essential concepts of Time, Space, and persistent material are derived. Thus, primarily we must not conceive of events as in a given Time, a given Space, and consisting of changes in given persistent material. Time, Space, and Material are adjuncts of events."
>
> - Whitehead (1919)

## 1. Introduction

To begin with, let us note a difficulty that might have been felt by many of the readers of this paper's title. It seems as if the central terms in the title – 'Perception' and 'Natural Philosophy' – are wholly irrelevant and disjunct from each other. However, one of the aims of this introductory section is to convince the reader that it is only *seemingly* so, while in actuality, both the terms mentioned above are intimately linked. The first important clue toward this conviction is the adjective *Whiteheadian*.

Following up on the *Whiteheadian* clue means explicating what natural philosophy is and what definition(s) Alfred North Whitehead gives to it. The first obvious definition that suggests itself to common sense is that natural philosophy is the 'Philosophy of Nature.' Of course, this is tautologous unless we further clarify what we mean by nature. Further, Whitehead immediately suggests a second definition of natural philosophy, which is 'Philosophy of Natural Sciences.' Thus, the term natural philosophy has a dual meaning, blurring the distinction between Philosophy and Science. It is also important to note that this blurring was always the case in the history of Western Science, starting from Newton, Leibniz through Maxwell and Faraday up until Einstein and Whitehead (Athearn, 1994). We will return to this relationship between Natural Philosophy and Science in a bit, but before that, we must look at what Whitehead means by nature.

"Nature is that which we observe in perception through the senses" (Whitehead, 1920, p. 3). This quote is the most crucial statement of Whitehead's natural philosophy and adherence to William James' Radical Empiricism (Auxier & Herstein, 2017). We will get ahead of ourselves if we tread this 'radical empirical' path. So, let us park it for the moment and note that this definition of nature immediately puts the two terms mentioned above into indirect relation – 'Perception' and 'Natural Philosophy.' Furthermore, Whitehead also defines nature as that which natural sciences study – "[N]atural sciences, that is, to the sciences whose subject-matter is nature" (Whitehead, 1920, p. 2). Combining these two definitions, we understand natural science as the science whose subject matter is 'that which we observe in perception through the senses.' With these explications, we are halfway through our goal of understanding the unity of this paper's title.

In the last couple of paragraphs, we have established what nature and natural science are. We still have to know what natural philosophy is. Whitehead answers that natural philosophy is *general* natural science. "Thus, the philosophy of [natural] science only differs from any of the *special* natural sciences by the fact that it is natural science at the stage before it is convenient to split it up into its various branches" (Whitehead, 1922, p. 5, emphasis ours). Thus, we see him conceiving of natural philosophy as a

*general* natural science, further solidifying the relation between natural philosophy and science we previously noted.

In consequence, natural philosophy qua *general* natural science includes within its ambit all natural scientific theories from Newton's Mechanics, Maxwell's Electromagnetism, and Einstein's Relativity to James' Psychology (Desmet, 2023). Elucidating such a *general* natural science is the task that Whitehead set for himself. To the extent that this paper is a study in Whiteheadian natural philosophy, such is the task we set for ourselves as well, thinking together physical and psychological science.[1]

Before we move on, let us briefly summarize the relation and relevance of natural philosophy to perception. There is an intimate connection between perception and nature; between nature and natural science; between natural science and *general* natural science; This brings to full completion one of the stated aims of this introduction. The following few passages serve as a guide to the core content and the intended goals of this paper, along with a broad outline of the subsequent sections.

"The primary task of a philosophy of natural science is to elucidate the concept of nature, [...], to exhibit the fundamental entities and the fundamental relations between entities in terms of which all laws of nature have to be stated" (Whitehead, 1920, p. 46). Succinctly put, the essential question that natural philosophy has to answer is: What are the fundamental relations and fundamental entities so related in nature? The answer given by Whitehead to this question forms the core of his natural philosophy and our next section. Concurrently, we will also look at the classical answer (given mainly by Descartes, Newton, and Locke) to the above-stated question, which goes by the name mechanistic materialism.

We present Whitehead's radical 'concept of nature' and the classical theory in intuitive, ordinary language terms. We resort to logical symbols only when we think they help drive home a point or for compact presentation. The justification for this decision is due to our focus in this paper on conceptual lucidity, not preciseness, for conceptual understanding comes first.[2] This also pertains to the mathematical 'Method of Extensive Abstraction' (MEA), which is the foundation of the bridge that Whitehead builds between the 'world of perception' and the 'world of science.' The preceding sentence reinforces the complex yet quintessential relation between one's theory of nature and the theory of perception. In that section, we will also note some of the crucial features of Whitehead's theory of perception, contrasting it with the classical theory rather unsystematically. In a subsequent section - Direct Perception - we make these unsystematic notes explicit and systematic by giving an understanding of what is 'direct' about perception in Whitehead's philosophy.

Thus, the primary goal of this work is to present a correct (to the best of our scientific knowledge) conception of nature (in contrast to mechanistic materialism) as given by Whitehead. The secondary goal of this work is to bring Whitehead's ideas into contact with the theory of direct perception in psychology, which, to the best of our knowledge, has never been attempted. The radicality and novelty of Whitehead's ideas speak for themselves, and we hope this work lays the platform for more exchange between Whitehead scholars and psychologists. We end the study with a brief conclusion.

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[1] Though we will not go into all the details of Whitehead's theories of Mechanics, Electromagnetism, and Gravity. Only those relevant to this paper, specifically space, time, sense, and perceptual objects. We refer the readers to Palter (1960), Herstein (2006) and Desmet (2010) for a complete technical account.

[2] "There can be no true physical [and psychological] science which looks first to mathematics for the provision of a conceptual model" (Whitehead, 1922, p. 39). However, this does not mean that mathematics is not essential to Whitehead's philosophy. In the *final* analysis, logical preciseness is equally crucial as conceptual lucidity.

## 2. Whitehead's Natural Philosophy

The best way to start this section is by briefly stating Alfred North Whitehead's academic biography. It is generally accepted that Whitehead's career could be broadly divided into three periods – Cambridge, London, and Harvard. The Cambridge period was his career's mathematical and mathematical logic phase, resulting in notable works like UA, MCMW, PM (vol I-III), and IM. The London period was his mathematical physics and natural philosophy phase, authoring PNK, CN, and R, which is the main focus of this paper. The later Harvard period was his metaphysical and speculative philosophy phase, during which he wrote his magnum opus - PR, moving towards questions of more ultimate nature than his natural philosophy (which itself is 'quite ultimate' in scope). While there are these differences and discontinuities in his academic career, there are also many continuities between these works. The most important being the mathematical character of almost all of his works (Auxier & Herstein, 2017; Desmet, 2010).

We make this emphasis on the mathematical character because one could summarize, albeit with some qualifications, Whitehead's natural philosophy as a search for "mathematical theory of a hypothetical substructure of the universe, uniform under all the diverse phenomena" (Whitehead, 1947, p. 285). This search is connected to "the problem of space," one of Whitehead's two career-long problems.[3] It is well acknowledged among Whitehead scholars that the seed for Whitehead's mature solution to the said problem is present in his 1906 memoir 'On Mathematical Concepts of the Material World' (MCMW) (Durand, 2008; Eastman & Desmet, 2008; Mays, 1961; Simons, 2007). It is to this memoir that we now turn to understand better the classical 'concept of nature' and Whitehead's alternative.

"Whitehead in MCMW might be said to be engaging upon a mathematical (or logical) investigation of various possible ways of conceiving the nature of the material world" (Mays, 1961, p. 237). Specifically, he sets out two (punctual and linear) broad classes of mathematical concepts of the material world and several variants of them. Our focus here will be only on Concept I and Concept V because they reflect the classical mechanistic materialism and an early version of Whitehead's 'ether of events.' Before we explore these two concepts in detail, we need to set out some structural features of all the mathematical concepts presented in MCMW.

These common features are but a version of what Whitehead takes to be the features of any natural philosophy, i.e., to exhibit the fundamental entities and relations between entities. However, in this inquiry, he limits himself to the *material world* and not nature. For example, he defines the material world as "conceived as a set of relations and of entities which occur as forming the 'fields' of these relations" (Whitehead, 1906, p. 466). The main point is that the set of fundamental relations and fundamental entities uniquely identifies each concept.

For all the five concepts presented there, Whitehead posits three fundamental relations with variations in their properties and entities so related. These three relations are 1) Essential (Space-) Relation, 2) Time-Relation, and 3) Extraneous-Relation(s). The essential relation is a polyadic relation ($R_S(s_1, s_2, s_3, ..)$) whose field is formed by the geometrical entities. The time relation is a dyadic relation ($R_T(t_1, t_2)$) whose field is formed by the temporal entities (which in all the five concepts are instants of time).

[3] "Whitehead's theory of extension has been generating an increasing amount of interest amongst logicians, computer scientists, and mathematicians in recent years [...]. Whitehead's mature theory of extension represents the culmination of a lifetime of work on what might be called "the problem of space" [...]" (Auxier & Herstein, 2017, p. 59).

Extraneous relation(s) deal with the space occupation of the particle(s) of matter at instants of time ($R_E(p, s_1, t_1)$) through which the laws of dynamics can be defined. These structural features are common to all the five concepts. We are now better positioned to explore the specifics of Concepts I and V. Here, we will limit ourselves only to the essential relation because the most significant difference between the concepts in MCMW is present only there.

In Whitehead's words,

> "According to this concept of a material world, which we call the *Classical Concept*, the class of ultimate existents is composed of three mutually exclusive classes of entities, namely, *points of space, particles of matter, and instants of time.* Corresponding to these classes of entities there exist the science of *Geometry*, of *Chronology*, [...], and of *Dynamics*" (Whitehead, 1906, p. 467, emphasis in original).

Corresponding to these fundamental entities, we have three fundamental relations, with the essential relation being triadic $R_S(s_1, s_2, s_3)$ between any three *points* $s_1, s_2$, and $s_3$. The field of this relation is the 3-D Euclidean space, which is the absolute space of mechanistic materialism. The term 'absolute' means that the essential (space-) relation is independent of time for its content and points of space is an ultimate existent. The same goes for time, but in this memoir, all five concepts consider it absolute (i.e., the time-relation is independent of space for its content, and instants of time an ultimate existent). Before we look at the inherent problems in the classical concept, let us describe Whitehead's early version of 'ether of events.'

In his early 'ether of events' (Concept V), unlike Concept I, the ultimate existent class contains only two entities – linear objective reals and instants of time. These linear objective reals are "conceived after [...] a *straight line* [not *points*], which has a particular direction" (Mays, 1961), with an empirical interpretation of "the lines of force of the modern physicist" (Whitehead, 1906, p. 482). The essential relation in this concept is a pentadic relation $R_S(l_1, l_2, l_3, l_4, t_1)$ where $l_1, l_2, l_3$, and $l_4$ are all linear objective reals and $t_1$ an instant of time (Whitehead, 1906, p. 505). The important conceptual innovation to note here is that points of space are no longer ultimate existents but are rather derived from something more primitive and that this conception is motivated by advances in physics.[4]

The logic and algebra of relations that Whitehead uses to derive points and the corresponding Euclidean space in Concept V is beyond the scope of this paper. However, we point out that he *does* derive the Euclidean space and that it is neither ultimate nor independent of time (as seen from the essential relation above). However, time in this concept is still absolute, having the same time relation as in Concept I. This concludes the contrast between the classical concept of the material world and Whitehead's early alternative, which lays the groundwork for a theory where neither points, instants, nor particles are fundamental entities. We will now look at some of the problems in both Concept I and V, thereby giving a smooth transition to Whitehead's mature theory.

### *2.1. Problems*

One can categorize the problems inherent in the above concepts as logical, scientific, and philosophical. The logical problem is the simplest, being one of parsimony. Whitehead criticizes the classical concept based on Occam's principle that it multiplies the fundamental entities beyond necessity (Whitehead, 1906, p. 468). In comparison to

[4]It is worth noting here that Whitehead wrote his Trinity Fellowship dissertation on Maxwell's theory, so the empirical/scientific impulse was present right from the start of his career.

this concept, Concept V posits only two classes of fundamental entities, so it is a step forward in that aspect. However, anticipating further development in Concept V, he says, "The complete concept involves the assumption of only one class of entities as forming the universe. Properties of 'space' and of the physical phenomena 'in space' become simply the properties of this single class of entities" (Whitehead, 1906, p. 525).

Concerning scientific problems, both Concepts I and V are somewhat guilty. We have instants of time as an ultimate existent in both concepts, flowing absolutely, with its contents independent of space. However, this was not a scientific problem in 1906 because until then, "the magnificent stroke of genius by which Einstein and Minkowski assimilated time and space" (Whitehead, 1922, p. 88) did not happen (at least not Minkowski's genius). However, Whitehead discusses Faraday's vision of the material world as composed of 'tubes of force' through his linear objective reals in Concept V. But since this memoir is discussed 'purely for the sake of its logical (i.e. mathematical) interest,' he does not go too deep into physics. However, his alternative concept is a (partial) step forward, even concerning science.

We now turn to philosophical problems. We remind the reader that MCMW in and of itself has "no concern with the philosophic problem of the relation of any of these concepts [of the material world] to existence" (Whitehead, 1906, p. 467). However, when that relation *is* made, which is precisely what mechanistic materialism does, a whole set of problems arises. In fact, the mechanistic materialist makes a one-to-one relation between his Concept I and nature/existence. Simply put, the mistake of mechanistic materialism is that they move from a limited domain ('concept of material world') to a broader domain ('concept of nature') without making any changes in their conceptual categories suitable for the broader domain.

We give a suitable scientific analogy for heuristic purposes. When a classical mechanist tries to determine a pulley and cable system's position/velocity, she can abstract away the pulley's color, the cable's shape, etc. Furthermore, in some cases, she can also abstract away the friction between the pulleys and cables, giving us adequate predictions. Nevertheless, it is a fact that as this science moves to a broader domain, it has to take those frictional forces into account as well. The problem with mechanistic materialists is that they do not consider the 'frictional forces' when they move to the broader domain of nature.[5]

This pervasive tendency among scientists and philosophers is what Whitehead later christened as 'The fallacy of misplaced concreteness.' To sum up, mechanistic materialists make a claim about nature when all that they *can* make is a claim about the material world from Concept I. Even in this limited domain, Whitehead cursorily hints that the classical concept is inadequate owing to advances in modern physics. So, we are now in a position to state the final conception of *nature* as given by mechanistic materialism: There is the absolute container called space ('given Space') existing independently, with a universal clock ('given Time') flowing equably and absolutely, with particles of matter having different space occupation relations at different instants of time based on dynamical laws. That is all there is to *nature.*

Let us now look at the 'whole set of problems' arising from this concept of nature. The foremost problem with saying that nature is nothing but a whirring of point particles according to necessary laws is that the world we look and perceive is largely unaccountable. No amount of mathematical gymnastics with point particles has given us the colorful, rosy-smelling flower we encounter. However, it is an undeniable *fact* of

[5]These 'frictional forces' in Whitehead's terms are the sense, perceptual, delusive objects, extensive relations, etc. We give a complete account of these and how they are related to mechanistic materialism, 'ether of events,' and perception in 2.3, 2.4, and 2.5. See also Note 6.

our experience. Furthermore, it is also a fact that the science that had these presuppositions (space, time, and matter as ultimate) had real success. The attempt made by Descartes to bring these two facts into coherence was the cartesian split of matter ('real' nature – res extensa) and mind ('apparent' nature – res cogitans). Materialists chose the matter side of the split, Idealists chose the mind side, and Dualists were in the middle of nowhere. Regardless of which of these three camps one belonged to, all three presupposed this split either in theory, in practice, or both. Whitehead called this split 'The Bifurcation of Nature' and rejected all philosophies that presupposed it.

The question of which came first, the Cartesian bifurcation or the classical concept of nature, is irrelevant to this study. It is only of interest to us that these two ideas are intricately linked. If one were a materialist like Democritus, one could simply say, "By convention sweet, by convention bitter, by convention hot, by convention cold, by convention color. In reality, atoms and void" (Goodman & Caramencio, 2013, p. 27) without ever telling us what you mean by 'convention.' That is because, as a materialist, those sense experiences are nothing but illusions and are irrelevant to understanding 'real' nature. Dualists like Locke were not satisfied with this, giving meaning to the term 'convention' as 'psychic additions' made by the mind. Thus, for Locke, there are the 'primary qualities' present in the 'real' world and the 'secondary qualities' added by the mind to matter.

The actual origin of currently mainstream theories of perception - entities of the 'real' world impinge on the mind, leading to our perception of a colorful, 'apparent' world *mediated* by psychic additions or 'mental processing' (stimulus enhancement, inferring hidden causes) - is to be found here. The last few sentences depict how significant and intertwined the philosophical problem is with perceptual psychology.[6] To complete our brief historical account, we note that this classical line of thought undergoes twists and turns over time, like Hume's sensory empiricism, Kant's transcendental and post-Kantian idealism, etc. As important as these works are, we do not think they go beyond the confines set by the classical conception of nature.[7]

There are plenty of other problems for the mechanistic materialist, like the place of aesthetic and moral values, purposes, goals, thoughts, imaginations, etc.[8] in reality and how to account for them. However, Whitehead considers them not to fall within the scope of natural philosophy. Thus, his solution to those 'more ultimate' questions will not be considered here[9]. Having said that, to the extent psychology makes inquiries about values, purposes, and goals (which we think it should), it will have to get metaphysical, at least according to Whitehead's classification.

Getting back to natural philosophy from our metaphysical digression, we are led to the following conclusions about the classical concept: With all its 'misplaced concreteness' and bifurcations, mechanistic materialism can account for neither the richness of our perception nor the success of our sciences. We need an alternative concept of

[6] We need to emphasize here, lest the psychologist thinks Whitehead is a 'behaviorist,' with no theory of mentality, that he is the farthest one could ever get from behaviorism. For natural philosophy, "No perplexity concerning the object of knowledge [which is nature] can be solved by saying that there is a mind knowing it" and "the synthesis of the knower and the known" (Whitehead, 1920, p. 28), is left for metaphysics. Thus, the relevance of perceptual experience in natural philosophy does not mean 'higher phases of experience,' like conceptual imagination and thoughts, are not real. They belong to a much broader domain of speculative philosophy/metaphysics.

[7] We did not go into the details of this path because depicting that story would require much subtlety, especially with Kant's philosophy, than what we are currently capable of.

[8] Analogously and satirically called 'tertiary qualities' by (Desmet, 2016)

[9] In Whitehead's own words: "The *values* of nature are perhaps the key to the metaphysical synthesis of existence. But such a synthesis is exactly what I am not attempting" (Whitehead, 1920, p. 5). See also Note 6.

nature, and that is where we now move.

### *2.2. Whitehead's Concept of Nature*

Let us recap the previous subsection to contextualize Whitehead's alternative concept of nature. There was the logical problem of parsimony and the constraint that a satisfactory concept should employ as few fundamental entities and relations as possible. There was the empirical/scientific problem of absolute space & time and the emerging unification of space-time and relativistic effects to be accounted for. Finally, there is the philosophical problem of bifurcating nature into a 'real' world of science and the 'apparent' world of perception, which has to be addressed. In other words, Whitehead aims for a philosophically satisfactory, empirically adequate, and logically parsimonious concept of nature. Fast forwarding 13 years, Whitehead presents the first systematic exposition of his natural philosophy in PNK and CN, satisfying all the above criteria.

In contrast to Concept V in MCMW (which had two fundamental entities and three fundamental relations), Whitehead posits only one class of fundamental entities, called Events, and two fundamental relations – Extension and Ingression. The fact that he posits only one class of entities and two fundamental relations satisfies the relatively simple criteria of logical parsimony. The real deal lies in our understanding of how the bifurcation of nature is avoided and how the relational theory of space and time demanded by modern physics is addressed adequately. Specifically, we need to show *what* properties of events, extension, and ingression allow us to bridge the 'world of perception' with the 'world of science,' and *how* Whitehead achieves that, all the while being scientifically robust. That is the task before us in the following few subsections. Surprisingly enough, the place to start this journey is through an account of Whitehead's radical empiricism. We end this subsection with a succinct summary of his 'ether of events,' around which all of our following subsections revolve.

> "[T]he concrete facts of nature are events exhibiting a certain structure in their mutual relations and certain characters of their own. [...] The mutual structural relations between events are both spatial and temporal. If you think of them as merely spatial you are omitting the temporal element, and if you think of them as merely temporal you are omitting the spatial element. Thus, when you think of space alone, or of time alone, you are dealing in abstractions, namely, you are leaving out an essential element in the life of nature as known to you in the experience of your senses" (Whitehead, 1920, p. 167).

### *2.3. Whitehead's Radical Empiricism*

We begin this subsection by noting that Radical Empiricism is an important, if not *the* most important, aspect of Whitehead's natural philosophy (Auxier & Herstein, 2017, Ch. 2). It is the solution to the problem of the bifurcation of nature. The bequest that Whitehead inherits from radical empiricists like James and Bergson.[10] As mentioned earlier, the importance of radical empiricism is exhibited in Whitehead's definition of nature - "Nature is that which we observe in perception through the senses" (Whitehead, 1920, p. 3). In other words, the starting place of natural phi-

[10]Though we are not sure if either James or Bergson solved the bifurcation problem with the lucidity and precision of Whitehead. Bergson had his *Calculus of Intuition* (Gunter, 1999), but we are unsure if it is as robust as Whitehead's MEA, and we do not think James had such a method. Irrespective of that, Whitehead's debt to them is obvious in his writings.

losophy is our immediate sense perception and getting it *as correct as possible*. The question now is, 'How does this solve the bifurcation problem?'

Briefly stated, Whitehead's strategy is to start with immediate sense experience and 'define,' via the Method of Extensive Abstraction (MEA), the 'world of science.' For example, Whitehead says, "Accordingly nature at an instant, since it is not itself a natural entity [factors of sense perception], must be *defined* in terms of genuine natural entities. Unless we do so, our science, which employs the concept of instantaneous nature, must abandon all claim to be founded upon observation" (Whitehead, 1920, p. 57, emphasis ours). There are two important points to note in this quote. One is the importance he gives to concrete sense experience, and second, he does not by any means repudiate the instants of time (or points of space) as being 'mere abstractions' but is motivated to provide a solid ground for their successes and usefulness. This is Whitehead's radical empiricism.[11]

This strategy means that we need to know 1) What Whitehead takes concrete sense perception to be and 2) How, through MEA, Whitehead bridges abstract science and concrete perception. We will focus on the first question in this subsection and the second in the next. We will also see how the scientific problem stated previously is addressed there. We will also answer the 'what and how' questions of the previous subsection by answering these questions.

To get to an answer to the first question, we start with what Whitehead says are three components in our natural knowledge - Fact, Factors, and Entities - and their connection to sense awareness. Fact is defined as the "undifferentiated terminus of sense-awareness" (Whitehead, 1920, p. 13), which he says is the ultimate starting point of natural knowledge. He reinforces this and also gives a positive characterization by saying, "In the *first place*, there is posited for us a general fact: namely, something is going on" (Whitehead, 1920, p. 49). We will get back to this positive characterization in a moment. Then, he defines factors as the "termini of sense-awareness, differentiated as elements of fact." Finally, "entities are factors in their function as the termini of thought." Such entities, which are factors of fact, are called natural entities, while entities that are not so will not fall within our consideration here.

Now, we need to grasp the characterization of fact as 'something going on.' Whitehead means by that phrase that we have never experienced nature as standing still. It is always moving on. "There is no holding nature still and looking at it" (Whitehead, 1920, p. 14). It is always in passage. For example, when I look out through my window, I perceive the birds chirp*ing*, wind blow*ing*, leaves flutter*ing*, cars mov*ing* and there is always 'something going on.' Even if we restrict ourselves to some artificial situation, like enclosed within a dark room where *seemingly* nothing happens, at the very least, our percipience of that 'nothing happening situation,' which is a part of nature, is 'going on.' This wooden table on which I am writing is also an occurrence, albeit with more enduring characters than the events above. Whitehead says, "An event does not in any way imply rapid change; the endurance of a block of marble is an event" (Whitehead, 1922, p. 21). Thus, our sense awareness always discloses nature and elements of nature as a passage, a happening, which Whitehead calls events.

Moving on to factors, the differentiated elements of fact, there are broadly two factors in our sense awareness. One is the 'discerned' and the other 'discernible.' The discerned is comprised of those elements of fact whose individual characters are vividly discriminated. The discernible elements are not so discriminated but are still given in

[11] Or better yet Radical Realism (Auxier & Herstein, 2017, Ch. 10), given his sympathetic treatment of abstractions and ideality. See also (Auxier, 2013, Ch. 4) for more on this, especially for Jamesian Pragmatism.

our sense awareness as a 'bare something' with *definite relations* to the field of discerned entities. This means that, for Whitehead, not just relata but relations between relata are also directly given in sense perception. "Evidently the relations holding between natural entities are themselves natural entities, namely they are also factors of fact, there for sense-awareness"[12] (Whitehead, 1920, p. 13).

For intuition, let us consider an example of discerned and discernible events. When we look at a sphere, we are aware of the outside of the sphere in all its colors, textures, and other individual characters. We are also aware of the sphere as being *between* me and the blue wall, or *above* the white table, and so on. Thus, we also perceive the spatial[13] relations holding between the discerned events. Furthermore, even if we do not discern the events happening inside the sphere (when we do not know if it is hollow or solid), we are still aware of a 'bare something,' called the 'center,' which has a definite relation to the discerned outside events. That 'bare something' is known by us not in its individual character ('cognizance by adjective') but by our awareness of its relation to the field of discerned events ('cognizance by relatedness').

We now bring in Whitehead, the mathematician, to elaborate on the 'refined distinctions' we mentioned in Note 12. On top of positing that relations are 'factors of fact, there for sense-awareness,' he also says that the space-time relations between *all* events are *uniform*, in contrast to the relations between characters of events. The source of this knowledge of uniform space-time relations is also experiential (prehensions), but that will drag us to 'more ultimate' questions, so we will not go there.[14] What this means is that the geometry of space-time relations and their givenness in our sense experience must have constant curvature, not variable curvature. This uniformity in curvature need not just be 0 (as in Euclidean geometry) but could also have other values but has to be constant/uniform (Eastman & Desmet, 2008).

This uniformity of space-time relations is at the root of our 'cognizance by relatedness,' allowing us to experience not just the space-time relations between discerned events but *all* of nature - the discernible for that sense awareness. It is important to remember that *all* of nature is discernible, but only some part of it is actually discerned.

> "The discernible is *all* nature as disclosed in that sense-awareness, and extends beyond and comprises all of nature as actually discriminated or discerned in that sense-awareness" (Whitehead, 1920, p. 50, emphasis ours).

Thus, the discerned events and the discernible events (factors) make up the fact for that sense awareness, which is one relationally complex event. Furthermore, inherent in sense awareness is the grouping of this relational complex into simultaneous events (extended 'now') for that sense awareness and those not so.[15] Thus, if we limit this whole of discernible to a specific bound, we get a specific event called 'duration,' "which is all nature *now present* as disclosed in that sense-awareness" (Whitehead, 1920, p. 52, emphasis ours). All the events of nature related to that percipient event as 'now' form the now-discernible, and of those events, ones whose individual characters are

[12] For James scholars, this assertion might be familiar, but Whitehead builds on it for more refined distinctions.

[13] We should be careful here about the usage of spatial/temporal because events are spatio-temporal, not in the sense that they happen *in* space or *in* time. In what sense they are will be explained in detail in 2.4.

[14] "In particular, this pre-epistemic grasp [prehensions] of the world is the source of our quasi- a priori knowledge of space which enables us to know of those uniformities that make cosmological measurements, and the general conduct of science, possible" [Herstein, IEP].

[15] The 'for that sense awareness' phrase in this sentence is crucial because unlike in the Newtonian view there is no absolute simultaneity, but rather the "meaning of simultaneity may be different in different individual experiences" (Whitehead, 1922, p. 67) in Whitehead's theory.

discriminated compose the now-discerned. This whole of nature, now-discernible for that sense awareness, is called duration, which is the answer to our first question.[16] This subsection partially explains the first sentence of the 'ether of events' quote in 2.2.

### *2.4. Whitehead's Method of Extensive Abstraction*

Before we get into this subsection and answer our second question on MEA, let us do a quick summary. For Whitehead, the ultimate data for sense awareness are events, characters of events, and relations between events. Owing to the uniformity of the spatio-temporal relatedness between events, "the immediate fact for awareness is the whole occurrence of nature" (Whitehead, 1920, p. 14). By reason of the inherent 'sense of now' in any sense awareness, the crucial notion of duration for that sense awareness is established. Thus, the event, which is called duration, is a special kind of event - "whole of nature which is limited only by the property of being a simultaneity" (Whitehead, 1920, p. 52). Having laid this out, we now move into our second question of how Whitehead bridges the gap between concrete perception and abstract science and the place of MEA in this move. We will start with one space-time system and then advance to multiple space-time systems, which is the basis of Whitehead's theory of relativity. To get there, we first need to absorb some properties of events and the relation between them (extension) to lay the groundwork for MEA.

The first important property of events is that their happening is utterly unique. An event happens 'just where it does and when it does,' and no concrete event is ever repeatable. Even if I take the same bus, at the same time, sitting in the same seat every single day to my office, none of those 'repetitive' events are *identical* to the other. The second important property of events is that they are spatio-temporally extensive. As mentioned earlier, they are spatio-temporal not in the sense that they occur *in* space or *in* time, but in the sense that each event is a four-dimensional extensive-volume *from* which space and time can be abstracted. Thus, the ultimate nature is only the ether of events with its fundamental relations of extension and ingression, not a static space-time block. We will use the word spatio-temporal only in this sense from here on.

Thirdly, events are relata of the homogeneous dyadic relation called extension and heterogeneous polyadic relation called ingression. A relation is homogeneous if it relates similar entities and heterogeneous if not. Extension relates only events, whereas ingression relates events and its characters/objects. In the following subsection, we will examine the relation of ingression and the accompanying theory of characters/objects. Here, we will focus only on extension and how Whitehead *defines* the 'world of science,' especially space-time system(s) through his MEA. There are other properties of events like non-persisting, non-changing, apprehended, etc., but the above three

[16]We understand that Whitehead's claim about 'whole of nature' and 'all of nature' simultaneous with my specious present is directly given for awareness is rather difficult to grasp. His later cosmological works give a complete technical explanation of this claim, which we cannot get into here. We apologize for the following lengthy quote, but it gets to the root of the matter: "In his earlier work, Whitehead lays great stress upon an account of perception whose most unusual and important feature is that it asserts the possibility of an awareness of distant events in their character of bare relata [discernible] with respect to the qualitatively perceived events [discerned] nearby. Such a minimal awareness of spatially distant events is taken as a primitive, given fact in the early doctrine of perception whereas it is replaced in the philosophy of organism by an elaborate explanation of just how a percipient event manages to perceive its contemporary world [all nature now-present] in what is called the perceptual mode of 'presentational immediacy'" (Palter, 1960, p. 2). We will take it as a given that such awareness of distant simultaneous events (only as bare extensive relata, not in its specific individual details) is possible and proceed further.

properties are sufficient for now.

Continuing with our exploration of the relation of extension between events, Whitehead says, "Every event extends over other events which are parts of itself, and every event is extended over by other events of which it is part" (Whitehead, 1919, p. 63). Let us take an example to get an intuition. Assume I see a patch of yellow on the wall in front of me for five seconds. According to Whitehead, the concrete situation of the yellow patch for the entire five seconds is an event ($e_1$). Take any one second within these five seconds, say third to fourth second, and that is an event too ($e_2$). Take any spatial part of this yellow patch, say the top half, for the entire five-second period, and that is an event too ($e_3$). Now, the event $e_1$ *extends over* both the events ($e_2$ and $e_3$), and this is the fundamental intuition for extending over or extension.

One can also see that *extending over* is a part-whole relation. That is, event $e_2$ is a part of the event $e_1$, and event $e_1$ will be a part of another whole, say the event that is this entire room for that five seconds ($e_0$), and so on. Thus, the events of nature and the relation of extension form a continuum that can be formally stated as a mereological theory.[17] The properties of this continuum, stated axiomatically in Whitehead's mereological theory, are essential for the method of extensive abstraction. We will review only some properties here to understand how space-time system(s) are abstracted from this continuum. We refer the reader to (Simons, 2007; Whitehead, 1919) for all the axiomatic details.

Some important properties of the continuum are that the relation of extension that forms it is non-reflexive, transitive, asymmetrical, and non-atomic. No event can extend over or be a part of itself (non-reflexive), and if an event ($e_2$) is a part of the event ($e_1$), and the latter event is a part of another event ($e_0$), then $e_2$ is a part of $e_0$ (transitive). Thirdly, if an event ($e_2$) is a part of another event ($e_1$), then $e_1$ cannot be a part of $e_2$ (asymmetric). Finally, every event is always a part of another event(s), and every event will have another event(s) as its parts. In other words, there are no minimum or maximum events in the continuum (non-atomic), and every event is open both 'above' and 'below.' These properties, along with others like density, continuity, compactness, etc., form the basis of Whitehead's non-serial mereology of events.[18]

With this in place, we now move to the serial mereology of events, which imposes two conditions on the non-serial mereology. Specifically, if a set of events satisfies two further conditions, then the relation of extension between those events becomes a serial relation. These two conditions are: 1) Given any two events of this set, one extends over the other, and 2) No event is extended over by all the events of the set. A set of events that satisfies these two conditions is called an Abstractive Set, which could be imagined as a series of Russian dolls extending over one another without any smallest doll (second condition). An Abstractive Element is a set of such Abstractive Sets that satisfies a further condition (K-Equivalence). It is important to reemphasize that no unextended event exists in any abstractive set or element, but still 'convergence' to a *natural non-existent* like an unextended instant of time can be *defined*. This *defining* of natural non-existents like instants from abstractive sets and elements (extended events) is precisely what MEA achieves. It is an analogous application to physics and geometry of how mathematicians *define* irrational numbers as a series of rational

[17] Mereology is just a technical name for studying such part-whole relations. "Following Lesniewski, I call a formal theory of the part-whole relation and cognate concepts a mereology" (Simons, 2007).

[18] Broad (1920) succinctly summarizes the non-seriality of extension confined to just these properties by saying: "This [non-serial] means that, although all events extend over some events and are extended over by others, yet there are pairs of events which do not stand to each other either in the relation K [Extension] or not-K [not-Extension]."

numbers even if the limit of that series is *non-existent* (Broad, 1920).

We now have most of the ingredients to see how Whitehead's MEA helps in *defining* space-time system(s). What we concretely experience in our sense awareness are durations, which are events. From this, by further conditions, one can define an abstractive set of durations and a set of such abstractive sets that satisfy still further conditions (K-Equivalence). Such a set of abstractive sets called an abstractive element, yields a moment, 'all nature at an instant.' Each moment is nothing but a duration stripped off any temporal extension, and so is also called an instantaneous 3-D space. A series of such moments abstracted from the continuous sense experience of one observer (in rest or uniform motion) forms a serially ordered time system. Such a series of moments and its corresponding instantaneous spaces form *one* space-time system. Thus, using MEA Whitehead solves part of the bifurcation and relativity problem by abstracting non-experienced moments and a non-absolute space-time from our concrete experience of extensive durations. Our next goal is to understand his multiple time systems. We must return to our Note 15 to comprehend that.

Whitehead is very clear that there is no unambiguous, universal, point-like, precise 'now' in nature. This was precisely the presupposition of the mechanistic materialists with their absolute, unique serial time. Whitehead is also clear that nature is not a static space-time block where the present or future is meaningless, and their distinction is but a 'stubborn illusion.'[19] Whitehead takes our experience of nature as seriously as the abstractions that science distills from it. The most crude fact for our experience is that nature is 'going on.' It is a passage, a process, a creative advance. Our concrete sense awareness discloses a unique 'slab' of this creative advance owing to our unique spatio-temporal standpoint (uniqueness of our percipient event) which we have called 'duration.'[20] It is possible to prolong this 'slab' temporally by staying in rest or uniform motion. Only within such a prolonged 'slab,' which Whitehead calls one family of durations, that time and space emerge as serially ordered abstractions and gain their meanings.

However, for different sense awareness (specifically, those in relative motion w.r.t the above sense awareness), a different 'slab' of the very same creative advance is presented. Prolongation of *this* 'slab' yields a different family of durations and, hence, a different space-time system with different meanings. By different meanings of space and time, Whitehead is saying that 'here' & 'there,' 'now' & 'then' mean different things in different 'slabs' of nature. This forms the basis of his multiple space-time systems and solutions to many relativity problems. In his own words,

> "The paradoxes of relativity arise from the fact that we have not noticed that when we change our time-system we change the meaning of time, the meaning of space and the meaning of points of space" (Whitehead, 1922, p. 56).

There are a lot of subtleties and technicalities we could unpack in Whitehead's multiple space-time systems and the subsequent derivation of a unique four-dimensional manifold, but dwelling any longer on that will take us away from psychology. The critical point is that starting from his radically empirical account of sense experience, Whitehead derives the abstractions of pseudo-Euclidean Minkowski space-time - quintessential for modern physics - through his MEA. Building from this as his base,

[19] This view of nature was *supposed* to be the only alternative due to the relativity of simultaneity and thus began the denigration of 'psychological time,' famously captured in the Einstein-Bergson debate (Canales, 2015).

[20] Whitehead expresses this uniqueness through his relation of cogredience. "An event can be cogredient with only *one* duration" (Whitehead, 1919, p. 70, emphasis ours). It is also important to note that our 'sense of now' is closely coupled with the spatio-temporal standpoint.

he further gives an account of electrodynamics (STR) and gravitodynamics (GTR), each having to do with characters/objects (charge and mass, respectively) of events. As mentioned earlier, we will not look at every detail of this aspect of his physics; we will only accentuate relevant points in the following subsection. To conclude this subsection, we direct the reader's attention to the 'ether of events' quote in 2.2 and point out that we have covered sentences two, three, and four in this subsection. It is to understand the 'characters of their own' phrase in the first sentence that we now turn to.

### *2.5. Whitehead's Theory of Characters/Objects*

This subsection would be the last in our exposition of Whitehead's natural philosophy but in no way the least. Along with the previous subsections, this subsection completes Whitehead's solution to the bifurcation problem, being relevant to both psychology and physics. If we could succinctly summarize this subsection, it would be that in Whitehead's natural philosophy, objects are theorized not as *substantive*, but instead as *adjectival*.[21] In the classical conception, objects - considered inert, isolated, enduring substratum in which inhered primary qualities (like size, shape, motion) - are fundamental. In Whitehead's natural philosophy passing, relational events are the fundamental entities, and objects are adjectives of events situated in them. Matter is just another adjective of events, sailing in the same boat as other adjectives like colors, smells, perceptual characters etc. This subsection aims to elaborate on the above sentences and the consequences that follow. To accomplish this task, we need to gain some understanding of objects and their properties in Whitehead's philosophy.

The first important property of objects is that they are repeatable. The exact shade of yellow (sense object) that I see on a yellow patch is also simultaneously an ingredient in the car outside my window and could also be an ingredient in other events in nature. Thus, unlike events, an object is repeatable; it is 'there and then, *and* it is here and now.' The permanence found in nature is because of the repetition of adjectival objects. The shade of yellow on my yellow patch repeats itself over successive events, thereby conveying a certain recognizable permanence. The second important property of objects is that contrary to spatio-temporal events (in Whitehead's sense), objects are not spatio-temporal. That is, events have passage. They are passing, and we abstract space and time from this passage. However, objects do not have passage. "Objects are elements in nature which do not pass" (Whitehead, 1920, p. 143). Thus, objects are primarily "without time and space" (Whitehead, 1919, p. 63).

It is important here to clarify why objects are non spatio-temporal. As mentioned above, the essence of objects is that they are enduring, permanent, 'a factor of nature without passage.' As such, given that they are elements of nature without passage, they are non-temporal. Furthermore, we have also seen in the preceding sections that the fundamental insight of the relativity principle (and our concrete experience) is that time and space always come together. Taking these two points together leads to the implication that objects are factors in nature that are non-spatio-temporal and to which the order of space-time does not apply. This seems like a rather radical point of Whitehead's natural philosophy but is a coherent extension of the insight of relativity principle. In this sense, objects are 'without time and space.'

[21] Whitehead uses the words adjectives (from 'cognizance by adjective'), characters and objects interchangeably. "In fact the character of an event is nothing but the objects which are ingredient in it" (Whitehead, 1920, p. 143).

Thirdly, objects are the relata of the relation called ingression. An object ingredient in an event is said to have a particular mode of *ingression* into that event. Just as Whitehead derived the uniform space-time manifold of physics from the relation of extension between events, he derived the non-uniform physical field (EM and gravitational field) from the relation of ingression. We will not be exploring the latter derivation in detail. However, we will discuss the different types of objects in nature that are relevant for perceptual psychology and for gaining a feel for that derivation. The last important property for our purposes is that, in contrast to events (which are perceived through *apprehension*), objects are perceived through *recognition*. However, both apprehension and recognition are direct, immediate, and non-intellectual in Whitehead's view.

Returning to the relation of ingression, Whitehead says that this relation is general and that there are many different modes of ingression. These different modes of ingression are due to the existence of different types of objects. "There are obviously very various kinds of objects; and no one kind of object can have the same sort of relations [mode of ingression] to events as objects of another kind can have" (Whitehead, 1920, p. 145). One such mode of ingression that is important for natural science is called 'situation.' Ingression is a general relation because it is the relation of an object to *all* of nature.[22] Situation is a more 'concentrated form' of ingression expressing the relation of an object to a more limited, definite event. Furthermore, Whitehead says he will use the term situation to mean the particular relation and the definite event to which the object is 'situation-ally' related.[23]

We have now laid down all the concepts and properties required to push ahead with Whitehead's typology of objects in nature and its place in bridging our concrete perception with abstract science. To start, the number of types of objects in nature is indefinite, according to Whitehead, and for our purposes of psychology and physics, three types are of utmost importance. They are sense objects, perceptual objects, and scientific objects. These three types of objects form an ascending hierarchy, with each higher type presupposing only the immediately lower type. Sense objects are the simplest and most fundamental of all natural objects, presupposing no other type. So, we will start from there and see how perceptual objects logically presuppose them.[24]

Let us start by considering some cases of sense objects. Returning to our example in 2.4 of me seeing a 'patch of yellow on the wall in front of me for five seconds,' the specific shade of yellow *in itself* is the sense object. Similarly, a concert hall 'filled by the sound for a tenth of a second' is an event, but the specific sound *in itself* is a sense object. Thus, "a particular sort of color, [...] , or a particular sort of sound, or a particular sort of smell, or a particular sort of [bodily] feeling" (Whitehead, 1920, p. 149) are examples of sense objects. All ingressions of sense objects into nature involve four sets of events (which may overlap). These are 1) a percipient event, 2) a situation event, 3) active conditioning events, and 4) passive conditioning events. For

[22] "[E]ach object is in some sense ingredient throughout nature; though its ingression may be quantitatively irrelevant in the expression of our individual experiences" (Whitehead, 1920, p. 145).

[23] "[B]y a double use of the word 'situation,' I will call the event in which an object is situated 'the situation of the object'" (Whitehead, 1920, p. 147).

[24] Here, we would like to remind the reader of Whitehead's rejection of the bifurcation of nature. This rejection implies that sense objects are not resident in the mind (as in Lockean ideas) but are real characters characterizing real events in nature. The redness of the rose is *not* a 'psychic addition' by the mind onto a configuration of material particles. Furthermore, any object (including sense objects) is recognized only as characters of events in which they are situated. So, the traditional conception of simple, atomistic sensations like Humean 'ink-dots' are not Whiteheadian sense objects. A more apt analogy would be *Gestalt* psychology's figure (object) - ground (event) perceptual experience. "[T]here is no recognition of sense-objects except as in relation to external events" (Whitehead, 1919, p. 83).

compactness, we depict this analysis of ingression as $I_{so} = R(p, s, ac, pc)$ where $p$ is the percipient event, $s$ is the situation event, and so on. Thus, ingression is a complex, polyadic relation compared to the classical binary substance-quality relation.

In our 'yellow patch' example, percipient event ($p$) is the relevant bodily state of the observer (me), $s$ is the 'yellow patch' in front of me (where I see the yellow), $ac$ are the "events whose characters are particularly relevant for the event (which is the situation) to be the situation for that percipient event" (Whitehead, 1920, p. 152), namely the 'yellow patch' in front of me and the state of the room as to illumination. Finally, the $pc$ are events of the rest of nature, whose characters are *not* particularly relevant for that percipient and that situation, but which provides the general spatio-temporal framework for them. In this scenario, the situation event is an $ac$.

If it were the case that I was perceiving the 'yellow patch' via a reflective mirror, then $s$ would be some event in front of me and 'behind' the mirror (where I see the yellow). The set of $ac$ would consist of the 'yellow patch' behind me (not in front of me), the mirror, and the state of the room as to illumination. $pc$ are events of the rest of nature.[25] Contrary to the previous case, the situation event is not an $ac$ but is rather a $pc$. This is because the 'yellow patch' event that I perceive (in front of me) is not one of the three $ac$ we listed above ('yellow patch' behind me, mirror, illumination events). Thus, the situation event is not an $ac$ in this case. This analysis of 'ingression into nature' is important for understanding all other types of objects, especially delusive, non-delusive, and scientific objects. Before we get to these types, we need to look at perceptual objects.

Whitehead's examples of perceptual objects are the commonly recognized black coat, white table, stone, tree, etc. We do not perceive a black coat merely as a patch of black color but rather as a 'coat,' i.e., as 'something more' than a mere sense object - a perceptual object. Whitehead says that the 'insistent perceptive power' of these perceptual objects has driven modern and scholastic philosophy into treating them as *substantive* objects, culminating in mechanistic materialism. Thus, Democritus' 'atoms and void' is nothing but the *substantive* stone made smaller and spherical—a nature composed exclusively of inert, isolated stones. Whitehead constantly tries to bring to the fore and remind us of the continually passing, relational events *within* which objects present themselves as more or less permanent characters.[26] The first step in heeding this reminder is to resist treating objects as substances and start seeing them as adjectives of events.

We cannot stress enough the importance of this conception of stones, trees, and coats as *adjectival* characters of events and not as some material *substratum*. All 'factors of nature without passage' are objects, and all objects (including perceptual objects) are relatively permanent *adjectival* characters of events. It is understanding this fact about nature that aids in rejecting the bifurcation of nature. For as we will see below, perceptual objects are the basis of physical objects, which in turn are the basis of scientific objects. Some of these objects are more subtle, while some are plain and obvious. Either way, all of them are adjectives characterizing actual events in nature.

We have now established that perceptual objects, just as much as sense objects,

[25]The differentiation between $ac$ and $pc$ is not sharp and clear cut. Whitehead says, "Conditioning events may be divided into two main classes which are *not* strictly discriminated from each other" (Whitehead, 1919, p. 86, emphasis ours). However, the main difference is that $pc$ makes only spatio-temporal contributions while $ac$ makes both their spatio-temporal and ingredient objects as contributions for that percipience and that sense object.

[26]In Whitehead's words, "Events are named after the prominent objects situated in them, and thus both in language and in thought the event *sinks behind* the object, and becomes the mere play of its relations" (Whitehead, 1920, p. 135, emphasis ours).

are adjectival ingredients of events; relatively permanent characters recognized in a continuum of happenings. However, we still have not seen the link between sense and perceptual objects. To get that link, we have to note that many situations have more than one sense object situated in them. For example, the cake that I perceive is not only the situation of pink color, but is also the situation of vanilla smell, sweet taste, circular shape, and so on. "It is a law of nature that in general the situation of a sense-object is not only the situation of that sense-object for one definite percipient event, but is the situation of a variety of sense-objects for a variety of percipient events" (Whitehead, 1920, p. 154). Thus, every situation is home to such a complex relational pattern (significations) of sense objects, which is nothing but the perceptual object ingredient in that situation. This relational pattern is the link connecting sense objects and perceptual objects.[27]

So, just to reiterate, perceptual objects are relational patterns of sense objects recognized as relative permanence in situations. Importantly, unlike the traditional conception where the unknown/hidden scientific objects cause internal sensations (in the eye/brain/mind) from which the external percepts are reconstructed/inferred, Whiteheadian sense and perceptual objects are both external and in nature.[28] The link between perceptual objects and sense objects within the specious present is not one of causation but one of signification/relatedness. "[T]he ingression of a sense-object into nature is *significant* of perceptual objects, so that thereby perceptual objects are known by *relatedness*" (Whitehead, 1947, p. 109, emphasis ours).

Recognition of perceptual objects is possible because of our 'cognizance by relatedness.' We examined the relevance of 'cognizance by relatedness' concerning spatio-temporal relations in 2.3. However, the same capacity is also essential for what Whitehead calls the 'conveyance' of one sense object by another. It is by this 'conveyance' and, by extension, our 'cognizance by relatedness,' that we can directly recognize perceptual objects - "a factor of nature directly posited in sense-awareness" (Whitehead, 1920, p. 155). Whitehead does not explicate further the connection between perceptual and sense objects. However, as a true radical empiricist, he is willing to consider any empirically robust psychological theory of perception. The only condition is that sense and perceptual objects should be *in* nature and their recognition direct, without any intellectual mediation.

There are two kinds of perceptual objects: 'delusive perceptual objects' and 'non-delusive perceptual objects.' The latter are also called 'physical objects,' the bridge between perceptual and scientific objects. Concerning delusive perceptual objects, its situation event is a *pc* (see above) for the ingression of that object into nature. The mirror scenario analyzed above applied to a perceptual object, such as a black coat, would be a delusive perceptual object. Regarding non-delusive perceptual objects, there are two criteria to be satisfied. 1) The situation is an *ac* for the ingression of

[27]Our exposition of the link between perceptual and sense objects is simplified due to changes in Whitehead's thought. In his initial works of PNK and CN, Whitehead held the view that perceptual objects are a class/group of associations of sense objects (Russell's 'class' theory). However, in the works of R and UC, he abandons the 'class' theory for the 'control' theory of perceptual objects where perceptual objects 'control' or 'condition' the ingression of sense objects in nature. What the 'control' theory means is that there is now a certain primacy to perceptual objects compared to sense objects. However, even in this view, recognition of perceptual objects happens only by way of sense objects. So, our assertion of a perceptual object being a complex relational pattern of sense objects still holds, albeit with some nuanced qualifications.

[28]However, this does not mean that bodily events like eye events, neural and brain events are irrelevant. These events are covered by $p$ in the above analysis of ingression ('relevant bodily state of the observer'). Some subset of $p$ would be what psychologists call sensation. Whitehead's point is that the situation event ($s$) is just as important, if not more, as the percipient event. If the color green did not ingress into the grass in the mode of situation, my percipience of the green grass would not even be possible.

any of its component sense objects, and 2) the same event is the situation of that perceptual object for an indefinite number of percipient events. A perceptual object satisfying both these conditions is a 'physical object.'

Under normal conditions (when our senses are not cheated), our perception is of 'physical objects' like chairs, tables, stones, etc. If not for most cases in which our senses are reliable, there would be no natural knowledge and science. However, this does not rule out the possibility of error in perception, and Whitehead's delusive objects cover such cases. With this, we have come to the end of the psychological part of Whitehead's theory of objects. Sense objects, perceptual objects, and physical objects lay the foundation for any theory of perceptual psychology. In fact, Whitehead says the foundations of *all* natural knowledge lie here.[29] Before we close this subsection, we would like to briefly touch on scientific objects and complete the solution to the bifurcation problem given by Whitehead.

As mentioned earlier, physical objects are the bridge between perceptual objects and scientific objects. This is because the situation of a physical object is a special kind of *ac*, called *generating event* (*ge*). This notion of generating events is essential for natural science. However, why is this so? What is it about natural science that an *ac*/*ge* becomes extremely important? The answer Whitehead gives is that "scientific knowledge is the endeavor to express in terms of physical objects the various roles of events as active conditions [*ac*/*ge*] in the ingression of sense-objects into nature" (Whitehead, 1920, p. 158). So if a sense object ingresses into nature, then science has to tell us the *ac*/*ge* for that ingression and how those events are systematically related in precise terms.

However, physical objects are not precise, simple, and uniform enough for this task, so scientific objects (like electrons, atoms, charges, and masses) are introduced. Thus, the sole purpose of scientific objects is to gain more precision in our science than what is possible with physical objects. With this assertion in mind, one can reformulate the above quote as "scientific knowledge is the endeavor to express in terms of *scientific* objects the various roles of events as active conditions in the ingression of sense-objects into nature." Bifurcation of nature happens when one forgets this close relation between scientific and sense objects, *both* being external and in nature. Another route to bifurcation is overlooking the fact that perceptual, physical, and scientific objects are all *adjectival* characters of events, not just sense objects. And neither of them is some 'stuff,' 'thing,' or material substratum.

While there are differences like uniformity and precision between scientific objects and physical/perceptual objects ingredient in *ac*, it has to be remembered that they are still objects. There are also other differences like scientific objects (electrons) are not directly recognized (at least not plain and obviously), but are more subtle.[30] It is the clear recognition of these objects that requires intellectual mediation and inferences. In sum, "Scientific objects are not directly perceived, they are *inferred* by reason of their capacity to express these characters, namely, they express how it is that events are [active] conditions." (Whitehead, 1919, p. 95, emphasis ours)

All physical and scientific objects are of the type 'material objects,' and by applying the MEA to material objects, one obtains ideal, precise event particles like point-charge

[29] "The situations of sense-objects form the whole basis of our knowledge of nature, and the whole structure of natural knowledge is founded on the analysis of their relations" (Whitehead, 1919, p. 85).

[30] "The characters which science discerns in nature are subtle characters, not obvious at first sight. They are relations of relations and characters of characters. But for all their subtlety they are stamped with a certain simplicity which makes their consideration essential in unraveling the complex relations between characters of more perceptive insistence" (Whitehead, 1920, p. 40).

and point-mass. These scientific objects (charge and mass) become the unextended event particles of the physical field in Whitehead's theory of electromagnetism and gravitation, respectively. In this manner, starting from our concrete perception of extensional events, adjectival objects, and their mutual relations, Whitehead derives the materialistic trinity of space, time, and matter.

This concludes our exposition of Whitehead's complete solution to the bifurcation problem, giving an account both for our perception's richness and our science's successes. In the next section, we will explain what is 'direct' about perception in Whitehead's concept of nature and why his philosophy is a type of 'direct realism' (Farleigh, 2003).

## 3. Theory of Direct Perception

To introduce this section, we would like to briefly sketch the problems with most mainstream theories of perception from a Whiteheadian perspective. Almost invariably, all theories of perception have scientific objects as their starting point. Specifically, the scientific object photon is supposed to strike the photon-sensitive retina, eliciting some sort of retinal pattern or image on the back of the eye. However, so the story goes, given that the retinal image is two-dimensional, but the world we perceive is 'three-dimensional,'[31] some sort of 'stimulus enhancement,' 'uncertainty reduction' or 'unconscious inference' must be carried out. This is posited to be done by the brain, and thus, the mainstream problem of perception becomes: 'How does the brain go from impoverished stimulus to a rich perceptual world?'

This assertion of ours as to the mainstream's problem should be commonplace for all perceptual psychologists and is not an inapplicable assertion to present-day theories. As recent as a year ago, (Vishwanath, 2023) describes the mainstream view as:

> "More specifically, the idea is that the visual system infers and reconstructs, through a process of inverse-optics, a unitary, veridical and internally consistent 'representation' of this objective external reality from the information available in the 2D optic array, and that it is this representation that we perceive" (Vishwanath, 2023).

Given this starting point, let us apply Whitehead's insights on nature, events, and objects to understand what is 'direct' about perception. Firstly, there are no existences in nature that are not extended, four-dimensional extensive-volumes. Even when we poke a 'pin-point' needle in our fingers, it has a spatio-temporal spread. Logical and mathematical ideals like points, one-dimensional lines, and two-dimensional planes/images do not exist in nature. An extremely tiny quantum event is also an event; a four-dimensional extensive-volume. To think that our retinal and eye events are point excitations, leading to two-dimensional images, is a case of misplaced concreteness.

With this understanding of nature and natural events in place, the supposed loss of information from a 'three-dimensional' world to a two-dimensional retinal image and the necessity to posit enhancement of impoverished stimulus or uncertainty reduction to get back the 'three-dimensional' world is rejected. There are four-dimensional events in the remote physical environment, four-dimensional events in the immediate bodily environment of eyes, and so is our percipience a four-dimensional event. This is one

[31] We wish psychologists paid some attention to the revolutionary advances in physics. For all the issues in Einstein's relativity and the standard interpretation, it is at least transpicuous that there is no 'three-dimensional' world either in concrete experience or in abstract science.

sense in which perception is 'direct' according to Whitehead's natural philosophy - a dimensional homogeneity and directness among all occurrences in the ether of events.

The second sense in which perception is 'direct' in Whitehead's philosophy has to do with the rejection of 'Bifurcation of Nature,' which has been a recurring theme throughout this paper. From a Whiteheadian point of view, starting from scientific objects like electrons or photons is fine, especially in scientific investigations. However, without understanding what we *mean* by a scientific object like the photon, electromagnetic wave, optical arrays, etc., our physical and psychological sciences would end up in a confused tangle. Providing such an understanding is precisely the goal of Whitehead's natural philosophy, thereby untangling some confusion in psychology (our focus).

Specifically, if a psychologist understands a scientific object like a photon to be some kind of a substantive, or that they are the *only* objective, in-nature, & external factors, then she is committing the fallacy of misplaced concreteness. It is a modified version of the materialist's starting point of matter (instead of photon) with the same presupposition of mechanistic materialism. Matter (or photon) are *not* all there is to nature, and every mainstream theory of perception presupposes this natural philosophy implicitly. Colors, tastes, smells, and other sense objects are objective, external, and in-nature, according to Whitehead, not just in our heads. This implicit presupposition of the mainstream theory leads to attempts at explaining our experience of colors and smells as a 'production' of some brain processes or mental inferential processes.

The difficulty of such an explanation goes by 'The hard problem of qualia' in contemporary philosophy. We believe such problems to be mere symptoms of the root problem of an inadequate natural philosophy. But how do we justify such a belief? To answer this question, we will repeat the same strategy of applying Whitehead's insights into nature, events, and objects.

The first point to note is that contrary to mechanistic materialism, scientific objects, and sense objects are of the same type of factor in nature. They are both *adjectival* characters of events in Whitehead's philosophy. In mechanistic materialism, matter (scientific object) is supposed to be *substantive* or a substratum, and colors (sense objects) are supposed to be qualities. Furthermore, such qualities as colors are supposed to be subjective, while other qualities like motion and solidity are objective. This split is the classic bifurcation of nature in materialism.

The difficulty of the 'hard problem,' within the presuppositions of materialism, becomes the difficulty of this jump between scientific and sense objects. The former are supposed to be objective and substantive, while the latter are subjective and adjectival. If the external, in-nature, material substances and their interactions cannot produce colors and adjectives, how can the brain (another material substance) produce colors? The Whiteheadian solution to the 'hard problem' is understanding scientific and physical objects as adjectival characters of events, equally external and in-nature as sense objects. With this understanding in place, the psychologist can – instead of asking how the brain 'produces' colors and tastes – rethink the brain's actual role in our experience of sense objects.

Our next target is the mental inferential processes, which are not concerned with materialism per se but dualism. In the case of dualism, there is a mental substance on top of material substance, and only the former can be *qualifi*ed by colors, tastes, and smells. This qualification is supposedly achieved by mental processes like deductive and inductive inferences based on unaccountable prior knowledge.

However, positing mentality and inferential capacities for the very experience of sense objects means that only certain high-grade organisms (like humans) are capable

of such experiences. Surely, low-grade organisms like amoeba are not capable of thought & other mental processes. Ergo, they are not capable of experiencing any sense objects. Whitehead rejects this dualistic line of thought, which presupposes the bifurcation of nature. A low-grade organism like amoeba experiences sense objects just as a high-grade organism like humans.

Obviously, there are differences in the sense objects experienced by an amoeba and a human, but at the very least, both experience the sense object, which Whitehead calls bodily feelings (see 2.5). Thus, though it may be the case that mental capacities and inferences make the perception of sense objects vivid, distinct, and clear, such perception is not *grounded* in mental processes. The ground for such perceptual experience of sense objects is the rejection of the bifurcation of nature. We thus justify our above-stated belief and assertion of 'difficulty' for the philosophies of both materialism and dualism. The above arguments also exhibit the second sense in which perception is 'direct' - by its rejection of inferential and thought processes as necessary for the perception of sense objects. In this case, the directness has to do with a sort of adjectival homogeneity and ingression of sense objects among all occurrences in the ether of events.

The third sense in which perception is 'direct' has to do with acceptance of the 'Solidarity Thesis.' Complete elucidation of the solidarity thesis will take us beyond the confines of the present study, which is limited to Whitehead's natural philosophy. However, the solidarity thesis is vital to the theory of perception, so it should at least be briefly sketched, if not fully elucidated. We would like to take the case of apprehension of events here to start that brief sketch.

First and foremost, our perception/percipience is an event. A Percipient event. The fundamental relation between events is the relation of extension. In Whitehead's metaphysics, these extensive relations between events mean that events in the 'immediate past' of my percipience have 'primary modal presence' in my percipient event. In fact, the entire metaphysical past of any event is 'modally present' within that event, although most of them do not have primary modal presence.[32] The crucial term in the above sentences is *modal*, and explaining it along with the logic of possibility (which could be loosely called Modal Logic) & the continuum of possibility (which could be loosely called Extensive Continuum) is beyond the scope of this paper.[33] All we have to understand is that there is a sense in which the immediate past of any event is *immanent* in that event.

One difficulty in grasping this relation between the immediate past of an event and the event itself has to do with what Whitehead calls an "extraordinary naive assumption of time as pure succession" (Whitehead, 1927). This assumption is nothing but the materialist's view of time as a series of instants, with each instant having the properties of a mathematical point. According to this view, every instant is extensionless and lies external to every other instant, with the only relation between each instant being pure succession. Extrapolating, one reaches the view of past events as merely externally related to the present event, playing no role in the latter's constitution.

Whitehead rejects such a view of time and its consequent relation between the immediate past and the present as a high abstraction. In Whitehead's words, "Time

[32] "Thus, if we allow for degrees of relevance, and for negligible relevance, we must say that every actual entity is present in every other actual entity. The philosophy of organism is mainly devoted to the task of making clear the notion of 'being present in another entity'" (Nobo, 1986, p. 373). Whitehead shows the logical, mathematical, and philosophical possibility of how one actuality or event can be modally immanent in another. However, the empirical possibility and evidence of such modal immanence will be significant in convincing people of this 'baffling, antithetical relation' (Whitehead, 1938) between any two events.

[33] A detailed and challenging discussion of these topics is found in (Auxier & Herstein, 2017; Nobo, 1986).

in the concrete is the *conformation* of state to state, the later to the earlier; and the pure succession is an abstraction from the irreversible relationship of settled past to derivative present" (Whitehead, 1927, emphasis ours). The conformation of the present event to the immediate past is possible because of the modal immanence of the latter in the former.[34] Thus, one crucial difference between Whitehead's process philosophy and mechanistic materialism is the concrete nature of time, the modal immanence of the past in the present, culminating in the solidarity thesis.

With the above stage setting, we can now answer how accepting the solidarity thesis furnishes the third sense of 'direct.' We will start by applying Whitehead's insights on nature, events, and objects as in the previous two cases. Let us take the concrete case of my perception of the green tree outside my window. First and foremost, that tree-actuality exists in itself and for itself as an event embodying a particular extensive region in the ether of events. Then, there is the complex ingression of adjectival characters/objects into that event as their situation. One such adjectival character is the sense object green; the other such adjectival character is the perceptual/physical object tree. Note here that the sense object green characterizes a region in the ether of events, an actuality existing in itself and for itself, thereby making it objective, external, and in-nature.

Then, that actuality becomes modally immanent in all events in its future and thus modifies the character of those future events. Starting from the remote physical environment, that tree-actuality modifies the electromagnetic events, then the immediate bodily environment of eye events, passing on to nerve and brain events. The final event relevant in this analysis is the high-grade percipient event, which, together with other such percipient events, constitutes my stream of human experience.[35] Again, we note that all the events mentioned above are four-dimensional extensive-volumes. Furthermore, every occurrence in the ether of events exhibits the solidarity thesis - the modal immanence of the immediate past.

So when we say the event that is the 'green tree outside my window' is directly perceived, we mean that the event that was the tree-actuality a few microseconds ago (past) becomes a *direct, immanent* part of the event which is my percipience now (present). Now, of course, this does not mean that other events like the electromagnetic light events and events of my eye are not a part. They are. The former corresponds to the remote physical environment, while the latter to the immediate bodily environment. Using the word environment to include bodily activities might sound odd, but Whitehead's definition of environment is based on temporality. That is, a critical part of any event's environment is all of its metaphysical past. Thus, if the event under consideration is a brain event, then the eye event *preceding* the said brain event would be a part of its environment. The same might be said of an ear event in the case of auditory perception.

We have digressed. The point to note is that, owing to the modal immanence of the immediate past events in any present event, there is a direct, internal, and immanent relation between the past tree-actuality and my present percipience of it. According to Whitehead, such a relation between an immanent past event and a present percipient event is a perceptual relation. Specifically, he calls such perceptions 'perception in the

[34] "The past consists of the community of settled acts which, through their objectifications [modal immanence] in the present act, establish the conditions to which that act must conform" (Whitehead, 1927).

[35] We would like to note a potential inconsistency in Whitehead's use of the term 'percipient event.' In his earlier natural philosophy, he *identified* it with the 'relevant bodily state of the observer.' However, in PR, the percipient event becomes "some thread of happenings wandering in 'empty' space amid the interstices of the brain." Thus, it is not *identified* with the brain but nevertheless closely coupled to it. Thus, the events that constitute the stream of human experience are closely related to the brain but are not identified with the brain.

mode of causal efficacy' (PMoCE). He believes this mode of direct perception to be metaphysically basic and is the ground of all other modes of perception (including our sense perception). Thus, the third and final sense (which helped us in incorporating the remaining two senses in one coherent example) in which perception is said to be 'direct' is the modal immanence of the causal past of an event within that event, also known as the 'Solidarity Thesis.'

However, there is a catch to this mode of perception. The perceptual mode of causal efficacy, even though it is primitive and is exemplified by all grades of occasions ranging from an amoeba to humans, is "unmanageable, vague, and ill-defined" (Whitehead, 1927). The 'clear and definite' perception of our environment in normal conditions is due to a different mode of perception called 'perception in the mode of presentational immediacy' (PMoPI). As the name suggests, this mode of perception has to do with relations between co-present or contemporary events. This latter mode of perception is observed only in high-grade organisms like humans. Our ordinary sense perception is one sub-modality of this general mode of perception. The question now becomes whether PMoPI is *direct* just as PMoCE, and what is the connection between the two modes?

In answering the first question, we bluntly say that PMoPI is indirect. By this, we mean that there is a necessary involvement of mentality and what Whitehead calls 'physical imagination' in PMoPI. To elaborate on this point, we will look at the connection between the two modes of perception. To recap, there is the *formal* existence (in itself and for itself) of an extensive region in the ether of events with complex ingression of characters/objects within it. Then there is the *objective* existence of that event in my percipience owing to the modal immanence of the past in the present. The objective existence abstracts from some of the objects characterizing the formal existence of an event but not all of the adjectival characters. Thus, the modal immanence or objectification of a past actuality will contain at least some sense objects which characterized the formal existence of that actuality. For example, the sense object green is present in the formal existence *and* in the objectification of that past actuality in my present percipient experience. As mentioned earlier, my perception of the tree-actuality in this mode is vague and ill-defined.

However much vague and ill-defined PMoCE be, it is the foundation for our clear and definite PMoPI and sense perception.[36] Specifically, the sense objects inherited through PMoCE from the settled past are transmuted to the contemporary world through 'physical imagination.' Two crucial points are to be noted here. One, the positing of physical imagination is not because of some impoverished stimulus or the necessity to get a 'three-dimensional' world from a two-dimensional image. Nor is physical imagination posited to 'infer' or 'construct' sense objects from senseless and insipid causal objects. The sole purpose for positing physical imagination is because contemporary events in nature are causally independent of each other. This is just another straightforward application of the relativity principle. Thus, our perception of the contemporary world has to be indirect, relying on our *direct* and modally immanent past world.

Whitehead says,

> "[P]hysical imagination has normally to conform to the physical memories of the immediate past: it is then called sense-perception and is non-delusive. It may conform to the

[36]Using the term 'sense perception' to denote one sub-modality of PMoPI is misleading because sense objects are present in both PMoCE and PMoPI. Thus, (Nobo, 2003) says, "When contrasted with sense-perception, it [PMoCE] is also termed, *somewhat misleadingly*, 'nonsensuous perception.'"

> physical memories of the more remote past: it is then called the image associated with memory. It may conform to some special intrusive element in the immediate past such as, in the case of human beings, drugs, emotions, or conceptual relationships in antecedent [. . .] occasions: it is then variously called delusion, or ecstatic vision, or imagination" (Whitehead, 1961).

The above quotation clarifies our previous assertion that sensory perception is one PMoPI sub-modality. Other sub-modalities include our experience in the present of a childhood event (sensory recollection), dreams, hallucinations, and other delusions (sensory construction), all experienced in the present percipience. All such modalities of PMoPI require a high-grade event capable of transmuting the information inherited from the settled past onto the contemporary present. This mode of perception is closest to saying that perception is an inferential activity or necessarily involves mentality. Even here, the precise differences between inferential mental activity (like deduction, induction, and abduction) and imaginative mental activity must be considered. However, we will assume that they are the same. Thus, we concede that high-level human sense perception is, in the sense described above, indirect and involves mentality/imagination. However, the foundation for that mode of perception is the direct and immanent perceptual mode of causal efficacy.

We are stressing the importance of the direct mode of perception because it proposes a solution to a pressing problem for most theories of perception - The problem of prior knowledge. Specifically, the problem is 'From whence does the prior knowledge necessary to make any inference come?' In the case of Active Inference, the question becomes, 'What is the source and origin of the generative models?' This critical problem is simply side-stepped with a cursory suggestion that evolution endows prior knowledge. The problem has significant consequences not just for the psychology of perception but also for the psychology of goals and agency (Raghuveer & Endres, 2023) and, as far as we know, does not have an adequate solution.

But how does Whitehead solve the problem of prior knowledge? Through the direct and immanent PMoCE, which is nothing but the modal immanence of the metaphysical past in the present, which again is nothing but the solidarity thesis. In other words, the information and prior knowledge required for a high-grade event to kick-start its physical imagination is *given* and is immanent within that event. The justification for such a solution comes from the concrete nature of time - '[T]ime is cumulative as well as reproductive.' It is because time is cumulative and reproductive that the past is immanent in any present event; and it is this immanent, given, objectified past that leads to our vague and ill-defined PMoCE; and it is this PMoCE that acts as 'prior knowledge' for clear and definite sensory perception in the case of high-grade organisms.

Just as we started the whole journey with Whitehead's ether of events quote, we will end the journey with a quote that applies Whitehead's ether of events to problems in epistemology, perception, and knowledge. Certain aspects of the quote presuppose an understanding of Whitehead's complete works, but we believe our exposition of his natural philosophy and our application of it to perception illuminate at least its vital aspects:

> "[T]he complete history of the universe, up to the moment in which it begets C [an event], is captured in the structural and qualitative features of C* [region in the ether of events], the dative phase and extensive standpoint of C. Thus, the universe that begets C is knowable by C, and by all occasions in the future of C, precisely because it is immortally captured in the texture of C*. This is why, in the organic philosophy, "the problems of efficient causation and of knowledge receive a common explanation by reference to the

texture of actual occasions"(PR 290)" (Nobo, 1986).

We will end this relatively dense section here. The purpose of the sections before this one was to familiarize the reader with the Whiteheadian factors of nature — events & objects — and underline the value of his ideas for physical science. The purpose of this section is to apply the familiarization gained to problems in psychological science and obtain a theory of perception coherent with the advances in modern physics.

The result of such a study is the proposal of one mode of perception, which is direct, immanent, and given. There is another mode of perception dependent on the former mode, but it is indirect. However, the indirectness is not because one has to make 'psychic additions' of colors, smells, and other sense objects to bland and vapid causal objects. Neither is it because of dimensional heterogeneity among occurrences in the ether of events. The primary reason for the necessity of indirectness in PMoPI is the causal independence of contemporary events in nature.

## 4. Conclusion

This has been a lengthy and onerous study, but we hope the trouble was worth it for the reader. As stated in our introduction, the primary goal of this paper was to present Whitehead's natural philosophy and its multifaceted elements. Every element of it - extension, events, space-time, cognizance by relatedness, sense objects, scientific objects, etc - plays a crucial role in giving us a philosophically sound, empirically adequate concept of nature. We also believe we have made good on our claim of gaining a synoptic vision embracing essential concepts of physics (space, time, mass, charge) *and* psychology (sense and perceptual objects).

If we were to sum up the main concluding takeaway for the reader, it would be the proposal to explore the consequences of rejecting the 'Bifurcation of Nature' and accepting the 'Solidarity of Nature.' Rejecting the bifurcation of nature means that 'the red glow of the sunset should be as much part of nature as are the molecules and electric waves.' One does not belong to the mental realm, and the other to the material realm. This rejection is implemented by a new conceptualization of what scientific objects like electrons, photons, and molecules mean, along with a new conceptualization of events and space-time.

Accepting the solidarity of nature means that the concrete nature of time is 'cumulative as well as reproductive,' or what is the same, the modal immanence of the metaphysical past in any present event. These two theses (Bifurcation and Solidarity) help define what is 'direct' about perception. These two theses also shed light on what is 'indirect' about perception and its dependence on 'direct' perception. In sum, we propose to consider the philosophically sound, scientifically adequate, and logically rigorous concept of nature put forth by Whitehead as the basis for perceptual psychology.

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