International Journal of Mathematics and Consciousness

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EDITORIAL INTRODUCTION TO THE JOURNAL

Throughout history, natural phenomena have been ultimately mysterious. Some of these phenomena were explained by religious belief, others by philosophical analysis. Since the 17th century, the modern scientific approach has found that many phenomena in nature obey clearly describable physical laws. This success greatly widened the ambit of scientific inquiry beyond the physical into the realm of what previously had been considered metaphysical or nonmaterial. Today, the territory of scientific inquiry has expanded to include how matter leads to consciousness.

Most common and popular models of consciousness share the postulate that physical activity in the brain is prior to consciousness. No current theory, however, has been able to resolve the problem of how physical processes in the brain give rise to subjective experiences. Even quantum mechanical theories, while suggesting potential mechanisms that might create "unexplainable" phenomena, fall short of answering the fundamental questions about subjective experience. This gap— between the objective, material brain and the intimately known, private qualia of subjective experience, or "what it is like" to experience something—has so far not been bridged. Some thinkers have even rejected qualia out of hand, asserting that we have insufficient knowledge of the physical world to evaluate their existence.

Some believe that early *Homo sapiens* depended entirely on sensory experience as a reference for what does and does not exist, and that only as our understanding evolved did we come to challenge the evidence of our senses. Certainly, the discoveries of modern science changed the way we looked at the world. They gave us intellectual models of the universe that often seemed to contradict our sensory model but which provided in fact more accurate pictures and were eventually confirmed by experimental observation.

Perhaps the most notable example is the shift from a geocentric to a heliocentric view of the cosmos as a result of the work of Copernicus, Kepler, and Galileo in the 16th and 17th centuries. More recently, inquiry into very small and very large time and distance scales in relativity theory, quantum mechanics, quantum field theory, and cosmology has radically changed our beliefs about the nature of matter and physical phenomena as our senses perceive and our intellects apprehend them. We may ask, what actually exists for us? And we may agree that everything is continuously changing; we may even agree that whatever appears not to change is only one of an infinite number of simultaneously existing possibilities. For example, in some models a particle can be everywhere at once, and the fact that we find it here and now suggests either that we have collapsed the infinitude of its possibilities in a single act of conscious experience or that it continues to exist everywhere in an infinite number of universes parallel to the one in which we experience it.

In all this uncertainty, one fact seems undeniable: the fact of our own awareness. Without awareness, we can neither perceive nor apprehend, neither see nor think nor dream. Commonly, this awareness is called consciousness: the observer, the

witness, the experiencer. If indeed this is the one undeniable fact, then it is timely that a scientific journal be dedicated to the study of consciousness as primary.

To be truly scientific requires that the journal obey rigorous methods of logic, research, and experimentation. At the same time, this requires that no *a priori* or unproven points of view stand in the way of new original postulates, previously explored theories revisited with new insights, or unconventional axioms.

The *International Journal of Mathematics and Consciousness* is founded in part to fulfill this need. The *Journal* opens the door to all mathematicians, scientists, and thinkers to present their theories of consciousness and the consequences thereof. With the requirement that such theories follow strict mathematical, logical argumentation and respect proven facts and observations, articles can be submitted for review, without restriction to their proposed axioms and postulates. The *Journal* also welcomes carefully reasoned articles that challenge commonly held, but not fully established, theories and beliefs.

1. Consciousness and "Consciousness at work"

Abstract concepts and subjective experiences such as love, friendship, beauty, devotion, happiness, inspiration, pain, despair, and deception, are, in and by themselves, hard to study scientifically because of their innate, subjective, personal nature. Even more difficult to study is the more abstract consciousness that seems to be like a screen on which these emotions, notions, and sensations are projected and experienced.

Modern cognitive neuroscience identifies various neural correlates of these mental states. The discipline of psychology attracted great thinkers who proposed various theories and methods of investigation, mostly focusing on the manifestations, observable or subjectively reportable signs and symptoms, and causes and effects of such inner experiences. Physicists recently have attempted to bridge the gap between the physical world and conscious experience through various quantum mechanical models.

Philosophy, metaphysics, and spiritual and religious studies delve into ontological, epistemological, and other fundamental questions, using more or less formal logic or a wide variety of opinions and postulates. In contrast, art forms such as music, painting, and fictional writing are outer expressions of inner experiences and creative thinking.

All theories, concepts, and creative work, whether scientific, psychological, philosophical, artistic, or spiritual are the manifestations of "consciousness at work." While it might be challenging to study "consciousness" as such, in and by itself, it may be easier to study "consciousness at work"—its dynamics and its manifestations.

The postulates that can be made about consciousness as an abstract phenomenon or epiphenomenon are most amenable to investigation by scientifically analyzing and studying "consciousness at work." The *International Journal of Mathematics and Consciousness* invites analyses of consciousness at work from various perspectives with a particular emphasis on mathematics.

2. Mathematics

Mathematics studies abstract forms, patterns, relationships, and transformations in an exact, systematic, and logical way. Forms and shapes like circles and triangles are the subject of geometry and topology. Patterns of number and operations lead to algebra. Relationships that change in time form the basis of calculus. Mathematics also includes the study of mathematics itself. The study of mathematical reasoning is undertaken by logic. Even questions about the limits of the mathematical method and the nature of mathematical knowledge can be addressed using the methodology of mathematics.

Using mathematical models of experimental observations of the physical world makes it possible to give a purely abstract formulation of real-life phenomena. Subjective mathematical reasoning, which is nevertheless entirely rigorous, applied to these models leads to new descriptions and predictions about the world.

Mathematics is fundamentally a method that finds patterns of orderliness in the subjective field of human intelligence and thought. Based on sets of axioms and postulates that are accepted without proof, mathematics gives a structure to the way our minds and intellects operate. It systematizes how individual human awareness perceives, discriminates, organizes, and expresses its own patterns of functioning. In our opinion, mathematics is certainly one of the most useful and scientifically manageable methods to study the interface between consciousness and physical phenomena.

Mathematics is in essence a subjective discipline that nevertheless allows us to organize and make sense of the physical universe in which we exist. Though subjective, it is precise and effective in objective scientific explorations. It is a fundamental and indispensable tool of all sciences, and at the same time, it is an expression of abstract human awareness and intellect.

3. Mathematics and Consciousness

The *International Journal of Mathematics and Consciousness* takes the position that methods of mathematics and mathematical modeling provide especially appropriate tools for studying the interface between consciousness and physical phenomena. Mathematics is a fundamental and indispensable tool of all sciences, while at the same time it is an expression of abstract human awareness and intellect. It is therefore the most precise scientifically reliable tool in the exploration of the dynamics of consciousness. It can be seen as the precise abstract representation of consciousness at work.

The ways in which human beings explore and express the experience of consciousness are as varied as nature itself. The following list contains some of the relevant sciences and other forms of human inquiry:

(1) Physics and chemistry (physical/quantum mechanical theories of consciousness at work)
(2) Biology and cognitive neuroscience (biological/electro-chemical/neural correlates of consciousness at work)
(3) Mathematics (abstract representation of consciousness at work)

(4) Psychology and cognitive sciences (objectification of subjective experiences of consciousness at work)

(5) Economics, particularly behavioral economics (production, distribution, and consumption of resources as models of the dynamics of consciousness at work)

(6) Philosophy (discursive representation of consciousness at work)

(7) Arts (subjective creative representation of consciousness at work)

(8) Religion (individual/group belief in the origins and dynamics of consciousness and consciousness at work)

(9) Spirituality (personal and totally subjective experience of consciousness at work)

(10) Study of pure consciousness itself (the field or screen "phenomenon" on which or by which all aspects of consciousness at work take place)

The *International Journal of Mathematics and Consciousness* maintains the position that of all such pursuits, mathematics, because of its rigor, depth, and effectiveness, is the most suitable discipline to study the interface between consciousness and the physical world. This *Journal* is devoted to exploring this interface using the rigorous approach of mathematics. We invite all mathematicians, scientists, and thinkers to submit papers using a mathematical approach to consciousness and "consciousness at work" in all its aspects.

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CONSCIOUSNESS IS ALL THERE IS:
A MATHEMATICAL APPROACH WITH APPLICATIONS

TONY NADER, MD, PhD, M.A.R.R.

ABSTRACT. This paper begins with the postulate that consciousness is all there is, reversing the customary paradigm of modern science that matter is all there is. After a discussion of this postulate, we propose placing it in a mathematical framework by introducing fundamental axioms that are motivated by the experience and dynamics of consciousness. We test the reasonableness of these axioms in two ways: by deriving consequences from the axioms and comparing these consequences to our experience of the world, and by verifying that heretofore unsolved problems can be resolved with this new paradigm. In particular, this approach provides a framework for a solution to the new problem of consciousness: How does the physical universe emerge from consciousness? In later papers we develop this axiomatic framework more fully with further details of the undefined concepts and descriptions of the axioms.

How consciousness arises from physical or material activity in the brain is the *hard problem* in the study of consciousness.[1] How can something physical lead to non-physical subjective "colors" and shades of awareness such as happiness, pain, the delightful redness or beauty of a flower, inspiration, love, hate, devotion, and spiritual experience?

Some thinkers have rejected the concept of consciousness out of hand by asserting that it is an epiphenomenon that neither exists by itself nor emerges as a non-physical product of matter and physical activity. However, in our view, there is not a single reliable hint of how the physical can produce the non-physical subjective experience of consciousness.

Modern scientific inquiries about the reality of matter itself lead to fundamental uncertainties about physical reality as we perceive it through our senses and apprehend it through our intellects. Some quantum mechanical observations and conclusions, thoroughly documented and substantiated in the past eighty years, question the very existence of matter as we conceive it in a classical perspective. Already in 1944 Max Planck [11] stated: "As a man who has devoted his whole life to the most clear-headed science, to the study of matter, I can tell you as a result of my research about atoms this much: There is no matter as such."

Neither Planck nor other quantum scientists mean that when we look at the moon we are having a hallucination. The assertion "there is no matter as such"

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[1]The terms "hard problem" and "easy problem" of consciousness were introduced by David Chalmers. See, for example, Chalmers [2] for more detail.

rejects the notion that matter exists in absolute terms on its own immutable level. It refers to the relative concepts of what matter is and how matter is composed. It suggests that matter does not exist in space and time on its own absolute level in the way our superficial sensory experiences seem to indicate.

The moon is made of molecules, which are made of atoms, which are made of elementary particles, which are made of excitations of fields, which themselves are expressions of more fundamental fields, ultimately pointing to a single unified field. All that we see is indeed waves of fundamental fields of energy. Elementary particles are nonlocal and given by probabilities, only collapsing to appear as specific objects under certain conditions.

It is not the purpose of this article to analyze these phenomena in detail but to highlight the relative nature of matter and how it can be appreciated from a different perspective.

In all this uncertainty, one thing we can be sure of: we are conscious individuals. Without awareness we can neither perceive, nor apprehend, nor see, assess, and draw conclusions, nor think, nor dream. The postulate of this article is that consciousness is all there is, that the ultimate field at the basis of all that we describe as matter is, in fact, a field of pure consciousness. This postulate is not new. Its most ancient proponents were the teachers of the Vedic tradition of knowledge in India, particularly Vedanta. It has been brought to light and expounded in modern times by Maharishi Mahesh Yogi. Maharishi has been the source, inspiration, and guide for the thoughts expressed in this article. He taught his techniques of research in consciousness and founded Consciousness-Based[SM] education, most prominently available at Maharishi University of Management, the publisher of this *Journal*. The postulate that consciousness is all there is also appears in various philosophical and religious theories and beliefs throughout history, continuing to the present day. (See, for example, Pearson [10].)

If consciousness were all there is, it would be correct to reverse the "hard problem" of consciousness and suggest that it is not how matter creates consciousness that should be studied but rather, given our fundamental postulate, how matter exists at all. How does matter make its appearance in the field of consciousness?

Accordingly, in this first article of the *International Journal of Mathematics and Consciousness*, I postulate that there is a primordial consciousness—a non-material, non-physical reality—that is neither classical nor quantum-mechanical, neither a phenomenon nor an epiphenomenon, that exists entirely by itself. It exists in absolute terms and does not depend on anything else for its existence.

This is so far a pure postulate. As a postulate or axiom, there need not be a direct logical or mathematical way to demonstrate it. It is an assumption. Mathematics is built on primary axioms and postulates that are accepted without proof. These axioms are adopted on the basis of intuition and long experience of those who have studied the field deeply. Moreover, evidence for the "rightness" of the selected axioms is seen in the consequences derived from the axioms. If the consequences match expected results and help organize and advance the field, the axioms are believed to have adequately "captured" the field. Likewise, in our approach, we consider adoption of this axiom to be initially reasonable, considering the available alternatives (see p. 3), and evidence for the correctness of our axioms will be found

in the "rightness" of their consequences, and their applicability in addressing a number of real-world problems in the areas of physics, chemistry, and biology.

Thus, the value of this initial fundamental postulate about consciousness being all there is will be subject to its ability to hold against facts, to explain hitherto elusive mechanisms of various phenomena, and to be in accord with logic, although perhaps contrary to some points of view and to some preconceived and unproven ideas about the nature of things.

Does a postulate that consciousness is primary entail the existence of a reality that is supernatural and ultimately inexplicable and indescribable, co-existing with our material universe? This was the approach of Descartes to the relationship between matter and consciousness: break the world into spirit and matter. The Cartesian view, however, begs two questions facing science now: "How does the non-physical (spirit or consciousness) interact with the physical (matter)?" and, more crucially for our purpose in this article, "How would consciousness lead to or appear as matter?"

Progress in physics has opened to our examination a realm at the basis of the physical that appears curiously non-physical. That knowledge, and our experience as the witness of thought and perception, seem to confirm for us the existence of the non-physical, yet we cannot see how the non-physical emerges from the physical, nor, for that matter, how the physical emerges from the non-physical.

We step back from our analysis for a moment and list a number of possible relationships between consciousness and matter:

(1) Matter emerges from some unknowable realm, evolves, and eventually produces consciousness (physicalism or materialism, with the "hard problem" of consciousness).

(2) Matter emerges from some unknowable realm, evolves, but does not produce consciousness; that is, consciousness is an illusion (physicalism or materialism, with no consciousness).

(3) Some kind of personal or impersonal consciousness is primary; from it, in some unknowable way, matter arises and is separate from consciousness. (This includes philosophies of idealism as well as theories of creation by a Creator.)

(4) Consciousness is all there is and does not create anything physical outside itself; matter is real only in terms of consciousness or as an appearance within consciousness. (This is the argument presented in this article.)

(5) Both consciousness and matter exist and neither arises from the other (dualism, often associated with the philosopher René Descartes).

(6) Consciousness and matter are two different ways of looking at one reality (neutral monism).

(7) Both consciousness and matter are illusions (in a weak form, skepticism; in a strong form, nihilism).

In this paper, I suggest that the fourth possibility accords best with both modern scientific theories and logical reasoning and is therefore the most acceptable hypothesis. Everything here will be built on the single hypothesis that consciousness is all there is. The difficulty with this hypothesis is obvious: how can it be that what we experience as most real, most existent—that is, matter, the physical—is in fact a

play of consciousness? Because this seems to be belied by our everyday experience, the paper has two goals. The first goal is to set up a general theory of consciousness based on the fundamental postulate that consciousness is all there is. By including in this postulate that consciousness is, in fact, conscious, we set up a self-interacting dynamics of consciousness, which leads as a consequence to all that we know and experience.

The second goal is to give support to this general theory by showing that a wide range of problems have straightforward resolutions once this postulate is assumed. These problems range from how to understand concepts in psychology such as ego, intellect, and mind, to issues in physics such as the "collapse" of the wave function.

Overview. The following is a brief overview of the paper. In keeping with the two goals just described, the first four sections address the first goal by setting up a general theory of consciousness, while the remaining sections address the second goal by applying the theory to gain a deeper understanding and more clarity on a range of issues dealing with consciousness and the interface between consciousness and "consciousness at work" in the "real" world.

In Section 1, I propose that there is a consciousness that exists in and by itself, independent of any personal owner of that consciousness. Furthermore, this consciousness is all there is, and this consciousness is itself conscious. To differentiate this consciousness from personal consciousness, it will be written as $\mathcal{C}$onsciousness throughout the paper. I explain that because this $\mathcal{C}$onsciousness is conscious, it can assume the three roles of observer, observing, and observed. In general, the ranges of these roles can be quantified in terms of the notions of *Observerhood*, *Observinghood*, and *Observedhood*. In Section 1, I also introduce the symbol SNG to refer to the Singularity of $\mathcal{C}$onsciousness and the symbol ALL to use when we talk about all possible roles of $\mathcal{C}$onsciousness.

Section 2 introduces the notion of a Bit of Consciousness as a triple of particular values of Observerhood, Observinghood, and Observedhood. This is followed in Section 3 by the understanding that nothing can be said to be real unless it is a triple with none of its components equal to 0. In other words, real existence requires an observer, a process of observation, and an observed. Section 4 discusses how multiplicity emerges from the Singularity of $\mathcal{C}$onsciousness by virtue of $\mathcal{C}$onsciousness being conscious. Because it is conscious, it is conscious of itself and "takes on" the three specific roles of observer, observing, and observed.

With Section 5, I begin the more applied areas of the paper starting with a brief introduction to the notion of omniscience as the memory of all that is. Section 6 describes how concepts such as ego, intellect, mind, and space/time can be viewed as spontaneous processes in $\mathcal{C}$onsciousness. For instance, intellect is the process of awareness of multiplicity, distinguishing one entity from another. Section 7 introduces the notions of soul, ego, intellect, and self and discusses the problem of the journey of the "self."

We also know that human beings experience a wide range of states of consciousness such as sleeping, dreaming, and waking. It is also possible to experience higher states of consciousness such as Transcendental Consciousness, Cosmic Consciousness, God Consciousness, and Unity Consciousness. Section 8 outlines how rising

to these higher states of consciousness can be understood in terms of the triples or Bits of Consciousness introduced in Section 2.

Section 9 discusses the famous problem in quantum physics called Schrödinger's cat and shows how it is resolved by recognizing that nothing exists without an observer, process of observation, and object of observation.

The remaining sections briefly apply the postulate that $\mathcal{C}$onsciousness is all there is to a range of topics including the laws of nature (Section 10); free will and determinism (Section 11); omnipotence as the ability to change anything to anything (Section 12); space, time, creation, and evolution (Section 13); differences in the consciousnesses of different individuals (Section 14); understanding the universe (Section 15); the meaning of the collapse of the wave function in quantum physics (Section 16), and the understanding of objectivity and subjectivity from the perspective that objects do not exist independently from subjects and the processes that connect them (Section 17).

Five topics, including the concepts of good and bad, are mentioned in Section 18 as areas for further study in later papers, and Section 19 is a summary and conclusion. There are several appendices after the list of references at the end of the paper; they contain a table of the main notations introduced in this paper, a summary of the main definitions and their implications, and a list of different ways a subject can observe an object.

1. The Nature of Consciousness

Whereas humans experience consciousness as a personal, subjective phenomenon, I am proposing here that there is a consciousness that exists in and by itself, independent of any personal owner of that consciousness. I postulate a consciousness that is all there is. From this postulate is derived the corollary that everything that seems to be separate from this consciousness is not, in fact, separate from it. Rather, anything that exists for an observer is an epiphenomenon of this consciousness, occurring, as it were, within it and not causally influencing it or in any way outside it. As noted above, to differentiate this consciousness from personal consciousnesses, I will write it with a script initial letter "$\mathcal{C}$." This $\mathcal{C}$onsciousness will also be referred to as Pure Consciousness to highlight the fact that it is all by itself, unmixed and unattached to anything else but itself.

Axiom 1. $\mathcal{C}$onsciousness $\mathcal{C}$ exists, $\mathcal{C}$onsciousness is all there is, and $\mathcal{C}$onsciousness is conscious.[1]

For simplicity, in the sequel, we will refer to this fundamental axiom or postulate as "$\mathcal{C}$onsciousness is all there is," with the understanding that we are including the rest of the axiom, that $\mathcal{C}$onsciousness exists and is conscious.

What is perceived by us as material or physical is a play within this $\mathcal{C}$onsciousness. The physical, material features perceived within $\mathcal{C}$onsciousness are, therefore, not considered to be nonexistent illusions. Because they are perceived within $\mathcal{C}$onsciousness, they are existent entities for those who are observing them. Such entities could

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[1] As explained later, by the phrase "is conscious" we mean that there is an observer, an observed, and a process of observation linking the observer and observed.

be perceived as abstract concepts, such as thoughts and feelings, or as concrete, material, physical objects.

Thus I propose there is a "singularity" that is 𝒞onsciousness. This singularity is non-physical and non-material. When perceived from the material viewpoint, it is nothingness. Nonetheless, as 𝒞onsciousness, it is a self-aware, self-referral existence. It is not limited by any concept of space or time; it cannot go anywhere; nor can it be the source of anything outside itself, because there is nothing outside it. This 𝒞onsciousness is absolute, non-changing, without beginning or end, and equal to itself in the sense that any transformation leaves it unchanged. If considered in terms of space and time, it is unbounded: in space, infinite; in time, eternal; in power, invincible. Superlatives could be applied to it and yet they do not define it, for it is beyond qualification and quantification. We denote this singularity that is 𝒞onsciousness by the symbol SNG and write Singularity with a capital S.

The peculiarity of Singularity is that it is *conscious*, and it is this peculiarity that opens the door to the infinite diversity that we observe and experience, which we will see as the theory unfolds.

It could be argued that we have traded one "hard problem" for another. How does the concrete, palpable, solid universe that we experience with our senses, obeying laws that we study and in part understand, arise from an abstract 𝒞onsciousness, which, in material terms, is nothingness? I propose to call the answer to this question a "hard solution"—hard because it is hard for us humans to accept that what we trust most, namely our senses, is deceptive. Indeed, this solution highlights the deceptive, changing nature of human sensory perception; it recognizes that what appears most abstract is the most real and that what appears most palpable is the most illusory. At the same time, it is the simplest, least convoluted, and most direct possible solution. In that sense, it is an easy solution—but not a simplistic one.

To begin to understand this intangible, non-physical Singularity that we call 𝒞onsciousness, we can compare it to our subjective experience of consciousness, that is, to the experience of our nature as conscious individuals. In contrast to the absolute state of this Singularity, human consciousness is variable in intensity and quality. One may be dull, alert, or sleepy, have hallucinations, or be focused with attention on one thing and not on another. A person's brain may be registering something but the person may not be conscious of it. Researchers have identified the unconscious, the subconscious, sleep, dream, coma, and other variations of the experience of consciousness. Some of these and other terms are widely agreed upon; some are used differently by different scientists and philosophers. Nonetheless, the basic dynamics of a conscious experience require that there is a subject (an observer) who has an experience of something (an observed). There must also exist a link or a process that connects the observer (subject) to the observed (object). This holds no matter what the quality, level, or state of consciousness.

There are therefore three roles to any conscious experience:

- ○ the observer (the subject—human, or anything else);[1]
- ○ the observed (the object of observation—a material object, a thought, or a feeling);

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[1] In this broad sense, any object can act as an observer since all objects detect or respond to their environments.

○ the process of observing (the connection between the observer and the observed—for example, detecting light or sound emitted from the object).

To say one is conscious of something is to acknowledge the simultaneous presence of these three roles; otherwise, there would be no conscious experience. Whereas this is true for any conscious experience, it *does not* follow that these three roles then *create* consciousness. They are conceptual and their presence implies the existence of consciousness but their presence does not construct it.

A common assumption is that the subject, the observer, has consciousness, and that it is on the "screen" of this consciousness that the experience of being conscious takes place, as if the functioning of the nervous system creates an interior screen and objects are then projected on this consciousness-screen via cognitive mechanisms. The analogy is to a cinema screen on which images are projected. In this view, the observeds—the objects—are feelings, thoughts, or perceptions of material objects.

Regarding this assumption that consciousness is some sort of screen, I make two comments. First, there are many reports of conscious experience *unaccompanied* by feelings, thoughts, or perceptions. People who meditate have reported such experiences. For example, individuals who practice the Transcendental Meditation® technique of Maharishi Mahesh Yogi call such experiences "Pure Consciousness" or "Transcendental Consciousness" [12]. In the Vedic tradition of meditation, those who had such experiences have called them *Samadhi*; many people in Western traditions have reported similar experiences [10]. In such experiences, the observed (the object of observation) is said to be $\mathcal{C}$onsciousness itself without any other content. This is a self-referral or auto-referral experience in which, through the agency of a human nervous system, $\mathcal{C}$onsciousness "looks at itself."

The second comment is that it is widely assumed that a nervous system is needed for any kind of conscious experience. Indeed, there is clear evidence linking the brain with different states of consciousness [12]. Before we begin analyzing how consciousness is related to a nervous system, to any other structure, or to any physical energy, we will have to define what a nervous system, or anything physical or material, actually is and how it emerges. This will be done later in this article. (See, for example, Section 3 describing how experiences emerge in $\mathcal{C}$onsciousness and Section 4 describing how multiplicity emerges from unity.)

The description of $\mathcal{C}$onsciousness proposed here, however, goes beyond an individual's "experience" of thoughts or no thoughts, or the requirement of an individual nervous system to experience consciousness. Rather, I postulate that there is a universal $\mathcal{C}$onsciousness beyond any personal experience of consciousness, a Pure Consciousness, which, as noted, I designate with an upper-case script "$\mathcal{C}$" to differentiate it from any local, variable, human, or other changing and limited consciousnesses.

Nonetheless, we could think of $\mathcal{C}$onsciousness as *analogous* to the experience in meditative states in which an individual's consciousness is observing itself—Transcendental Consciousness or *Samadhi*. Like that, $\mathcal{C}$onsciousness is the ultimate Singularity, observing itself by itself but without any outside agency or medium such as a human nervous system.

Because $\mathcal{C}$onsciousness is conscious, it has inherent within its nature the three roles of observer, observing, and observed. And because it is Singularity, there is

nothing but itself looking at itself. Thus, $\mathcal{C}$onsciousness is the observer, the process of observation, and the observed.

As stated earlier, the theory presented in this article is "$\mathcal{C}$onsciousness is all there is." One must acknowledge at the same time that there are different kinds of consciousness: different flavors, states, levels, and so on. The only way for these two statements to be simultaneously true is that the one $\mathcal{C}$onsciousness (SNG) has different flavors, states, and experiences of itself.

We have already described how SNG must assume the different roles of observer, observed, and process of observation in order to be conscious. We are also aware that different observers (such as human beings) have different flavors, levels, and states of observing ability. There are, therefore, different ways of being an observer, different conditions and processes of observing, and different objects and ways objects can be appreciated. Different possibilities of observer, observing, and observed can be quantified. For example, a man, let's say John, has a number of ways he can be an observer, a number of observing situations he can be in, and a number of ways he can be observed as an object. We call the range of ways John can be an observer his Observerhood potential or Observerhood range. Similarly, we call the various ways he can be observed his Observedhood potential. And we call the different processes of observation he can be involved in his Observinghood potential.

On this basis, and to assist us in further analyzing the self-interacting dynamics of $\mathcal{C}$onsciousness, we start by quantifying each of these three ranges as follows:

○ The range of the observer role of $\mathcal{C}$onsciousness can be quantified in terms of its *Observerhood* potential or range; we use the symbol O^R to denote this range. Since $\mathcal{C}$onsciousness is all there is, every possible way to be a conscious observer is already in $\mathcal{C}$onsciousness. We introduce the symbol ALL^R to denote all possible ways that $\mathcal{C}$onsciousness itself can be an observer. For the Singularity of $\mathcal{C}$onsciousness, O^R is infinite and, in fact, $O^R = \mathrm{ALL}^R$.

○ Likewise, the range of the observing role of $\mathcal{C}$onsciousness that can link an observer to an observed can be quantified in terms of its *Observinghood* potential or range; we use the symbol O^G to denote this range. Since $\mathcal{C}$onsciousness is all there is, every possible way to link an observer to an observed (every process of observation) is already in $\mathcal{C}$onsciousness. In parallel with the previous definition of ALL^R, we introduce the symbol ALL^G to denote all possible ways $\mathcal{C}$onsciousness can be a process of observation. For the Singularity of $\mathcal{C}$onsciousness, O^G is infinite and, in fact, $O^G = \mathrm{ALL}^G$.

○ Similarly, the range of the observed role of $\mathcal{C}$onsciousness can be quantified in terms of its *Observedhood* potential or range; we use the symbol O^D to denote this range. Since $\mathcal{C}$onsciousness is all there is, every possible way to be observed is already in $\mathcal{C}$onsciousness. Again, in parallel with the previous definitions of ALL^R and ALL^G, we define ALL^D as all possible ways $\mathcal{C}$onsciousness can be observed or be experienced as an object. For the Singularity of $\mathcal{C}$onsciousness, O^D is infinite and, in fact, $O^D = \mathrm{ALL}^D$.

Having a value ALL^R for O^R means that $\mathcal{C}$onsciousness has no limitation in its ability to observe. There is nothing that it cannot and does not observe. It is always observing everything, which means that it is observing only itself since there is nothing else to be observed. Likewise, $O^G = \mathrm{ALL}^G$ means that all possible

observings, that is, all possible relationships among observers (subjects) and observeds (objects), are implicit in $\mathcal{C}$onsciousness, and the only possible relationship in $\mathcal{C}$onsciousness is itself with itself. Similarly, $O^D = \text{ALL}^D$ means there is no limit to what $\mathcal{C}$onsciousness can appear to be as an object of observation; that is, it is all possible objects and, at the same time, the only object is itself. We denote the aggregate of ALL^R, ALL^G, and ALL^D by ALL.

Our second axiom gives a formal statement that $\mathcal{C}$onsciousness is uniquely determined by the concepts O^R, O^G, and O^D. In this axiom and throughout the paper, we use the convention that, whenever some *entity*, some aspect of $\mathcal{C}$onsciousness, E, is uniquely determined by properties $p_1, p_2, \ldots, p_k$, we write

$$E = E(p_1, p_2, \ldots, p_k).$$

Axiom 2. $\mathcal{C}$onsciousness $= \mathcal{C}$onsciousness $(O^R = \text{ALL}^R,\ O^G = \text{ALL}^G,\ O^D = \text{ALL}^D)$.

Since O^R, O^G, and O^D represent the ranges of all possible roles of Observerhood, Observinghood, and Observedhood of $\mathcal{C}$onsciousness, respectively, this axiom describes the full potential of $\mathcal{C}$onsciousness. It describes what this entity is, including the range ALL^R of its ability to observe; the various environments and conditions ALL^G in which it can operate; and the range ALL^D of the different ways it can itself be observed.

As described above, the statement $O^R = \text{ALL}^R$ means that the ways $\mathcal{C}$onsciousness can be an observer encompass all possible ways of being an observer. Similarly, the statement $O^G = \text{ALL}^G$ means that the ways $\mathcal{C}$onsciousness can participate in a process of observation encompass all possible processes of observation. Finally, the statement $O^D = \text{ALL}^D$ means that the ways $\mathcal{C}$onsciousness can be observed encompass all possible ways of being observed as an object.

The range of all possibilities of being an observer, process of observing, or object of observation lies between two extremes. The first extreme is nothingness, which means that there is no observing ability, no power to participate in a process of observing, and no capacity to be perceived or seen as an object in any way. The opposite extreme is the ultimate ability of being observer, object, and process of observation. That ultimate ability is akin to having the Singularity itself participate as an observer, process of observation, and object of observation. This supreme level of being an observer is Singularity in the context of an observer; the supreme level of observing is Singularity in the context of the process of observing; and similarly, the supreme object of perception is Singularity in the context of being an object of observation.

In order to distinguish Singularity itself from its participation in the role of an observer, a process of observation, or an observed, we shall use the term ULT to refer to Singularity in the context of experience. In particular, we write ULT^r for Singularity in the role of the observer, ULT^g for Singularity in the role of the process of observing, and ULT^d for Singularity in the role of the object of observation.

Thus, ULT is not SNG itself, but rather an aspect of experience that most closely resembles SNG. Within ALL are all possibilities—including the possibility to experience Pure Consciousness or Singularity itself and the possibility to have no experience at all. Consider John experiencing Pure Consciousness. This is a

particular instance of Observerhood, Observinghood, and Observedhood. Using symbols, we write this as the triple $(\text{John}, y, \text{ULT}^d)$. This means that John is experiencing Pure Consciousness, since the object of experience is ULT^d.[1] This is in contrast to the triple $(\text{John}, y, 0)$ where John is not experiencing anything at all.

We also use the notations O^R, O^G, and O^D in the context of any particular entity $E = E(O^R, O^G, O^D)$ other than $\mathcal{C}$ in a more general way as follows. When the superscripts R, G, and D are uppercase in the symbols O^R, O^G, and O^D, they indicate the range of the *full* potential of Observerhood, Observinghood, and Observedhood associated with a particular entity E as an observer, process of observing, or object of observation. When the superscripts r, g, and d are lowercase in the symbols O^r, O^g, and O^d, they indicate the expression of Observerhood, Observinghood, and Observedhood, respectively, in a particular instance of the entity E.[2]

This notation can be summarized as follows:

- *Observerhood*: The symbol O^R denotes the collection of all possible observer roles of an entity E and O^r denotes an actual observer role of entity E in a particular instance.
- *Observinghood*: The symbol O^G denotes the collection of all possible observing roles of the entity E determined by the conditions, laws, and constraints that can influence the observing process and O^g denotes the actual conditions, laws, and constraints defining a particular observing role of E.
- *Observedhood*: The symbol O^D denotes the collection of all possible ways for an entity E to be perceived as an object and O^d denotes an actual way the entity E is being perceived as an object under specific conditions or circumstances.

For example, the potential of Observerhood of a person can range from a highly alert, awake state to a drowsy, sleepy, or even comatose state. The O^R of that person will define his or her Observerhood range or potential. Under special circumstances, when the person is in a specific capacity of Observerhood, the notation defining this specific state will be written as O^r.

2. Bits of Consciousness

Later in this article, some of the wide-ranging implications of our two fundamental axioms about $\mathcal{C}$onsciousness being all there is will be addressed. In particular, we will discuss how all that appears to be matter and physical comes to be actually experienced and perceived as matter and physical. Before that discussion, a few definitions and clarifications will be helpful.

The word "consciousness" conventionally refers to that aspect of our humanness in which we are aware of our environment and ourselves. Since the individual conscious experience is entirely subjective, the consciousness of one individual cannot

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[1] We will use the notation (x, y, z) to denote a *triple*, where the first component x is an observer, the third component z is an object of observation, and the second component y is a process of observation linking the two.

[2] When we use the notation O^R, O^G, and O^D or O^r, O^g, and O^d, generally the associated entity E will be clear from the context. However, when necessary or for extra emphasis, we will write O^{R_E}, O^{G_E}, and O^{D_E} or O^{r_E}, O^{g_E}, and O^{d_E}.

ascertain what another's consciousness is like. Based on pure subjectivity, on the face of it, I cannot know for sure if anyone else has a consciousness similar to mine or, for that matter, any consciousness at all. Furthermore, most of us humans believe, perhaps rightly, that we are privileged with a special kind of consciousness in comparison with other living beings and, with more certainty, in comparison with inanimate objects—a kind of consciousness that enables us to be self-aware. To avoid thinking that what is being discussed here relates only to these ideas, it is important to be clear that the consciousness we are discussing is different from mere Observerhood.

Observerhood is only one of the three roles of $\mathcal{C}$onsciousness; it is the ability to sense, detect, feel, witness—in short, to experience—anything. A Geiger counter, for example, will have an Observerhood quality as a particle detector that measures ionizing radiation, but, from an everyday point of view, a Geiger counter is not said to have consciousness. However, the *togetherness* of the Geiger counter, the ionizing radiation, and the measuring process is an example of what we will call a Bit of Consciousness.

To take another example, a person looking at a flower will have an Observerhood that will vary depending on her or his alertness, wakefulness, memory, stress, and other factors. There also could be a computer-like, camera-like, or zombie-like kind of observation of the flower. In short, there are many different values of Observerhood that could be the O^r of a Bit of Consciousness, but in every situation the Bit of Consciousness will consist of three roles, O^r, O^d, and O^g, together.

Let us illustrate this with a specific example where a woman Jane is simply looking at a flower (assuming no other aspect of the flower such as smell or touch is being experienced) and denote this Bit of Consciousness by the triple (O^r, O^g, O^d).

In this, the symbol O^r represents what Jane's particular Observerhood value is at this particular moment. This O^r depends on Jane's level of alertness, interest, and whatever is within Jane that allows her to see and therefore participate in this particular Bit of Consciousness as an observer. This includes, among a multitude of factors, the sensory and other neural mechanisms of Jane's nervous system involved in the processing of the information, including her memory and previous experiences.

The term O^d corresponds to the flower's Observedhood value. This is the flower's inherent ability to be observed under the circumstances. The circumstances are defined by O^g. The term O^g represents the conditions and laws of nature operating during the process of observation. They include, among a multitude of factors, the lighting conditions in the room where the observation is taking place, the mechanisms of light reflecting off the flower, and light landing on Jane's retina. They also include the laws of biology, chemistry, and physics that allow the neural mechanisms inside Jane's nervous system to operate under the prevailing conditions. If there were, for instance, a toxic gas in the room that disturbed Jane's nervous system making her sleepy or even unconscious, the observation process would certainly be different.

Jane observing the flower under specific conditions, denoted by $\mathcal{C}_\phi$ and given by the triple

$$\mathcal{C}_\phi = (O^r, O^g, O^d),$$

is what we refer to as a Bit of Consciousness. If on another day Jane puts on colored glasses or is in a different mood, if the light in the room changes, or if the flower fades, the corresponding Bit of Consciousness will be different, even if it is the same Jane looking at the same flower in the same room. Jane, the room, and the flower have changed even if they are superficially considered the same. And so does the Bit of Consciousness change. It is a new experience.

We now give the formal definition of a Bit of Consciousness.[1]

Definition. A *Bit of Consciousness* is a triple (O^r, O^g, O^d), where the roles O^r, O^g, and O^d are members of Observerhood, Observinghood, and Observedhood, respectively, present in a particular instance.

The components O^r, O^g, and O^d are the roles of observer, observing process, and object of observation, respectively. They play their respective roles according to their positions in the triple. We will refer to the absence of a particular role in a triple as Nothing and we will use the symbol 0 in the corresponding place to indicate that. Thus, a Bit of Consciousness is a triple with no components equal to 0. The absence of all three roles in a triple will be referred to as Nothingness and denoted by $(0, 0, 0)$.

What would the triple (O^{r_1}, O^g, O^d) be like if O^{r_1} were the Observerhood quality of a monkey, an ant, a camera, or a Geiger counter? We might not be able to answer this question, but we suspect the Bit of Consciousness would be different. Yet in every case such a triple will still be considered to be a Bit of Consciousness. How this is so will be discussed later in this article. We take Observerhood in its widest meaning to include not only human beings but also anything that detects, reacts, or interacts. For example, in Section 9, we consider an electron in an Observerhood role detecting a magnetic field.

Now, suppose John were observing the flower at the same time as Jane. John observing the flower will be yet another Bit of Consciousness. This particular Bit of Consciousness will also be different from the Bit of Consciousness of Jane observing the flower introduced previously. Yet, because of the similarities between John's and Jane's nervous systems, we can safely assume that the experience of John is more similar to that of Jane than to that of an ant or a camera! The more John is like Jane, the more the experiences and appreciations are alike. It is important to note at this stage that the term Bit of Consciousness is used to denote an individual specific experience in $\mathcal{C}$onsciousness. In this definition it is clear that not all Bits are equal, neither quantitatively nor qualitatively.

If an individual observer, in a Bit of Consciousness, has a high degree of Observerhood, it is possible for that observer to simultaneously experience or observe that actual Bit of Consciousness as an object in a second Bit of Consciousness. The observer is then said to be conscious of a conscious experience. This would be another level of Observerhood observing the Bit of Consciousness. The first Bit of Consciousness is now itself an observed. For example, we can define for Jane a new

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[1]To maintain the overall flow of the discussion, we will give as few formal definitions as possible in the body of the paper. However, a complete list of terms and their formal definitions are contained in Appendix B. These include such everyday terms as real, virtual, nothing, nothingness, to be, entity, existence, and manifestation. In the Appendix, they are defined within the setting of this paper.

Bit of Consciousness $(O^{r_2}, O^{g_2}, \mathcal{C}_\phi)$, corresponding to Jane being conscious of her flower experience $\mathcal{C}_\phi$.

3. How experiences emerge in Consciousness

This article proposes "Consciousness is all there is." In saying that "Consciousness is all there is" we are denying the existence of the physical (or the material) *outside* of Consciousness. At the same time, we do not have to deny the *existence* of the physical if we are able to view it as made of Consciousness.

To say the physical is made of Consciousness means that what is perceived as physical is an "experience" within Consciousness. To have an "experience" means to be conscious of something. As described earlier, to be conscious requires the triple of subject, object, and the process linking them. Nothing can therefore be said to be physically real if it is not such a triple. All that we conceive separately as subjects, objects, and processes are only virtual realities that can become components of a triple; but only a triple with no 0 components is real.

In terms of what is commonly called our concrete, physical, and material universe, we can therefore conclude: Nothing can be said to be real unless it is a Bit of Consciousness. There are scientific theoretical frameworks and experimental findings that lend support to this statement, but let us for now simply take it as a fundamental part or axiom of the theory presented in this article. This gives us two types of entities, real and virtual, which we define as follows:

Definition. An entity is *real* if it is a Bit of Consciousness, that is, if it is a triple with none of its components equal to 0. We will also refer to a Bit of Consciousness as a *real triple* or a *real entity*. Any triple with one or two components equal to 0 is said to be a *virtual triple* or a *virtual entity*. Nothingness $(0, 0, 0)$ is a virtual triple but not an entity. Furthermore, any entity u that is not a triple is also said to be a virtual entity because it can be represented by one of the virtual triples $(u, 0, 0)$, $(0, u, 0)$, or $(0, 0, u)$, depending on the intended role of u. See Figure 2 in Appendix B to see the relationships between these terms.

On their own, the components x, y, and z of a triple (x, y, z) are merely potentialities: x has the potential to observe, y has the potential to be a process of observing, and z has the potential to be observed. But when they are components of a triple, then they actually play their respective roles of observer, process of observing, and observed; the triple they form is said to be real.

In the context of a real triple (x, y, z), the observed z appears to be real to the observer x under the observing process y. This appearance of being real requires the presence of all three components because the appearance *depends* on all three components. The outcome they create is a particular appearance within Consciousness in which each component influences what appears to be real. For example, consider John, a person with normal vision, viewing a blank white page lit by sunlight while wearing glasses with red lenses. The appearance to John of a red page is determined by the white page, sunlight, and the red lenses in this Bit. If we change to yellow lenses, the page would then appear to John to be yellow, not red. Similarly, what appears to John to be real will change if sunlight is replaced by a blue light or the white page is replaced by a green one. Thus, what appears to be real is not determined by the object alone, the subject alone, or the process

alone. What appears to be real is determined by all three roles in the triple; that is, appearing to be real is relative to a real triple.

What appears to be real is determined by all three roles in a triple. We cannot separate out the phrase "z appears to be real" from the rest of the statement. For example, consider Jane looking through glasses at a page. The statement "red page z appears to be real," on its own, loses information about the virtual page z. One interpretation is that Jane is wearing red lenses and the page is white. Another is that Jane has clear lenses and the page is red. Therefore, we cannot say "red page z appears to be real" in an absolute way. What appears as real can only be described or understood in the context of its own Bit of Consciousness, namely, z appears as real to observer x under the observing process y.

What we are calling real is not the result of a magical transformation in which something virtual (not observed) miraculously springs into existence (by being observed) with a concrete solid material "body." Something z appears to be real only in the context of an observation, while something z remains virtual if it is not in the context of an observation.

What appears to be real to an observer will be different under different conditions and states of awareness. There are different perspectives on reality and these perspectives depend on the specifics in the triple. A triple therefore defines a "point of view" about the components of the triple. We are calling something real in relative terms and that is why we have to define the circumstances. These circumstances are defined by the components of the specific Bit of Consciousness. However, outside Bits of Consciousness, an entity is virtual, meaning it is non-localized in time, space, or circumstances. This is analogous to saying something is a non-localized wave function. Once observed, it becomes real relative to that triple.

Since the reality of an entity is relative to a Bit of Consciousness, what is real may vary significantly between Bits without representing the full nature of the entity. For example, Jane can be observed by a variety of observers at the same moment. Her husband, her children, her students, friends, enemies, and her pets will perceive her differently in their respective Bits of observation at that moment. All of their observations of Jane are perceived as Jane, yet no two of their observations are the same. Each observer feels as though they are observing Jane. However, their observations will always be relative to one or another aspect of Jane.

Each observer will perceive some aspects of Jane as being real, but what each perceives as real is relative, not absolute; none of them perceives in that instance all that Jane is. Therefore, we cannot say that Jane has manifested to any of them in her absolute reality as one entity that is a definite collection of Modes, Patterns, and Networks. (See Section 4 for the definitions of Modes, Patterns, and Networks.)

In contrast to the relative experiences of the above observers, let us consider an observation of Jane by an omniscient observer. Such an observer could observe all of Jane's Modes, Patterns, and Networks at the same time. Only from the perspective of an omniscient entity can Jane be considered to be real in absolute terms. Furthermore, from the perspective of an omniscient observer, there are no virtual entities because the omniscient observer can observe any possible entity including those that we may consider as virtual. Therefore, virtual status is also a relative concept depending on the observer.

According to the above discussion, how Jane appears to be real varies between different observers. Furthermore, how Jane appears may also vary over time for a single observer. This can be illustrated as follows: Jane is a real object that I can see. Jane is never the same; what I see depends on the specific moment of observation, how I define my perspective on what Jane is, and if she remains the same or changes over time (a fraction of a second, a day, a year, a lifetime . . .). When I am not observing Jane, she is virtual to me; yet, at the same time, she can be very real in different ways for myriad other observers (people, objects, planets, atoms, and so on).

This means that the only way we can talk about reality is in terms of triples, where the three components are all not 0.

John can close his eyes and think of Jane; he is then part of a real triple where John is the observer, his thinking is the observing process, and the thought of Jane is the observed object. This Bit of Consciousness can be represented by the triple (John, thinking, a thought of Jane). This triple is real by itself and the thought of Jane appears to be real to John during his thinking process. Although the thought of Jane appears real, Jane herself is not being experienced by John in this Bit of Consciousness; hence, Jane herself is virtual in this context. Since the thought of Jane is one component of a triple and not itself a triple, the thought of Jane in John's mind, when taken on its own outside that triple, must be considered virtual. Many people can be thinking of the same Jane at the same time in different ways. John can think of her as playing the role of a subject: Jane, he thinks, must now be solving a mathematics problem. He can also think of her as playing the role of an object: her students in the classroom are observing her. Taken on their own, these are virtual roles and virtual realities as far as the "real" Jane is concerned. During these moments of John's thoughts, the "real" Jane might be dressed in a completely different way than John imagines. She can be in a different place and be doing different things than John thinks.

Based on the knowledge and the state of consciousness of John at the time he thinks about Jane, he can be more or less accurate about what the "real" Jane is or is not doing. In the waking state of consciousness, if he knows exactly where she is, he can be closer in his thinking process to what the "real" Jane is. In the dream state of consciousness, he can be adamantly sure that Jane is having dinner with him while she is in "reality" giving a lecture in another part of the world.

Only a triple consisting of a subject, a process of knowing, and an object may be called real by itself.

3.1. **How experiences emerge in $\mathcal{C}$onsciousness.** Let us now backtrack to ask how various experiences that appear different emerge within the one Singularity of $\mathcal{C}$onsciousness.

One might think that consciousness is entirely defined by O^R, Observerhood. However, without O^D and O^G also present, even $\mathcal{C}$onsciousness—the Singularity itself—remains pure potentiality: $\mathcal{C}$onsciousness has no existent reality in the material or physical sense. Yet, we are saying "$\mathcal{C}$onsciousness is all there is" in an absolute sense. For $\mathcal{C}$onsciousness to exist as real even in an absolute sense, it has to be conscious, that is, it must be a real triple itself. This means $\mathcal{C}$onsciousness must have an inherent structure of observer, process of observation, and observed.

This three-in-one nature of $\mathcal{C}$onsciousness is a concept, yet the perfect symmetry of the Singularity of $\mathcal{C}$onsciousness is "broken" by this concept. Nothing actually different from $\mathcal{C}$onsciousness emerges. There are just two points of view within $\mathcal{C}$onsciousness. From one point of view, $\mathcal{C}$onsciousness is Singularity and pure potentiality. From the other point of view, $\mathcal{C}$onsciousness is a real and conscious entity having three values within itself. These three values are its own self (observer), looking at its own self (observed), in an auto-referral or self-referral process of observing.

With this concept of three-in-one, $\mathcal{C}$onsciousness appreciates itself from a perspective of "real" existence rather than just as a potentiality within Singularity. This breaking of symmetry does not occur because of any outside agency, for there is nothing outside Singularity; it happens because Singularity is $\mathcal{C}$onsciousness and $\mathcal{C}$onsciousness is conscious, which means $\mathcal{C}$onsciousness has inherently a three-in-one nature. Further, the symmetry breaking is not a sequential process developing over time. There is no time in the Singularity and therefore no time when the three and the one are separate, no time when there is one without the three.

To illustrate the three-in-one nature of $\mathcal{C}$onsciousness with an analogy, think, for example, of a man called John who is a doctor and has a wife and children. He can say: I am a doctor; I am a husband; I am a father. It is the same John, but he can look at himself in terms of different aspects of himself. Here the function being performed highlights the various aspects of the one man. Similarly, the one $\mathcal{C}$onsciousness, when it assumes its function of being conscious, sees within itself three different roles: observer, observed, and process of observation.

Let us now see how the idea of John as a doctor becomes "separated" from the original idea of John. When John is a doctor and functions fully and wholeheartedly as a doctor, he is in some ways not a husband or a father. Of course, inherently he is the three but, when attended to fully and unequivocally, this one function eclipses the others. In other words, if theoretically John can function one hundred percent as a doctor in the most ideal situation with no other interference from any other aspect of his nature, then the Bit of Consciousness corresponding to John working as a doctor has an ideal Observerhood doctor quality. This Bit of Consciousness can be written as the triple $(O^{r_{\text{doctor}}}, O^g, O^d)$, where $O^{r_{\text{doctor}}}$ represents the Observerhood of John as one hundred percent doctor, O^g represents the particular environmental conditions under which he is functioning, and O^d is the patient that John is treating in his or her Observedhood quality.

This analogy can shed light on the way in which Singularity can be conceived if it were to take on its three roles separately. As stated above, there is no time when the three roles and the one $\mathcal{C}$onsciousness are separate, and there is no time when the one $\mathcal{C}$onsciousness is without all three roles. However, for the purpose of analysis, we can conceptually conceive of Singularity taking on each of the three roles in isolation, without the other two roles being present; that is, while remaining all that there is, Singularity assumes only one of the three roles. This can be represented by a triple where one of the components is Singularity, denoted by SNG, and the other two components are each 0, representing the absence of two roles. Such a triple will be a virtual entity, not a real Bit. There are three such triples, one for each of the three roles of Singularity in a triple.

In order to explain this more fully, we introduce the following notation:

$$\mathcal{C}_r = (\text{SNG}, 0, 0), \ \mathcal{C}_g = (0, \text{SNG}, 0), \ \mathcal{C}_d = (0, 0, \text{SNG}).$$

These triples are explained as follows:

- In the triple $\mathcal{C}_r = (\text{SNG}, 0, 0)$, we have $O^r = \text{SNG}$ while O^d and O^g are both 0. This is the *virtual entity* in which Singularity assumes only the role of an observer (SNG), without an observing process and an object of observation—it is the *virtual entity* corresponding to the total or fullest potential of the Observerhood aspect within $\mathcal{C}$onsciousness and nothing else.
- In the triple $\mathcal{C}_g = (0, \text{SNG}, 0)$, we have $O^g = \text{SNG}$ while O^r and O^d are both 0. This is the *virtual entity* in which Singularity assumes only the role of a process of observation (SNG), without an observer role and an object to observe—it is the *virtual entity* corresponding to the total or fullest potential of the Observinghood aspect within $\mathcal{C}$onsciousness and nothing else.
- In the triple $\mathcal{C}_d = (0, 0, \text{SNG})$, we have $O^d = \text{SNG}$ while O^r and O^g are both 0. This is the *virtual entity* in which the Singularity assumes only the role of an observed (SNG), without an observer role and a process of observation—it is the *virtual entity* corresponding to the total or fullest potential of the Observedhood aspect within $\mathcal{C}$onsciousness and nothing else.

It is not that $\mathcal{C}$onsciousness gets divided into three. It is just the same $\mathcal{C}$onsciousness assuming three different roles. This is why the term *virtual entity* has been emphasized in the above descriptions. Since, according to our theory, $\mathcal{C}$onsciousness is all there is, $\mathcal{C}$onsciousness must necessarily be Singularity; when it assumes only the role of observer, then the observer is all there is; there is no observing or observed. In this case, the only concept is the observer: $\mathcal{C}_r = (\text{SNG}, 0, 0)$. This applies in the same way for the other two triples, $\mathcal{C}_g = (0, \text{SNG}, 0)$ and $\mathcal{C}_d = (0, 0, \text{SNG})$.

In fact, the above three entities cannot exist by themselves. As described earlier, everything is $\mathcal{C}$onsciousness or Bits of Consciousness. If any component of a triple has the value 0, which represents absence of the respective, then the triple is only virtual and can be entertained but does not exist by itself. As defined earlier in this section, this is actually the definition of a *virtual entity*, namely a triple (x, y, z), where one or two of the components x, y, or z is equal to 0.

If Jane and the flower are the only things existing in a total void and it is pitch-dark with no interaction possible between Jane and the flower (hypothetically, not even gravity), then the O^g of experiencing the flower is 0 and Jane has no experience of the flower. The idea is there and the situation is a potential concept, but the concept is not a Bit of Consciousness and one cannot ascertain whether the flower, or Jane for that matter, is really there! Except, of course, if Jane or the flower were to interact with someone or something else in some other way. (This is substantiated by modern physics and the principles describing de-coherence or the collapse of the wave function briefly discussed later in Section 9.)

In our analysis of reality, therefore, we find two types of entities: real entities (Bits of Consciousness requiring the three-in-one structure of $\mathcal{C}$onsciousness) and virtual entities. The "hard" part of the solution to the problems of consciousness and

reality reside in our proposition that objects that practically everyone calls existent and real are virtual. Furthermore, consciousness and processes of consciousness, which are generally considered most abstract, are the most real in our theory.

Virtual entities, however, can be entertained (or conceived!). When they are conceived, which means when they are "observed" by $\mathcal{C}$onsciousness, they appear as a component of a Bit of Consciousness, and the Bit of Consciousness is itself real.

Definition. A *Concept* is a virtual triple z that has the role of an observed in a real triple (x, y, z); that is, a Concept is a virtual triple that appears to be real and to exist for some observer in a real triple.

The triples $\mathcal{C}_r$, $\mathcal{C}_d$, and $\mathcal{C}_g$ given above are, therefore, only virtual entities and cannot be considered as existing on their own in any way. They are not Bits of Consciousness. They are simply mere virtual entities. However, since they are virtual within Pure Consciousness, they can be observed by $\mathcal{C}$onsciousness. So we can deduce the existence of the following Bits of Consciousness $\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$ as follows:

$\mathcal{C}_\rho = (\mathcal{C}, \mathcal{C}, \mathcal{C}_r)$, $\mathcal{C}$onsciousness observing its Observerhood nature,
$\mathcal{C}_\gamma = (\mathcal{C}, \mathcal{C}, \mathcal{C}_g)$, $\mathcal{C}$onsciousness observing its Observinghood nature,
$\mathcal{C}_\delta = (\mathcal{C}, \mathcal{C}, \mathcal{C}_d)$, $\mathcal{C}$onsciousness observing its Observedhood nature.

Thus, $\mathcal{C}_r$, $\mathcal{C}_g$, and $\mathcal{C}_d$ are Concepts in $\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$, respectively. We add to these three the primordial experience of the Singularity SNG experiencing itself as Oneness, namely, the entity

$$\mathcal{C}_{\mathrm{SNG}} = \mathcal{C}_{\mathrm{SNG}}(O^r = \mathrm{ULT}^r, O^g = \mathrm{ULT}^g, O^d = \mathrm{ULT}^d),$$

which is the Bit of Consciousness $(\mathrm{ULT}^r, \mathrm{ULT}^g, \mathrm{ULT}^d)$. Hence, we have four aspects of the primordial reality—one ($\mathcal{C}_{\mathrm{SNG}}$) is Singularity and the other three ($\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$) are the divided nature of that Singularity.

4. Multiplicity Emerging from Unity

Now, let us look more closely at the Singularity of $\mathcal{C}$onsciousness and the multiplicity that results from its nature to be conscious.

In Axiom 2 we described $\mathcal{C}$onsciousness as the entity

$$\mathcal{C} = \mathcal{C}(O^R = \mathrm{ALL}^R, O^G = \mathrm{ALL}^G, O^D = \mathrm{ALL}^D).$$

This says that all there is and all there can be is $\mathcal{C}$ and is in $\mathcal{C}$. That is, $\mathcal{C}$ is the field of all possibilities.

By exercising its own nature and capacity to be conscious, $\mathcal{C}$onsciousness knows itself, thereby becoming a triple—in so doing, becoming a reality and not just a potentiality. It is able to be conscious of itself, simultaneously taking on each of the three specific roles, observer (subject), process of observation, and observed (object).

4.1. **Modes of Consciousness.** When a Bit of Consciousness occurs, it is a real entity. As we have seen above, this real entity must be a specific triple $b = (x, y, z)$ with no 0 components. As a real entity, $\mathcal{C}$ will have its own abilities to play any of the three roles within new triples. It can be in the role of an observer (with a range of Observerhood abilities). It can, as well, participate in processes of observation (with

a range of Observinghood possibilities), and it itself can be observed in different ways (with a range of Observedhood possibilities). This leads to the definition of the *Mode* M_b of a Bit of Consciousness b.

Before giving this definition, recall that, as was stated in Section 2, when the superscripts R, G, and D are in uppercase, they indicate the range of the full potential of Observerhood, Observinghood, and Observedhood for a particular entity. For the entity b, we now define the following:

- ○ Observerhood: The symbol $O^R(b)$ denotes all observers made possible by b.
- ○ Observinghood: The symbol $O^G(b)$ denotes all possible observing processes made possible by b.
- ○ Observedhood: The symbol $O^D(b)$ denotes all possible objects made possible by b.

Using this notation, we now define the Mode of a Bit of Consciousness.

Definition. Given a real Bit of Consciousness b, the *Mode* M_b of b is defined as the collection of triples (x, y, z), where at least one of the following statements is true: x is an element of $O^R(b)$, y is an element of $O^G(b)$, z is an element of $O^D(b)$.

The *Core Mode* M_b^* of a Bit b is defined to be the subcollection of Bits (x, y, z) in M_b such that at least one of x, y, or z is equal to b. This is written in symbols as

$$M_b^* = \{(x, y, z) \mid x = b \text{ or } y = b \text{ or } z = b\}.$$

To illustrate the idea of a Core Mode, let's take a simple example of a particle ρ interacting with another particle δ in a medium γ (the process connecting them). The Bit of Consciousness $b = (\rho, \gamma, \delta)$ describes the interaction. This entity b is the Bit of Consciousness in which the particle ρ plays the role of an observer, another particle δ plays the role of the observed, and γ plays the role of the process linking them. The result of this interaction, the togetherness of the three factors in a triple, which we call b, could itself be a new particle or any of a number of other entities depending on the starting values of ρ, γ, and δ. We nevertheless have a new real entity b. This new entity b can itself participate as an observer, a process of observation, or an observed in a number of ways in a number of other interactions or Bits of Consciousness. For example, the interaction $b = (\rho, \gamma, \delta)$ could be the object of observation in a spark chamber.

A Mode is not itself a Bit of Consciousness. But the concept of a Mode allows us to differentiate an actual Bit from the various ways in which the Bit can itself make possible one of the three roles within other triples.

4.2. **Patterns and Networks.** We will now build on this idea of the Mode of a Bit of Consciousness by defining Patterns and Networks. This will enable us to handle more complex situations. We start with the example of John seeing a flower.

When John sees a flower we have a Bit of Consciousness

$$j = (\text{John}, \text{seeing}, \text{flower}).$$

After John sees the flower, he is no longer the same John. He has had an experience and, to whatever extent that experience influenced him, he has changed. The Bit of Consciousness j that changed him creates a transformation. Even if the flower faded or he went to another place where there are no flowers, John would perceive

things from the perspective of j. The Mode of j now includes how John sees, is seen, or influences any situation. It is obvious that John is a lot more complex than this. He has gone through innumerable other experiences that together define his potential, range, and abilities. These experiences he has gone through and the multitude of Modes they create make John what he is. This collection of Modes is an example of what we call a Pattern.

Definition. A *Pattern* is a collection of Modes together with a collection of relationships between the Bits of Consciousness that make up those Modes.

We now introduce the idea of a Network to describe the functional dynamism within a Pattern.

Definition. A *Network* is a Pattern together with functional or dynamic interconnections among the Bits of the Pattern.

The difference between a Pattern and a Network is similar to the difference between an X-ray scan and an MRI (magnetic resonance imaging) scan. For example, an X-ray scan of the body is a static image of the bones and tissues. This corresponds to the definition of Pattern. In contrast, an MRI scan can also measure functional activity such as blood flow within and between organs, which corresponds to the definition of a Network.

Having defined Bits, Modes, Patterns, and Networks, we use these new definitions to look at the concept of Singularity and its differentiation into multiplicity. Recall that $\mathcal{C}$onsciousness has its own status as Singularity, namely, the entity

$$\mathcal{C}_{\mathrm{SNG}} = \mathcal{C}_{\mathrm{SNG}}(O^r = \mathrm{ULT}^r, O^g = \mathrm{ULT}^g, O^d = \mathrm{ULT}^d),$$

and $\mathcal{C}$onsciousness may look at itself in three different ways, which we can express in terms of the three virtual entities $\mathcal{C}_r$, $\mathcal{C}_g$, and $\mathcal{C}_d$, defined earlier in Section 3:

- $\mathcal{C}$onsciousness looks at its Observerhood, which we called the Bit of Consciousness
$$\mathcal{C}_\rho = (\mathcal{C}, \mathcal{C}, \mathcal{C}_r),$$

- $\mathcal{C}$onsciousness looks at its Observinghood, which we called the Bit of Consciousness
$$\mathcal{C}_\gamma = (\mathcal{C}, \mathcal{C}, \mathcal{C}_g),$$

- $\mathcal{C}$onsciousness looks at its Observedhood, which we called the Bit of Consciousness
$$\mathcal{C}_\delta = (\mathcal{C}, \mathcal{C}, \mathcal{C}_d).$$

In all three cases, $\mathcal{C}$onsciousness is looking at itself as an object, whether that object is its Observerhood, Observinghood, or Observedhood. Thus, the one $\mathcal{C}$onsciousness gives rise to three Bits of Consciousness, $\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$. Now, with the generative concept of Mode, which was introduced to account for the idea that each experience modifies the collection of possible subsequent experiences, a new level of the infinite potentiality of $\mathcal{C}$onsciousness is revealed—new ways of looking at itself are unfolded. According to this concept, these three Bits of Consciousness give rise to new Modes denoted by $M_{\mathcal{C}_\rho}$, $M_{\mathcal{C}_\gamma}$, and $M_{\mathcal{C}_\delta}$, as shown in Figure 1.

These Modes, $M_{\mathcal{C}_\rho}$, $M_{\mathcal{C}_\gamma}$, and $M_{\mathcal{C}_\delta}$, then take on a generative life of their own. The new Bits in these three Modes, collectively, form a new level of Bits. In turn, each of these new Bits generates its own Mode consisting of more new Bits, which form yet another new level.
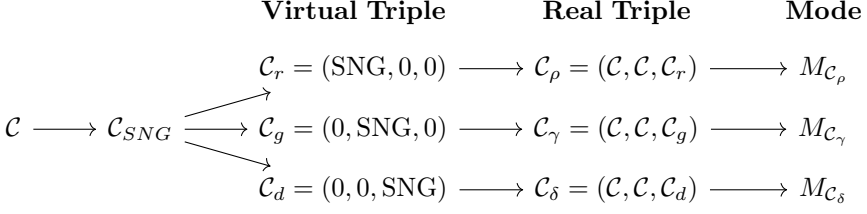
$$
\begin{array}{ccc}
\textbf{Virtual Triple} & \textbf{Real Triple} & \textbf{Mode} \\
\mathcal{C}_r = (\mathrm{SNG}, 0, 0) \longrightarrow \mathcal{C}_\rho = (\mathcal{C}, \mathcal{C}, \mathcal{C}_r) \longrightarrow M_{\mathcal{C}_\rho} \\
\mathcal{C} \longrightarrow \mathcal{C}_{SNG} \longrightarrow \mathcal{C}_g = (0, \mathrm{SNG}, 0) \longrightarrow \mathcal{C}_\gamma = (\mathcal{C}, \mathcal{C}, \mathcal{C}_g) \longrightarrow M_{\mathcal{C}_\gamma} \\
\mathcal{C}_d = (0, 0, \mathrm{SNG}) \longrightarrow \mathcal{C}_\delta = (\mathcal{C}, \mathcal{C}, \mathcal{C}_d) \longrightarrow M_{\mathcal{C}_\delta}
\end{array}
$$

FIGURE 1. Diagram showing how $\mathcal{C}$onsciousness gives rise to three Modes.

The process continues: Starting from any level of Bits, those Bits give rise to their own Modes consisting of new Bits. Collectively, these new Bits form the next level. Continuing in this way, successive levels of Bits are created. The resulting infinite pyramidal formation of Bits is what we will call a *Cascade*.

The emergence of Modes from Bits occurs naturally because of the nature of $\mathcal{C}$onsciousness to be conscious and at every level of differentiation everything that is created is $\mathcal{C}$onsciousness. A Mode is not a real object; however, it can appear as a component of a Bit of Consciousness as an observer, as a process of observing, or as an object of observation. It has an Observerhood range, an Observinghood range, and an Observedhood range.[1]

As described earlier, the primordial Pure Consciousness or $\mathcal{C}$onsciousness is infinite and unbounded. By itself, it is fullness of $\mathcal{C}$onsciousness. It is all there is. The dynamics of its emergence into multiplicity take place as the Bits of Consciousness are generated by $\mathcal{C}$onsciousness looking at itself as an object. However, as we saw before in Section 3, the original components $\mathcal{C}_r$, $\mathcal{C}_g$, and $\mathcal{C}_d$ within the Bits $\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$ are only Concepts and are therefore nothingness. $\mathcal{C}$onsciousness finds as a result that it is nothingness (a point), while at the same time it knows that it is all there is. Thus, it is also fullness (infinity). $\mathcal{C}$onsciousness knows itself to be fullness and nothingness at the same time, but from different perspectives. It is infinity and point.

It is important to note that infinity refers to the pure, unmixed, undisturbed, eternal, unbounded, silent Pure Consciousness that is Oneness, Singularity of $\mathcal{C}$onsciousness. Here, point refers to an entity that emerges from the dynamics of that Pure Consciousness observing itself. In the remainder of this section we will develop this idea by using the notation $\mathcal{C}_{\mathrm{totality}}$ and $\mathcal{C}_{\mathrm{SNG}}$.

Along with virtual elements, Modes include potential Bits of Consciousness in the infinite play of $\mathcal{C}$onsciousness within itself, with cascading infinite possibilities of triples of O^r, O^g, and O^d that lead to an infinite number of Modes having all possible kinds of O^r, O^g, and O^d.

All Modes exist virtually in Pure Consciousness. That is, all infinitely many possible Modes exist simultaneously as virtual entities within Pure Consciousness.

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[1]It is good here to note again that neither objects nor subjects nor processes exist in and by themselves. In and by themselves they are only virtual entities. Only the Bits of Consciousness containing them are real.

The entity $\mathcal{C}_{\text{totality}}$ is the sum total of all possibilities in $\mathcal{C}$onsciousness—all that there is or ever could be. This can be expressed as

$$\mathcal{C}_{\text{totality}} = \mathcal{C}_{\text{totality}}(\text{ALL}^R, \text{ALL}^G, \text{ALL}^D).$$

Here, $\mathcal{C}_{\text{totality}}$ refers to all possible Bits, dynamics of Bits, Modes, Patterns, Networks, and virtual or real entities of $\mathcal{C}$onsciousness. These are infinite in number, including 0 and ULT itself. It defines a range which is unlimited, and $\mathcal{C}_{\text{totality}}$ is fullness of all possibilities. It highlights the dynamism within the one undisturbed Singularity which we defined in Section 3 as

$$\mathcal{C}_{\text{SNG}} = \mathcal{C}_{\text{SNG}}(O^r = \text{ULT}^r,\ O^g = \text{ULT}^g,\ O^d = \text{ULT}^d),$$

which is the Bit of Consciousness $(\text{ULT}^r, \text{ULT}^g, \text{ULT}^d)$.

The entity $\mathcal{C}_{\text{SNG}}$ highlights the infinite silence aspect of $\mathcal{C}$onsciousness, while $\mathcal{C}_{\text{totality}}$ highlights the infinite dynamism aspect of $\mathcal{C}$onsciousness.

Having set up the general model, let us now turn to applications of the model to the descriptions and resolutions of a wide range of issues related to consciousness. A complete development of these issues will involve more axioms, but in this paper we simply describe the way in which the issues fit into the general model. We start with memory as the first application.

5. Omniscience and Memory

We begin with the definition of memory.

Definition. *Memory* is a Bit of Consciousness MEM $= (x, u, b)$ where b is a real triple $b = (x, v, z)$ in which the observer x is the same observer as in MEM. In the real triple (x, u, b), b is x's Memory (under u) of the observation of z (under v). Note that the Memory occurs subsequent to the observation and not at the same time, which is witnessing (see Section 8.7).

To remember is to be aware of what is stored in Memory. The field of all possibilities $\mathcal{C}_{\text{totality}}$ is the collection of all possible aspects of the dynamics of $\mathcal{C}$onsciousness. What is stored in the field of all possibilities is the simultaneous co-existence of all that there is—all possible Bits, Modes, and entities of $\mathcal{C}$onsciousness.

We just expressed $\mathcal{C}_{\text{totality}}$ as

$$\mathcal{C}_{\text{totality}}(\text{ALL}^R, \text{ALL}^G, \text{ALL}^D).$$

All simultaneously co-existing aspects of $\mathcal{C}$onsciousness are stored in $\mathcal{C}_{\text{totality}}$. As a storage, $\mathcal{C}_{\text{totality}}$ could be seen as Memory. But to actually remember or be aware of all that there is, we have to observe it. So we get the new Bit of Consciousness

$$\mathcal{C}_{\text{Memory}^{\text{totality}}} = (O^r, O^g, \mathcal{C}_{\text{totality}}).$$

In this case, Memory is not just storage but is actually being conscious of ("remembering") all that there is. There is, therefore, a state of awareness in which everything is remembered. This awareness of the collection $\mathcal{C}_{\text{totality}}$ as well as the awareness of each of the entities in that collection is what we define as *Omniscience*.

6. Processes in $\mathcal{C}$onsciousness

We have within $\mathcal{C}$onsciousness the following notions:

(1) Singularity, SNG: the non-physical, non-material singularity of $\mathcal{C}$onsciousness

(2) Virtual entity: a triple with one or two of its components equal to 0

(3) Bit of Consciousness: a triple with none of its components equal to 0

(4) Mode of a given Bit of Consciousness b: the collection of all Bits of Consciousness that are "related" to b

(5) Pattern: a collection of Modes together with relationships among the Bits contained in the Modes

(6) Network: a Pattern together with dynamics or functional connectivity of the relationships in the Pattern

(7) Cascade: the result of the processes that spontaneously generate new Bits, Modes, Patterns, and Networks

Starting at the top of the list, Singularity can only be "observed" by its own self! Nothing is big enough to contain it. All else is smaller and cannot behold it.

Singularity is $\mathcal{C}$onsciousness. It observes itself and has within it the three concepts of observer, observed, and process of observation. When these three Concepts are separately observed by Singularity, three Bits of Consciousness emerge, namely $\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$. These Bits are real even though they are based on virtual entities. These real Bits lead to novel ways of being conscious because they can function as an observing process; they also color the way to observe and be observed. These novel ways or colors are novel Modes of Consciousness. Modes are themselves conceptual.[1] Nothing is real except triples whose components are all not equal to 0. Modes, Patterns, and Networks are virtual entities but they are built from real Bits. A Bit emerges from Concepts but is real. A Bit takes a life of its own by giving rise to a Mode of Consciousness, whose Bits in turn generate successive Modes resulting in an infinite Cascade.

There is, therefore, a point of view by which one can justifiably say that everything other than Singularity is just a Concept within Singularity. The Singularity, however, has an infinite diversity of Concepts cascading into Bits, Modes, Patterns, and Networks. Singularity is ONE, but unlimited diversity emerges within its nature as $\mathcal{C}$onsciousness.

An interesting point is that a Bit is real but the experience of the observer of the Bit cannot be fully appreciated from outside the Bit itself. For example, when John looks at the flower in a room, a Bit of Consciousness emerges which we denote by $C_{\mathrm{Jrf}} = (\mathrm{John}, \mathrm{room}, \mathrm{flower})$. Anyone can see John looking at the flower, but no one can experience exactly what John experiences. Jane in the same room cannot know what $(\mathrm{John}, \mathrm{room}, \mathrm{flower})$ is; that is personal to John. Jane can experience the simultaneous presence of John, room, and flower. She can have her own Bit of experience about them together or separately but Jane cannot experience what

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[1] All expressions with uppercase superscripts indicate a range of possibilities. For a Mode, a triple with uppercase superscripts is the range of the Mode. Anything defined by ranges is a virtual entity but can be a component of a Bit of Consciousness.

John is experiencing in the Bit C_{Jrf}. To fully and completely experience what John is experiencing in the Bit C_{Jrf}, one would have to be John in this specific interaction.

On the other hand, concepts such as man, flower, planet, and all the unlimited number of concepts are virtual entities, and all of them can potentially be observed, either as what we normally call objects or as concepts such as thoughts and imaginary entities. Modes, Patterns, and Networks are virtual entities that can therefore be observed. Jane can imagine what John is experiencing and might even be able to have an experience similar to his. All the possible ways John could observe a flower in a room are open to Jane's consideration and possible experience.

A Cascade emerges from the original three Bits, $\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$, and their three Modes, $M_{\mathcal{C}_\rho}$, $M_{\mathcal{C}_\gamma}$, and $M_{\mathcal{C}_\delta}$. This, therefore, generates the progression of one into three—$\mathcal{C}$onsciousness as pure existence, becomes existent (becomes conscious). Because the three are different from one another, the concept of uniqueness is there spontaneously.

6.1. **Ego.** The uniqueness just described is what constitutes the sense of individuality or self of the entity. The sense of self, therefore, emerges as different from just observing oneself. One can see oneself and one can consider oneself to be unique. These are two different Bits of Consciousness. Uniqueness is comparative. If there is only One (Singularity), there is no sense of uniqueness. Uniqueness arises when there are at least two and one of these considers itself as unique among the bunch! Uniqueness is seeing oneself as different from others. Uniqueness also arises when an outside observer sees one as different from the rest. This is the *Ego*.

6.2. **Intellect.** The three Bits of Consciousness, $\mathcal{C}_\rho$, $\mathcal{C}_\gamma$, and $\mathcal{C}_\delta$, emerging at the same time from Singularity, spontaneously give rise to the process of $\mathcal{C}$onsciousness called Intellect. Any one of these three entities can see itself as being different from the other two and each can see the difference between the other two. This is discrimination, the distinguishing and deciding faculty of $\mathcal{C}$onsciousness, which we call *Intellect*. Multiplicity cannot exist without discrimination. In fact, discrimination is the process that both generates multiplicity and maintains its existence. Without it, the idea of "many" cannot be appreciated. It is important to note that the Intellect is not a new and independent faculty or entity. It is simply the observation of differences and this is a process inherent in the nature of $\mathcal{C}$onsciousness to be conscious. Hence, being conscious of multiplicity means separating one entity from the others. The Intellect is therefore the process of awareness of multiplicity, distinguishing one entity from another.

6.3. **Mind.** Cascades include processes as well as independent entities. Each entity is distinct from every other entity and this distinction is, by itself, also discernible. The ability to observe one entity and then another, wandering between entities, is a process that can be appreciated in $\mathcal{C}$onsciousness; this process is called *Mind*.

We have, therefore, uniqueness (Ego), distinction (Intellect), and the ability to wander between observations of different entities (Mind).

6.4. **Space/Time.** Different entities, which are all part of multiplicity, can be observed simultaneously (two or more together) or sequentially (one after the other). The simultaneous observation is *Space* and the sequential observation is *Time*.

All entities co-exist and can be simultaneously perceived as individual Modes or Networks within multiplicity. A tree is a Network. The sky is a Network. The forest can be seen as a collection of trees, that is, a Network called forest. Also, a whole scene including the mountain, the forest, the houses, the birds flying, the clouds moving, and the sky can be perceived as one entity (a large Network) or a group of entities.

We have said above that entities are unique and distinct. Different entities can be observed simultaneously. Their *simultaneous* existence as unique and distinct defines space. In contrast, the *sequence* in which they can be observed defines time. Space is a concept of co-existence of different entities. It is a necessary aspect for the elements of multiplicity to be simultaneously observed. Two entities cannot occupy the exact same space at the same time. Otherwise they would be exactly the same entity and therefore not unique and distinct.

Two entities that can occupy the exact same space but at different times are identical virtual entities that can be observed at different times. They are the same virtual entity, but they are not part of the same Bit of Consciousness. Therefore, as real entities (triples with no component equal to 0) they are different. As virtual entities (triples with one or two components equal to 0), they are the same. For example, there is one virtual electron $(0, 0, \text{electron})$; however, two electrons, one on the Earth $(\text{John}, \text{measuring}, \text{electron})$ and one on the moon $(\text{astronaut}, \text{measuring}, \text{electron})$, are two different objects of observation.

Another example that illustrates how one virtual entity can appear differently in different Bits is that John is a whole collection of potentialities of John; all potentialities of John may not actualize in a lifetime. John is a collection of Modes, Patterns, and Networks; in different subcollections there will be different aspects of John that manifest as real entities. Yet, the virtual self of John as a collection of Modes, Patterns, and Networks remains the same even when aspects of John change from circumstance to circumstance. All the potentialities of John are included in the virtual self of John.

Space, therefore, is not a big place where things sit or move. Space is a concept allowing the observation of two (or more) separate entities simultaneously. For this, the entities need to be observed as objects in the same Bit of Consciousness. For example, in the Bit of Consciousness $(a, b, c+d+\cdots+x)$ the various entities $c, d, \ldots, x$ are observed simultaneously. The process called space allows this simultaneous observation to happen.

If there were only one entity, there would be no concept of space. Singularity is beyond the concept of space. For space to be conceived of, there must be the simultaneous observation of two or more entities.

Time is another process allowing the experience of multiplicity. Time allows the observation of many, even within the confines of a space that was occupied by one object. This happens as one object is out of awareness and another object replaces it. This is the sequential appreciation of multiplicity. Even if there were only one confined space, sequence allows one object to appear and disappear and the other object to replace it within the same general area of space. Time is therefore the process that allows the entities of multiplicity to be experienced in sequence. Singularity is not subject to time. Singularity is omnipresent and beyond time

and space. Time and space are themselves virtual. The triples (John, sees, Jane) and (John, sees, Joan) are real, but the idea that the two triples exist together is a concept. Time and space are part of the mechanics of observation; they are processes; their presence is *deduced* from the observation. Their mechanics are observable. They are part of O^G.

Let us look at an example from physics that appears to contradict this model. Theoretically, in a Bose-Einstein condensate, a large number of bosons can all be in the same quantum state, including being in the same spatial position. Starting around the year 2000, Bose-Einstein condensates of heavy atoms, in particular, Bose-Einstein condensates of rubidium-85 atoms, were created. In these experiments, thousands of rubidium atoms appear to be in the same quantum state, hence in the same spatial position.

However, on closer examination, our model is not contradicted: These rubidium atoms are quantum-mechanically delocalized. Their presence in the exact same place may be possible theoretically, but no measurement can determine the exact location in space of any atom.

If such a measurement of a rubidium atom were possible, then according to the Heisenberg uncertainty principle, it would acquire infinite momentum; this means that in an infinitesimal instant of time, this atom would be delocalized over an unbounded spatial area. Such a hypothetical atom, due to its infinite momentum, would also have to have infinite energy, which is experimentally not possible. Thus, it is impossible to determine for sure whether these rubidium atoms actually occupy the same location in space at the same time.

In this example, even though many rubidium-85 atoms are in the same quantum state and spatial position, the Heisenberg uncertainty principle states that no two of them can occupy the same place at the same time. So this experiment does not contradict our model in which passage of time is necessary for two objects to occupy the same location in space.

In our model, time and space are fundamentally only concepts that allow us to experience multiplicity, either simultaneously in space or sequentially in time. Singularity itself is beyond time and space, and, as our concepts of reality fathom fields of consciousness (such as quantum phenomena) that are "nearer" to Singularity, time and space take dimensions and proportions that are not easily conceivable in classical perspectives. They are, however, fully in agreement with the model presented in this paper.

6.5. **Eight Primary Processes.** Let us now look at a more familiar experience that illustrates many of the aspects of $\mathcal{C}$onsciousness that we have been describing in this section and the previous section. John looks at a bouquet of roses and then sees Jane walking into the room. Jane rearranges the roses in the vase. John thinks that they look much nicer in the new arrangement, he thinks how they have been transformed, and for a moment all his awareness is completely taken by the roses. Nothing else is in his mind. He realizes his mind was filled by that one experience. He turns to Jane and they discuss how each rose can be special, unique, and different from the other roses but how together they are also special, yet they think about how all roses are made out of the same kinds of atoms, which are themselves made

out of the smallest elementary particles, and how each elementary particle can be actually nonlocal and part of a field with quantum probabilities and wave functions.

All these individual observations are independent Bits of Consciousness. John, Jane, and the roses are collections of Modes and are therefore only virtual entities. The atoms are smaller collections of Modes and the elementary particles are yet smaller, more basic Modes. In this setting, we summarize eight primary processes or principles as follows:

- John and Jane observe the uniqueness and individuality of each rose; therefore each rose has its own identity. This is the broadest concept of *Ego*.
- They observe the distinctiveness between them—this is *Intellect*.
- Their awareness moves from one rose to another—this is *Mind*.
- They observe that the roses are different but exist simultaneously—this is *Space*. They also observe that different roses can occupy the same general space—different entities can exist in the same or different parts of space in sequence—this is *Time*.
- When the experience of the roses wholly absorbs John, his consciousness is completely filled by that one experience. When he realizes that he was totally absorbed by the experience, he is, in effect, noticing that all the space of his awareness was filled. This is analogous to the principle that a gas expands to fill completely the container it is put into. Therefore, we will call it the *Gaseous* process.
- Their attention goes from one flower to another. This can be thought of as one Bit of Consciousness (Jane, sees, first rose) transforming into another Bit of Consciousness (Jane, sees, second rose). Traditionally, transformation is associated with the *Fire* element.
- When they see how easily attention can flow from one Bit of Consciousness to another and how they can arrange the roses—this is *Fluidity*.
- The specific and relatively rigid structures of each rose, and of John and Jane themselves, form the process appreciated as *Solidity*.

In this way, there are eight processes that emerge spontaneously with the emergence of multiplicity. They are:

(1) *Ego*: Identity and uniqueness.
(2) *Intellect*: Distinction.
(3) *Mind*: Wandering, the possibility to freely move from observation of one entity to observation of another entity, where both entities could be real or virtual.
(4) *Space/Time*: Separation between one entity and another.
(5) *Gaseous* process: Ability of any observed entity to fully occupy the space of the awareness of the observer in a Bit of Consciousness.
(6) *Fire* process: Transformation of Bits, entities, and Modes.
(7) *Fluidity* process: Flexibility of the sequence of Modes or Bits of Consciousness.
(8) *Solidity* process: Specific structure and its constancy.

Let us look at another illustration of these ideas. An electron is by itself a virtual entity. In all multiplicity, there is only one virtual electron and not large numbers of electrons flying around waiting to be captured. The virtual electron, however,

can be observed by an unlimited number of observers. It can appear as if there are actually many separate and independent electrons. But objects such as an electron never exist in and by themselves. Objects are only virtual entities. Reality consists only of real triples. Virtual entities can be used in an unlimited number of instances and in various ways. A particular virtual entity, such as an electron, can co-exist in simultaneous or sequential Bits of Consciousness, thus appearing to be real in an unlimited number of ways. The collection of all possible such ways is called the *field* of the electron.

If we were to draw the field of all possibilities of $\mathcal{C}$onsciousness,

$$\mathcal{C}\text{onsciousness} = \mathcal{C}\text{onsciousness}(O^R = \text{ALL}^R,\ O^G = \text{ALL}^G,\ O^D = \text{ALL}^D),$$

on Cartesian coordinates with the x-axis for O^R, the y-axis for O^G, and the z-axis for O^D, there would be a point on the z-axis which referred to the concept of electron. (For more details, see [9].) The plane that crosses this point and is parallel to the x- and y-axes is the electron field. This is an oversimplification because it describes the electron when observed as such and not as a part of a complex structure. It is an oversimplification also because there are other dimensions involved, including sequence and therefore time, as well as Modes and their collections, which allow electrons to be available as constituents of other entities. Nevertheless, there is a field for every entity and, therefore, a field for everything and everyone. And these fields can be located as a plane. A field for John, the Jane field, the tree field, the atom field, and so on. (In a later paper I will discuss more about this with its implications and degrees of freedom.)

Since all eight processes described above are necessary consequences of $\mathcal{C}$onsciousness being conscious, they are as much a requirement for Singularity to be an existent entity as the original three-in-one concept. To be existent, therefore, Singularity must have not just the three-in-one structure. It must also have ALL. This ALL is *all* of everything in O^R, O^G, and O^D. In particular, it includes all the above-mentioned processes that emerge with the differentiation of unity into diversity. Diversity, therefore, is not just a diversity of virtual objects. It is also a diversity of virtual processes that create Patterns of collections of Modes, not just their constituent Bits. Any one collection of Modes can have a large number of Patterns that could be described in terms of orderliness or entropy.

Singularity is ALL and ULT together. We can look at these from different perspectives. From an existent/non-existent point of view:

- ALL is all manifestations, real and virtual;
- ULT can be interpreted as unmanifest.

We can also interpret ALL as dynamism and ULT as silence.

As in Section 4.2, the terms nothingness and fullness may also be used here. Just as the primordial $\mathcal{C}$onsciousness $\mathcal{C}$ can be seen as either nothingness or fullness depending on the point of view, ALL can be seen as either nothingness or fullness depending on the perspective or point of view, and similarly for ULT.

The greater the "differentiation" from unity to diversity, the greater is the potential for complexity, the larger the number of Modes, and the larger the possible collection of Modes. Complexity is also greater because the relationships between Bits are now, for example, subject to comparisons in space (distance), consideration

of sequence (time), similarity or dissimilarity (extent of transformation), flexibility (fluidity), and rigidity (structural rigidity). Furthermore, all processes are continuously subject to the eight primary processes, which are called *Prakṛitis* in Sanskrit. Thus, patterns arise which are more and more complex.

There is differentiation and isolation leading away from Singularity and separating different members of ALL. In the opposite direction, by combining Modes, there is unification getting closer and closer to Singularity (towards the unity and wholeness of ALL). Combining Modes may add complexification as well.

Dynamic processes resulting in Networks of Modes can take the Networks in one of three directions referred to as *Tamas*, *Rajas*, and *Sattwa* in Sanskrit:

(1) Destroying and diminishing tendencies: obstacles to the ability to behold ULT or see the togetherness and unity within ALL—*Tamas*;

(2) Restless tendencies: activities that do not lead to progress and therefore do not contribute to the ability to behold ULT or to see the togetherness and unity within ALL—*Rajas*;

(3) Evolutionary or constructive tendencies: growth towards greater ability to behold ULT or see the togetherness and unity within ALL—*Sattwa*.

In its wholeness, ALL contains the totality of the dynamic aspect of ULT. ALL *is* ULT in its dynamic aspect. (This will be developed further in a later paper.)

7. Who am I? Soul, Ego, Intellect, Mind!

Everyone and everything is a Pattern of Consciousness. An elementary particle is one tiny virtual entity in $\mathcal{C}$onsciousness. It is a virtual entity that leads to a manifest Bit of Consciousness when it is part of a process of observation with an observer of some sort. Human beings are highly complex and orderly compilations of large numbers of Modes of Consciousness. Yet, like particles, human beings exist virtually in $\mathcal{C}$onsciousness, but may appear as a component of a real Bit of Consciousness along with a process of observation and an observer.

We are not just an observer, an object, or a process of observation. We are $\mathcal{C}$onsciousness and $\mathcal{C}$onsciousness exists only in a three-in-one structure. We are bundles of Modes of Consciousness; the range of each of the three roles that is available to each of us defines our individuality. Whenever we examine something, look at something, or experience something, we are making and unmaking who we are. This is because we go through new Bits of Consciousness (experiences of whatever kind) and the Bits modify the collection of Modes of which we are composed.

The self s_E of any entity E at any given time is the togetherness of all Modes M_i that make up the entity. We now propose an axiom asserting the existence of the self s_E as an entity determined by Modes. Recall that, whenever an entity E is uniquely determined by properties $p_1, p_2, \ldots, p_k$, we write $E = E(p_1, p_2, \ldots, p_k)$.

Axiom 3. For each entity E, there exists a self s_E, called the *self of E*, defined by

$$s_E = s_E(M_1, M_2, \ldots, M_k; P_1, P_2, \ldots, P_m; N_1, N_2, \ldots, N_n),$$

where each M_i is a Mode, each P_i is a Pattern, and each N_i is a Network. Note that for each M_i there is a Bit b_i such that M_i is the Mode of b_i.

The Modes, Patterns, and Networks in the formula for the self of an entity may vary with time, circumstance, and perspective. As Jane has new experiences, new Modes will be added; consequently, her Patterns and Networks may change. The formula for self can be used to define Jane's self over her lifetime, or over her adulthood, or at her current status. Also, Jane's self as perceived by others will vary with their experiences and knowledge of her. Her husband, children, students, friends, enemies, and Jane herself will perceive her differently; hence, the Modes, Patterns, and Networks that they use to define Jane's self will vary with their perspective.

Some references to self in this article are given by a verbal description; for example, "identity and uniqueness" and "persistence of oneself through change." It is understood that underlying each such reference is a more detailed description involving Modes, Patterns, and Networks.

What constitutes a particular bundle of Modes with specific Patterns and Networks that are perceived together as an individual entity—say Jane—can be defined like all other entities with one undivided and three divided aspects:

(1) The holistic undivided aspect of Jane is represented in its full potential by

$$s_{\text{Jane}} = (O^{R_{\text{Jane}}}, O^{G_{\text{Jane}}}, O^{D_{\text{Jane}}});$$

this is the togetherness of all that Jane is.

(2) How Jane looks at her own $O^{R_{\text{Jane}}}$ is given by

$$s_{\text{Jane}^{O^R}} = (O^{R_1}, O^{G_1}, O^{R_{\text{Jane}}}).$$

(3) How Jane looks at her own $O^{G_{\text{Jane}}}$ is given by

$$s_{\text{Jane}^{O^G}} = (O^{R_2}, O^{G_2}, O^{G_{\text{Jane}}}).$$

(4) How Jane looks at her own $O^{D_{\text{Jane}}}$ is given by

$$s_{\text{Jane}^{O^D}} = (O^{R_3}, O^{G_3}, O^{D_{\text{Jane}}}).$$

The last three aspects highlight how Jane perceives herself as an observer under different circumstances, how she perceives the processes or laws of nature that influence her interaction with her environment, and how she perceives herself as an object.

Jane is all of these values together. This is her total individual being, called her *Soul* or *Jiva*, number (1) above:

$$s_{\text{Jane}} = (O^{R_{\text{Jane}}}, O^{G_{\text{Jane}}}, O^{D_{\text{Jane}}}).$$

Her Ego (*Ahamkar* in Sanskrit), is

$$s_{\text{Jane}^{O^R}} = (O^{R_1}, O^{G_1}, O^{R_{\text{Jane}}}).$$

Her ability to discriminate and think rationally, Intellect (*Buddhi* in Sanskrit), is

$$s_{\text{Jane}^{O^G}} = (O^{R_2}, O^{G_2}, O^{G_{\text{Jane}}}).$$

We shall let the symbol $O^{D_{\text{JE}}}$ mean the possible objects that Jane can observe. Her Mind, able to wander amongst those possible objects (*Manas* in Sanskrit), is

$$s_{\text{Jane}^{O^D}} = (O^{R_3}, O^{G_3}, O^{D_{\text{JE}}}).$$

Consider how we go about living and what we think is our self. It is always a sequence of Bits of Consciousness. We can be meeting with a friend, looking at a flower, thinking about the future or the past, and then examining our ideas, thoughts, the meaning of life, justice, law, and order. Thinking about ourselves in all these moments of existence, we see an observer, a process of observation, and an object. The three are inseparable, whether the object is a planet, a building, a friend, my own body, my own thoughts, my awareness of what I am thinking about, what I call myself, transcendental experience, or *Samadhi*; an object is always there and a process that connects our awareness to that object will always be there.

7.1. **Patterns of Being.** Modes do not simply lead to more or fewer qualities and potentialities. They are a basis for Patterns of Consciousness determined by the relationships between the triples in the Modes. Every complex entity entails Patterns of Bits of Consciousness that constitute the bundles of Modes. Humans and other entities continue to accumulate Bits of Consciousness that we call experience or knowledge, continuously transforming the Pattern we associate ourselves with. This is individual development, growth, and evolution.

Every aspect of our reality and every potential history that we could go through exist virtually in Pure Consciousness, which is the field of all possibilities. What manifests, however, depends on the coming together of three specific factors of $\mathcal{C}$onsciousness. As discussed earlier, three factors—O^R, O^G, and O^D—define the possibilities available to an individual entity with unique characteristics. They allow for the expressions of specific Bits of Consciousness through various combinations of the three roles. However,

$$s_{\text{Jane}} = (O^R, O^G, O^D)$$

is the togetherness of all that Jane can potentially experience and express at a particular moment in time. This means that s_{Jane} is a virtual entity within $\mathcal{C}$onsciousness and s_{Jane} therefore is not a real entity even though Jane can manifest in different ways (Jane observing the flower, Jane observing the moon, Jane observing the children) in the context of triples arising from combinations of specific elements in each of the three ranges in s_{Jane}.

Thus, s_{Jane} is a collection of possibilities. The individual possibilities can become realities under different circumstances. Therefore, even though Jane changes and can be observed under different circumstances in different ways (young, old, happy, tired, musician, scientist ...); even if she can herself be observing things from different perspectives (as a teacher, as a mother, as a poet, as a scientist ...), Jane still operates within a defined collection of what her potentialities are and s_{Jane} defines this collection. Within this collection, there can be a large number of possible Patterns. These Patterns are shaped by which Bits of Consciousness are observed and therefore highlighted. There are therefore different possible Patterns associated with the same s_{Jane}. This is how s_{Jane} is a virtual identity but with different Patterns manifesting within the possibilities of s_{Jane}. Each Pattern emerges from the Modes of Bits of Consciousness within s_{Jane}. Every new experience highlights or strengthens one aspect or another of the potentialities of s_{Jane}. Jane, therefore, as an individual at any moment in time, is herself some Pattern in s_{Jane}. What Jane knows about herself and her history and the continuity of her existence from

one observation to the next (going from one Bit to the next) is what Jane calls the persistence of herself through change. This is her Ego. There are, therefore, a large number of possible Janes within s_{Jane}. Indeed, Jane herself is never exactly the same Jane even within one lifetime of change, growth, and development.

Furthermore, any collection of individuals has its identity. Any group of humans—family, society, nation, world—has a collective consciousness that plays a fundamental role in its collective decision-making and identity. A society is therefore also a Network in the same way that an individual is a Network of smaller entities or Modes. A group of individuals is a Network made out of individuals and has its identity as a group. There are also Patterns of being that have their own identity, such as a family, society, or nation, that is modified as each of the members of the group changes and develops.

7.2. **Consciousness and Awareness.**

7.2. **Consciousness and Awareness.** Our individual small Memories are the awareness we have of the Bits of Consciousness that contribute to making the Pattern that we are. Some of these Memories vividly rise to consciousness under certain situations, while others can remain latent or subconscious, while some might not be available for retrieval until the full range of possibilities of our Observerhood (O^R) is used.

It is self-evident in our model, for example, that Singularity is a fundamental aspect of our being. An individual might never become aware of that on a direct experiential level until his/her/its awareness expands (see Higher States of Consciousness, Section 8.2).

The only true self of everything and everyone is the ultimate $\mathcal{C}$onsciousness. It is all there is. Therefore, we will write it as *Self* (with uppercase S). Jane, like everything else, is also "that," but she is not aware of it. What she perceives herself to be and the memories she has of herself and what she has been or is going through is an awareness of the various Patterns of her as Jane. Jane as an individual entity, perceiving itself, is in reality one special way of perceiving Singularity. When Jane sees herself, she is seeing Singularity from a limited point of view—the point of view known as Jane at that moment in time. Indeed, it is Singularity itself seeing itself with the point of view of Jane. In the final analysis, everything is always happening within $\mathcal{C} = \mathcal{C}(\text{ALL}^R, \text{ALL}^G, \text{ALL}^D)$. Thus, $s_{\text{Jane}} = (O^R, O^G, O^D)$ is a subcollection contained within $\mathcal{C}$. The ultimate true reality of Jane's self is that it is itself Singularity, Self. All other perceptions and identifications are just various points of view.

When Jane thinks me, myself, my ego, my being, and my identity, she is being aware, thinking about, and talking about the ultimate Singularity as seen through her own specific point of view. It is like two people wearing two differently colored glasses and looking at the same white object. One says the object is red; the other says it is yellow. In the same way Jane, John, David, Ravi, and Ali each look at the same Singularity from their own level of awareness and perspective—and each separately says this is Jane, John, David, Ravi, or Ali. Each also identifies with that perception as being one's own dear, inner, intimate, and private self.

7.3. **The Journey of the Self.**

7.3. **The Journey of the Self.** What happens to us after death? What is our karmic responsibility? Is there a continuity of our human individuality, with specific

features and histories? As just discussed, in this theory any Bit of Consciousness, any experience, any virtual entity, is a triple (O^r, O^g, O^d) which belongs to $\mathcal{C} = \mathcal{C}(\text{ALL}^R, \text{ALL}^G, \text{ALL}^D)$. In fact, any triple, whether real or virtual, belongs to $\mathcal{C}$. Everything, therefore, that we observe, dream, or imagine is an aspect of $\mathcal{C}$. When Dr. John Smith (DJS) thinks of himself, he identifies himself with a name, looks, personal situation, role (doctor, father, friend), and so on. These change over time and under various circumstances. Yet, DJS knows that John, the child he was, daddy (the father), and doctor (the physician he has become) are all the same person, which he calls himself—his self, ego, or identity.

Everyone wonders what will happen to oneself. As one grows, takes one social role or another, ages, gains in knowledge and maturity, and dies, where is the "self"? Every atom and molecule in one's body is replaced or transformed many times over a lifetime. Appearances change, roles change, knowledge, wisdom, hopes, and expectations change. Objectively, physically, and even mentally, there is nothing that has been consistently the same throughout the life of John Smith, yet he still calls himself John Smith and perceives himself as the same individual with a special history and life.

It is the awareness and Memory of having gone through a history that allows the sense of self to be maintained. Things change but the perception of change maintains the continuity of an identity that is changing. One does not perceive change as novel creation but as transformation of an existing entity and that entity is identified as self. The *Self* in humans is $\mathcal{C}$onsciousness. It is not based on constancy of the Bits, Modes, Patterns, or Networks. The self is the perception of Pure Consciousness through a particular point of view, which is the result of a particular configuration of Modes, Patterns, and Networks.

One can imagine or write novels about hundreds of completely look-alike John Smiths with hundreds of different histories. These imaginary John Smiths might exist in multiple real and imaginary universes. Multiverse theories have been suggested to explain quantum-mechanical calculations and observations. Multiple universe perspectives have made their way into popular writings and fiction, with the possibilities of different John Smiths living simultaneously in different universes, each having a different history. The discussion about the self of John Smith, therefore, becomes even more intriguing. If John Smith can be in different universes with different histories, DJS of New York can wonder if all or some are also himself.

In this theory, all aspects of John Smith are virtual realities co-existing in the field of Pure Consciousness as members of ALL. This includes those aspects and history of DJS living in New York in the 21st century, as well as all possible aspects of look-alike John Smiths living under all kinds of circumstance and roles in all kinds of places and times. These co-exist as virtual entities in the unbounded field of Pure Consciousness, in ALL. These entities can take part in Bits of Consciousness sequentially or simultaneously, independently of a particular John Smith. As discussed above, in this theory, John Smith does not exist as real; only triples are real. Why and what aspect and history of John Smith can make it to "reality" is a matter of complex interaction between all that makes John Smith and the environment, creating specific Patterns of John Smith.

Not only all possible look-alikes of DJS, but also all virtual entities that we can perceive in our universe and that we could conceive or imagine in the past, present, and future, are simultaneously available in the unbounded field of $\mathcal{C}$onsciousness. They are simultaneously available as virtual entities. And, as we discussed, they appear as real only when they are part of a triple. To become part of a triple is to enter into real time and space.

7.4. **Two Analogies.** To make this clearer and more concrete, I offer two analogies. The first analogy is of a town with many buildings containing museums. A visitor goes to different buildings with different museums having different galleries with different artworks. The buildings are equipped with elevators, escalators, and stairs, which restrict the possible paths in which the visitor can move around. The visitor can choose to explore the artworks in the museums as he or she likes, but those choices are limited by which artworks are present in which galleries. The visitor can choose to leave a particular gallery, museum, or building and go to another one—that is the visitor's freedom—but the museum arrangements determine what artworks the visitor can see, and influence the order in which they are seen. Within the city, all the artworks exist simultaneously as all possibilities for the visitor's viewing, but the contents and sequences of that viewing are constrained. Different visitors, therefore, can go through different sequences in their visits creating different histories with different sequences of experience happening in time. Although all the artworks are displayed simultaneously, each is a virtual entity until it becomes a component of a Bit of Consciousness.

The second analogy makes the same point but perhaps with greater clarity. Let us imagine that there is a very fast complex computer with a nearly unbounded hard disc memory containing all possible kinds of images and scenery. Let us also say that there are sophisticated algorithms that can assemble those images in complex sequences based on the patterns of keyboard inputs one makes. A man who has never seen a computer before now sees this computer for the very first time and begins typing on its keyboard. Various images appear immediately on the screen. For him as an observer, the images come into existence one after another. He sees cause—his typing—and effect—the images suddenly appearing on the screen. He types and the computer produces a sequential flow of images, which gives him a sense of the passage of time. He believes he has freedom of choice because he chooses what key to type and his typing is apparently producing the images. What he does not know is that all imaginable images are stored simultaneously on the computer and that particular images are called to the screen according to rules also stored on the computer.

The images are stored in the hard disc in a digital format. If one were to take the computer apart and directly examine the hard drive, no images would be seen, only some sort of amorphous disc! Yet all images are there in an electronically coded form. In our analogy, the codes are like virtual entities that are simultaneously available at all times. When pressing the keys the codes become real images on the screen. The process of bringing images to the screen is the process of manifesting what is latent and virtual. Bringing virtual existence into real existence happens in sequence. This is because of the algorithms and also because of the fact that you cannot have two images simultaneously on the screen, even though they exist

simultaneously on the hard disc. The one screen limits you, and therefore you can only see the images in a sequence of time. It is possible to also have multiple screens and therefore multiple images at the same time. This is the concept of space.

The man, not knowing how the computer works, thinks that he is actually creating images in a sequence of time or in different spaces. He gradually realizes he is responsible for what happens, but he does not have a full grasp of how it works and why something happens at a specific time. He might have just pressed the sequence F L O W E R and a rose appeared. But previously the same sequence produced a tulip! What he does not know is that the computer is programmed to show a rose, a tulip, or any other flower based on the preceding pattern of keystrokes.

Now, the simultaneous virtual co-existence of all possibilities in the hard disc does not mean that disorder and chaos prevail. The programs and algorithms in our analogy are sophisticated and can account for any sequence of keystrokes.

Random, meaningless sequences of images can occur, but order, harmony, and perfection are also present and can also occur. In our analogy, the algorithms correspond to what we call the laws of nature, discussed later in Section 10. Pressing random keys becomes trial and error: As the man playing with the computer starts to understand how it works, he can gradually learn to press the sequence of keys that gives him the most fulfillment and satisfaction. This is what we call evolution: discovering the laws of nature and applying them to gain fulfillment and growth towards greater ability to behold ULT as well as unity and wholeness within ALL.

7.5. **Who is Dr. John Smith?** Coming back to Dr. John Smith, we will now ask who he is. We find in absolute terms that there is no such thing as a real observer, process, or object called DJS. Only the triple in which DJS appears is real as a specific entity with some constancy and identity.

The sense of self for DJS can be understood in terms of Patterns and Networks. Within the Network s_{DJS}, there will be different Patterns of John Smith. Some of these Patterns might not even be called John Smith and might be experienced or might live in a universe different from that of DJS of New York. There might, therefore, be within the same s_{DJS} a large number of different histories and apparent individuals. They all belong to the same virtual s_{DJS}. They all share, therefore, the same virtual *Jiva* (Soul). If two similar Patterns within s_{DJS} exist simultaneously, they can be said to exist in different spaces (different universes). If they are conceived as existing sequentially, they can be said to exist at different times. In this theory, space and time are processes (see Section 6.4 above).

The transformations in the Patterns of DJS during his lifetime eventually reach a point where the changes become quite dramatic compared to his starting point (birth). The conditions in which DJS's history has been taking place (the life of DJS) become inadequate for the continuing growth and development of his Pattern. This is when death occurs. The specific Pattern reached before DJS's death is no longer sustainable under the circumstances, resulting in DJS's death. The Pattern is then no longer observable. There are many points of view about what happens after death. One of them is reincarnation, understood as the same Pattern reappearing under more suitable circumstances and under different conditions with a different apparent identity. The newly reborn former Pattern of DJS continues to develop under new conditions and circumstances that are more suitable for that Pattern.

The reborn former Pattern of DJS will most likely carry a different name, although it still belongs to the same s_{DJS}. This is the concept of the continuation of the journey of the Soul.

The collection s_{DJS} contains a large number of smaller collections, including those related to particles, atoms, molecules, cells, organs, organ systems, and the entire physiology and anatomy. These are the various Networks that are based on the Patterns that give an identity to an individual. Learning, knowledge, and the experience of greater and wider aspects of nature and its dynamics develop the individual's Patterns of functioning and raise individual awareness from a narrow vision to a more and more expanded vision. On the other hand, any damage to the human anatomy and physiology is damage to the constituents—the Modes, Networks, and Patterns that form the individual.

When DJS (Dr. John Smith), as an entity in a specific time and space frame, is said to have died, this means that the living DJS is no longer observable under the prevalent conditions of the "physical" universe we live in. This does not mean, however, that the concept of DJS has vanished. People who have known DJS can still think of him, albeit each from his or her own perspective. Therefore, DJS can be the object of a thought and as such exist in part as a thought or Memory. These Memories of DJS or thoughts of him, however, are only with reference to the Bits of Consciousness that the various people remembering him have themselves been through.

When Jane remembers seeing DJS while he was taking care of a patient two months before he died, Jane is having a recollection of that one Bit of Consciousness $(\text{Jane}, \text{seeing}, \text{DJS} + \text{patient})$. In this particular Bit, DJS exists as part of the object of observation. Likewise, all Memories are about Bits of Consciousness— some Bits would be brief and limited such as a brief encounter with DJS, others more extensive and varied, such as when his wife, children, and friends remember him. The individual DJS is more "lively," more like the "real" DJS in the mind and Memory of his wife, than in the mind of a passerby who remembers seeing him in the street for a fleeting moment. Nevertheless, all these Memories are extracted from the Bits and Modes of Consciousness that constitute or are related to DJS.

Ordinarily, no one is able to encompass the entirety of Modes, Patterns, and Networks that are related to DJS. Neither his wife nor his children can, for example, observe the full scope of DJS. As such, therefore, even as an object of thought, the full spectrum of DJS would not be observable. However, if there existed an entity $\mathcal{A}$ capable of simultaneously recollecting all DJS's Modes, Patterns, and Networks, then, for this entity $\mathcal{A}$, DJS would be fully observable and the after-death virtual DJS would appear real in a triple $(\mathcal{A}, y, \text{DJS})$.

The object of observation of the triple $(\mathcal{A}, y, \text{DJS})$ would be the Soul of DJS—not only as a virtual entity but also as an existent real entity. The reality of the Soul of DJS however is not necessarily the same as the reality of DJS himself on planet Earth in our universe. In other words, DJS might not be embodied or perceived to be embodied in a physical form as his fellow men and women used to know him.

The transformations that occur after his death depend on who is observing him: (1) how entity $\mathcal{A}$ perceives him as an object of observation—his Observedhood potential, his O^D under the new conditions, (2) what the conditions and processes

of observation in the new realm (the Observinghood potential O^G) are, and (3) what his death does to his Observerhood ability (his O^R).

These three can be further explained as follows:

(1) Perception and knowledge by entity $\mathcal{A}$ are different from perception and knowledge by humans. Entity $\mathcal{A}$, who is capable of observing a much wider range of real and virtual entities, can be said to have an Observerhood potential that is much wider than we usually attribute to humans. This entity could even be in the realm of Omniscience. It would not be limited, for example, on the level of sight by a specific range of wavelengths nor the level of hearing by a specific range of frequencies. Entity $\mathcal{A}$ might not be limited by time and space as humans generally are. It could be said to perceive beyond classical physics and even quantum mechanics. What will DJS's Soul look like to entity $\mathcal{A}$? The quality and characteristics of the consciousness of $\mathcal{A}$ are different from ours. DJS could be seen as a wave or a ripple in the ocean of consciousness. Most likely, however, only entity $\mathcal{A}$ or the like of it can answer this question! Humans do, nonetheless, have different levels or states of consciousness, as will be introduced in Subsection 8.1 below.

(2) The death of DJS puts his Soul in an environment where the laws are most likely different from those on planet Earth. Thus, the Observinghood potential may also be different.

(3) The death of DJS means a disintegration of his "physical" structure, which means that the actual constituent Patterns and Networks that formed him have vanished from Earth. Entity $\mathcal{A}$ allows him (more accurately, allows his Soul) to be considered as real because the observerhood potential of $\mathcal{A}$ allows the creation of a triple $(\mathcal{A}, y, \text{Soul of DJS})$. Even so, this does not guarantee that the Soul of DJS after his death can observe itself.

8. Evolution and Higher States of Consciousness

Self-development and individual evolution occur within a lifetime, across lifetimes, and in multiple simultaneous existences, such as can be conceived in a multiverse reality. Jumps in evolution, such as going from mineral to organic life, from inanimate to animate existence, or from animal to human, occur as more and more collections assemble in the direction of the ability to experience greater and greater wholeness and ultimately to experience Singularity—ULT.

The direction of development of any individual entity, Network, or Pattern (the journey of the Self) can be:

(1) Towards lesser and narrower perspectives, leading to smaller and less organized Patterns. This happens when the Bits of Consciousness added to or highlighted in a Pattern are of a destructive nature; that is, they diminish the ability to see greater wholeness and singularity. This is usually called negative, bad, sinful, action against natural law, and so on.

(2) Without real change. No growth and no regression. New Bits of Consciousness are neither destructive nor evolutionary.

(3) Towards greater appreciation of wholeness and ultimate Singularity. New Bits of Consciousness lead to greater complexity and orderliness.

Ultimate states of development in the Patterns of any entity appear when the entity has grown in its ability to experience the reality of $\mathcal{C}$onsciousness as an unbounded field of all possibilities and the oneness of Singularity as the true essence of everything. There are stages in human awareness leading to these states. These states are then stages for further Pattern development. These states occur as the Pattern reaches the end of all endeavors, which is the fulfillment of the journeys of all Modes. The individual then becomes fully aware on an experiential level that his or her own self is ultimate Singularity. A particular individual will ultimately reach a highly developed Pattern allowing him or her to experience ULT as his or her own Ego. The point of view of the personal self now has reached ultimate awareness. What once was perceived as a personal self is now experienced as ultimate Singularity—the Self of everything and everyone! In human awareness, these ultimate states are called higher states of consciousness.

8.1. **States of Consciousness.** We have described Bits of Consciousness, Modes, Patterns, and Networks. These, in various combinations, lead to what individuality is. Humans, as individuals, experience and go through a wide range of states of consciousness (sleep, dreaming, waking, and so on). Within those states of consciousness, there is a wide range of variation between one individual and another. This has implications for the various choices an individual has and makes. Even if two individuals have similar overall ranges of possibilities available to them, the potential that one or another of those possibilities can be realized as a component of a Bit of Consciousness can be different.

Furthermore, in various states of alertness (drowsy, sleepy, wakeful, alert, hyperalert, and so on) and in various states of consciousness (waking, dreaming, sleeping, and so on), there are different potentialities that can be more or less available to an individual. What separates sleep from coma, for example, is the likelihood that one can recover and exercise certain qualities or abilities of Observerhood O^R. From normal sleep, one can wake up to a wakeful state quite easily. From coma this is less available and less likely. The range O^R, therefore, contains elements that are more available during one state of consciousness than another. In a later paper, these complex relationships will be expressed in mathematical formulations using the basic constructs presented in this paper. In the present paper, these states are simply mentioned and we give examples in the previous section and in the next section of how higher states of consciousness can be conceived in our model.

For an individual, the so-called normal states of consciousness are deep sleep, dreaming, and waking. Examples of altered states of consciousness are the vegetative state and coma. As we just mentioned, there are also higher states of consciousness, which Maharishi Mahesh Yogi has described—Transcendental Consciousness, Cosmic Consciousness, God Consciousness, and Unity Consciousness.

8.2. **Higher States of Consciousness.** It is within the range of possibility for any human being to rise to higher states of consciousness. This rise is accelerated through more frequent exposure to, and integration of, more orderly Bits of Consciousness. Any experience in an individual's life can strengthen the direction towards experiencing Singularity or can weaken it. The fastest way to strengthen the ability to experience Singularity is by favoring experiences of greater and greater

wholeness. There are various practices that aim directly or indirectly at that, including devotion to higher values and surrender to ultimate realities, as in prayer and religious piousness. There are also direct non-belief-based technologies of consciousness, such as the Transcendental Meditation technique and other technologies from Maharishi Vedic Science=. These technologies allow the individual Pattern to directly fathom the field of ultimate Singularity, which is referred to by Maharishi as Pure Consciousness.

By fathoming the field of Pure Consciousness or Singularity, $\mathcal{C}$onsciousness itself becomes more and more what we experience and know our selves to be. This development comes about simply by reinforcing the experience of Pure Consciousness through repeated practice. That this results in growth towards higher states of consciousness is not theoretical, but has been the experience of millions of people around the world. Research has documented changes in the quality of awareness that lead to higher states of consciousness, in which we experience the full range of possibilities. In other words, we expand our Observerhood O^R, giving us an expanded ability to experience everything from the fullest perspective. In terms of the model presented here, the repeated direct experience of Pure Consciousness through transcending reinforces the particular Bit of Consciousness that upholds $\mathcal{C}$onsciousness as infinite and primary. This makes that experience dominant, so that our appreciation of what our Self is starts to be seen in the light of Pure Consciousness.

8.3. **Transcendental Consciousness.** The experience of Pure Consciousness during the practice of the Transcendental Meditation technique leads the individual in the direction of Singularity. The individual approaches a state where the individual observer, the process of observing, and the object observed are all pure existence—Singularity and nothing else. This is called *Transcendental Consciousness*, which can be expressed as

$$\mathcal{C}_{TC} = (\mathrm{ULT}, \mathrm{ULT}, \mathrm{ULT}).$$

Being conscious of having transcended, of having experienced Transcendental Consciousness, is denoted by $(O^r, O^g, \mathcal{C}_{TC})$.

Experiencing the path towards Singularity is called *Transcending* and is denoted by $(\rightarrow\mathrm{ULT}, \rightarrow\mathrm{ULT}, \rightarrow\mathrm{ULT})$, where the term $\rightarrow\mathrm{ULT}$ denotes a value that is tending towards Singularity but has not yet fully reached it. Repeated experience of Transcendental Meditation leads gradually to deeper and deeper Transcending; which, in turn, leads to letting go of differences, going beyond everything relative, losing one's own limited identity as an individual entity, and merging with Pure Consciousness. The range of the observer O^R, the range of observing O^G, and the range of the observed O^D gradually expand as this experience is repeated on a regular basis until the next higher state of consciousness is achieved.

8.4. **Cosmic Consciousness.** As this experience of Transcending is repeated and stabilizes, the individual reaches the ability to experience Pure Transcendental Consciousness as being his or her true Self, even during the so-called normal states of consciousness: waking, dreaming, and sleep. The individual then perceives himself or herself as *being* Pure Consciousness. When fully stabilized, this is a higher state of consciousness called *Cosmic Consciousness* by Maharishi.

In this state of consciousness, the Observerhood O^R has expanded because of the effect of a new Mode being added to the self s. (See Axiom 3.) The new added Mode is the Mode M_{TC} of the Bit of Consciousness

$$\mathcal{C}_{TC} = (\mathrm{ULT}, \mathrm{ULT}, \mathrm{ULT}).$$

In mathematical notation, this means that Cosmic Consciousness for Jane has these four aspects:

(1) The togetherness of all that Jane is:

$$s_{\mathrm{Jane}} = (O^R, O^G, O^D).$$

(2) How Jane looks at her own O^R:

$$s_{\mathrm{Jane}^{O^R}} = (O^{r_1}, O^{g_1}, \mathrm{ULT}).$$

(3) How Jane looks at her own O^G:

$$s_{\mathrm{Jane}^{O^G}} = (O^{r_2}, O^{g_2}, O^G).$$

(4) How Jane looks at her own O^D:

$$s_{\mathrm{Jane}^{O^D}} = (O^{r_3}, O^{g_3}, O^D).$$

Note: In item 2, when Jane looks at her own O^R, her observer role O^{r_1} is not ULT. In fact, this observer role is reduced to just one value in this proposition and that is the ability to see ULT in oneself and nothing else.

In this, the perception of her own O^R has expanded to include Jane's perception of her self as being Pure Consciousness, unbounded and infinite, together with all previous possibilities. Observerhood O^R and O^{r_1} themselves are not infinite as they still do not see the field of all possibilities in the outer field of the senses. Nevertheless, this is the state according to Maharishi Vedic Science where one is considered to have reached liberation from the boundaries, so that the perception of the Self is not colored by Modes (which are virtual) and Bits (which are experiential).

8.5. God Consciousness.

In *God Consciousness*, the individual sees the perfect orderliness of the whole range of life and living and the perfection of divine nature even outside one's Self.

In mathematical notation, this means that God Consciousness for Jane has these four aspects:

(1) The togetherness of all that Jane is:

$$s_{\mathrm{Jane}} = (O^R, \rightarrow\mathrm{ALL}, O^D).$$

(2) How Jane looks at her own O^R; O^R is the object, which is still ULT,

$$s_{\mathrm{Jane}^{O^R}} = (O^{r_1}, \rightarrow\mathrm{ALL}^g, \mathrm{ULT}).$$

(3) How Jane looks at her own O^G; O^G is the object, which in this case is expanding to ALL^g,

$$s_{\mathrm{Jane}^{O^G}} = (O^{r_2}, \rightarrow\mathrm{ALL}^g, \rightarrow\mathrm{ALL}^g).$$

(4) How Jane looks at her own O^D; O^D is the object, which in this case is expanding to ALL^d,

$$s_{\text{Jane}^{O^D}} = (O^{r_3}, \rightarrow\text{ALL}^g, \rightarrow\text{ALL}^d).$$

In the development of higher states of consciousness in an individual, all three components in these aspects evolve towards ULT. The first to reach ULT is the most intimate part of our self, the perception of our own Ego; followed by the perception of what connects us to the environment, O^G; and finally the environment itself, O^D, as we see below in Unity Consciousness. The term $\rightarrow\text{ALL}$ denotes a value that is tending towards ALL, the collection of all roles, but has not yet fully reached it. When ULT is actually reached for O^G, with O^R already perceived as ULT, then Unity Consciousness is automatically achieved. This is not yet the case in God Consciousness, since in God Consciousness O^G is only tending towards Singularity.

8.6. **Unity Consciousness.** In *Unity Consciousness*, the individual perceives everything in terms of wholeness. All is truly One Unbounded Ocean of $\mathcal{C}$onsciousness in motion.

In mathematical notation, this means that Unity Consciousness for Jane has these four aspects:

(1) Togetherness of all that Jane is:

$$s_{\text{Jane}} = (\rightarrow\text{ALL}, \text{ALL}, O^D).$$

(2) How Jane looks at her own O^R; O^R is the object

$$s_{\text{Jane}^{O^R}} = (\rightarrow\text{ALL}^r, \text{ALL}^g, \text{ULT}).$$

(3) How Jane looks at her own O^G; O^G is the object

$$s_{\text{Jane}^{O^G}} = (\rightarrow\text{ALL}^r, \text{ALL}^g, \text{ALL}^g).$$

(4) How Jane looks at her own O^D; O^D is the object

$$s_{\text{Jane}^{O^D}} = (\rightarrow\text{ALL}^r, \text{ALL}^g, \rightarrow\text{ALL}^d).$$

Upon reaching Unity Consciousness, one has totality—absolute value of true perception of real and unreal, existent and nonexistent, boundaries and unboundedness.

8.7. **Witnessing.** Having defined the higher states of consciousness, we now consider a type of awareness, called witnessing, that is common in some higher states.

Definition. *Witnessing* is a Bit of Consciousness in which the observer x is observing a Bit of Consciousness in which the same observer x is observing an object; both Bits occur simultaneously, not as one after the other as in the case of Memory (see Section 5).

The nature of Witnessing depends on the state of consciousness; in the waking state of consciousness, it has a different form than in higher states of consciousness. We begin with the nature of awareness in the waking state of consciousness prior to Cosmic Consciousness.

For example, the observer x within a real triple (x, y, z), in the usual level of awareness in the waking state of consciousness, observes the object within that triple but does not observe the triple itself. In this case, although the triple is real,

it cannot be said to exist for John. John sees the flower—but when John sees the flower, the flower fills his consciousness and at the moment of seeing the flower he is aware of the flower but is not aware of the conscious instance of seeing the flower. However, a split-second later, he can become aware of having seen the flower. This is an immediate Memory of the triple; it does not occur simultaneously with the original event. Although the triple (John, sees, flower) is real, in this case, it cannot be said to exist because that triple was not simultaneously an observed in a real triple. Nevertheless, a Memory of it exists: John is aware that he saw the flower.

However, at another level of awareness in the waking state of consciousness, a situation can exist where the observer has a faculty to simultaneously see the flower without being totally overtaken by the flower. A person who is not yet established in Cosmic Consciousness could be alert enough to be aware constantly of what he is doing without knowing his full potential, without knowing that he is Pure Consciousness. For example, I see the flower and simultaneously I am conscious that I am seeing the flower. This is Witnessing in the waking state of consciousness before Cosmic Consciousness; it represents a higher level of awareness in the waking state of consciousness. In this case, the real triple (John, sees, flower), is said to exist simultaneously with John's perception of it as an observed, that is, (John, is aware of, (John, sees, flower)). Therefore, real triples can exist for an individual with a higher level of awareness in the waking states of consciousness. To represent this experience of Witnessing in waking state of consciousness, let

$$x = \text{John}$$
$$u = \text{sees}$$
$$v = \text{is aware of}$$
$$z = \text{flower.}$$

In terms of these symbols, we have the following triples:

$$(x, u, z) = \text{John sees the flower}$$
$$\text{and}$$
$$(x, v, (x, u, z)) = \text{John is aware of seeing the flower.}$$

The simultaneous dual observation can now be represented by

$$(x, u, z) + (x, v, (x, u, z)).$$

Witnessing in higher states of consciousness has an additional aspect. In Cosmic Consciousness and God Consciousness, John also knows that he is Pure Consciousness and that he is permanently identified with it. Therefore, John not only sees the flower and is simultaneously conscious that he is seeing the flower, he is also aware of himself as Pure Consciousness at the same time. If the triple (x, w, x) represents "John is aware of himself," then this Witnessing experience can be represented by

$$(x, w, x) + (x, u, z) + (x, v, (x, u, z)),$$

which is a simultaneous triple observation.

In a Witnessing experience in waking state of consciousness, Cosmic Consciousness, and God Consciousness, John is not part of what he is observing outside

of himself. He is an independent entity that can observe other "outside" entities. However, when John is established in Unity Consciousness, the object of John's perception is not an outside entity. It is his own nature; it is not separate from his Self. Therefore, the term "Witnessing" is not an appropriate description of his perception because there is no "outside" to witness; all of his experiences are within his Self. He experiences simultaneously himself, the flower, and his seeing of the flower, as aspects of his own Self, Pure Consciousness.

9. Wave Function and Its "Collapse"

The premise of this paper is that everything is $\mathcal{C}$onsciousness—Bits of Consciousness, Modes, Patterns, and Networks of Consciousness. Let us take again the example of an electron. An electron is a virtual entity defined by a specific Mode of Consciousness $M_e = M_e(O^R, O^G, O^D)$. The three components—O^R, O^G, and O^D—define the range O^G to be the conditions under which an electron can be observed, the range O^D to be the ways it appears as an object, and range O^R to be its own abilities to detect changes or react to the environment. Therefore, indeed, the electron has an Observerhood quality and a range of ways it can detect (or "observe") its environment. It can, for example, sense an electromagnetic field. As we have done throughout this paper, Observerhood is taken in its widest meaning to include not only human mental perception but also any detection, reaction, or interaction.

To try to find an electron as an isolated object that exists in the void will be looking for nothingness. Indeed, there can be the virtual entity of an electron

$$\text{VE}_{\text{electron}} = (0, 0, \text{electron}).$$

But, by itself, this is not real. There is, therefore, no justification to look for the electron as a separate entity. In our theory, the apparent collapse of the wave function does not mean that there is an actual electron somewhere, local or not, and now it is made to manifest by the observer. It means that conditions are made possible where a Bit of Consciousness can be generated in which the virtual electron is the object of observation—in other words, when there is also an observer and a process of observation.

Furthermore, there is no need to be looking for an electron running all over the place or spooky actions at a distance. Consider, for example, the famous thought experiment proposed by Erwin Schrödinger in 1935. A cat is placed in a sealed box together with a radioactive substance, a Geiger counter, and a bottle of poison. If the radioactive substance decays, the bottle of poison is broken and the cat dies. The Copenhagen interpretation of quantum mechanics says that a particle exists in all states until it is observed. Thus, until the box is opened and the cat observed, the radioactive substance has simultaneously decayed and not decayed, so that the cat is both dead and alive until someone looks in the box, at which time either the cat is observed to be dead or it is observed to be alive. This seeming paradox is resolved by our model, in which the cat is only virtual.

Simply put, in the experiment, a cat is in a box and whether the cat is dead or alive depends upon a particular sub-atomic random occurrence. However, whether Schrödinger's cat is dead or alive is simply a concept. The cat does not even exist

as an object in a void. Once the cat appears in a triple with a specific observer and process of observing, it will be either dead or alive, not both.

Everything that is real in the universe is a Bit of Consciousness and has a Mode, or is defined by a Pattern and Network of Modes of Consciousness. Schrödinger's cat, therefore, is not an independent entity. Independent "objects," whether humans, gods, particles, or cats, are only virtual entities.

Schrödinger's cat is part of a Bit of Consciousness consisting of observer, process of observation, and observed. Whether the Bit of Consciousness finds the cat dead or alive depends on the three factors together. Furthermore, the observer does not have to be a human or an animate object—it could be any entity, possibly even a particle capable of playing the Observerhood role.

Returning to our discussion of the electron, a standard question in quantum mechanics asks "Is the electron a wave or a particle?" Our theory settles this issue. According to our theory, an electron is neither. The electron is a virtual entity that appears as a wave when there are an observer and two slits in a barrier. The same virtual electron appears as a particle when there are an observer and only one slit in the barrier. In this case, it is a change in the process of observation O^g, from a two-slit barrier to a one-slit barrier, that leads to a different appearance. In fact, any change in one of the three components can lead to a different outcome. Rather than changing the number of slits, one could change the observer from a human to, let's say, another electron! The entity that is real is not the electron by itself as an object of observation, but the entire system involving the three components. It is important to note also that the three components are not limited to the individual scientist, the two-slit barrier or one-slit barrier, and the electron. The observer is actually the entire scientific community and public at large, and the process of observation includes the room, the country, the world, and the universe. All three components are by themselves only virtual entities that are realized through the union of the three of them in the roles of observer, observed, and process of observation.

Einstein asked a quantum physicist whether the moon would exist without an observer. Our answer is that nothing exists without an observer, process of observation, and observed. They are the three elements inherent in $\mathcal{C}$onsciousness being conscious. Everything is Bits of Consciousness (specific experiences), bundles of Bits, and Patterns of Consciousness.

We are neither just an ego, nor just a self, that observes. Rather, we are a bundle of Bits of Consciousness whose range of Observerhood, Observinghood, and Observedhood defines our identity. This bundle is the basis for Patterns of Consciousness. We are Patterns and Networks of Consciousness—so is everything else.

What we call our individual self, therefore, is, at the same time, our bodies, minds, and intellects, as well as all that has had an impression on us—our friends, relatives, all actions we perform, our learning, our experiences, our Memories. All we go through and have been through that leaves an impression on us is our human dimension and being.

Our individual self is a bundle of Modes, Patterns, and Networks of Consciousness. We influence what is in that bundle by our attention. Putting our attention on something creates a Bit of Consciousness that adds a Mode to our bundle, which

in turn can modify our Patterns of Consciousness. Therefore, what we repeatedly put our attention on grows stronger in our life. In effect, what we see, we become.

10. The Laws of Nature

As we discussed in our second analogy in Section 7.4, all modes of $\mathcal{C}$onsciousness co-exist simultaneously. This simultaneous co-existence of all interactions among observer, observing, and observed in the storehouse of infinite possibilities that is $\mathcal{C}$onsciousness does not mean that disorder and chaos prevail. Order, harmony, and perfection are also possible. In addition, we can conceive of observers present in many different modes in many kinds of universes. In our universe, there are constants, such as the speed of light c, Planck's constant $\hbar$, and Newton's gravitational constant G, which define the laws of nature—the laws by which observers and objects interact in our universe.

The ways two particles "look at" each other are described by the electromagnetic, weak, and strong forces. The ways two planets "look at" each other are described by gravitation or curvature of space-time. These and other laws and constants define the Observinghood possibilities or, we could say, perception possibilities—the many values of O^G—in our universe. They define constraints within that system. Some allow perceptions of events that apparently exist for only a split second; others allow perceptions that apparently are eternal. Regardless of their longevity, all perceived events are within $\mathcal{C}$onsciousness, and all these events co-exist all the time. The perception of time in our universe is a consequence of constraints on the system due to the specific Observinghoods O^Gs that define our universe. These constraints can mean that we observe events as occurring in specific sequences. For example, in our universe, the arrow of time points in one direction only.

This is similar to our common human experience. All possible ways of exploring reality are simultaneously present. However, in living, we go through them sequentially. It is our Observerhood feature that is constrained by registering sequences in time. When we go through life, one event after another, we feel these events are occurring or being created one after another and therefore in time. But, in fact, all are here and now and it is the constraints of our universe, which define our human condition, that appear to put events in time. These constraints, the laws of nature, are the values of O^G, the values of Observinghood.

The second analogy in Section 7.4 describes this idea well. We also offer another very simple analogy. We can think of a DVD on which a movie has been recorded. The DVD contains all the events of the movie simultaneously. But our DVD player constrains us to viewing the events of the movie in sequence over time.

11. Free Will and Determinism

The Observinghood range O^G of any particular entity defines the constraints under which this entity operates (observes). The Observerhood range O^R defines the ability of an entity to observe (to operate) within these constraints. Two different observers under similar O^Gs will have different ranges of possibilities. A man and a monkey on planet Earth could be considered to operate under similar O^Gs, but actually the ranges of their ability to operate or observe, and therefore their degrees of freedom, are different.

The Modes of Consciousness that together constitute an entity such as a human being or an animate or inanimate object are also factors that define the entity's O^R. This allows the entity to function within the range O^G and to be observed within the Observedhood range O^D. These are deterministic. The range within each of O^R, O^G, and O^D defines the degrees of freedom of the entity. Each new Bit of Consciousness narrows the range to a particular O^r, O^g, and O^d. As such, it narrows the range of possibilities that can emerge from (occur after) it. This is what is usually considered to be cause and effect, the deterministic aspect of natural law.

An atom, for example, operates under a very restricted range. A human being has a much wider range. Among human beings the range can vary substantially based on their states of consciousness, education, prejudice, and so on—in other words, based on the complex collection of Bits, Modes, Patterns, and Networks that creates their individuality.

Constraints (laws) on humans are not restricted to the so-called "physical" or natural laws, but can encompass beliefs and self-imposed or collectively imposed constraints. These can include moral, religious, national, cultural, and traditional laws. The difference between physical laws and man-made laws is in the degree to which they are considered deterministic or violable. The physical laws seen from a classical perspective are totally deterministic and inviolable. Man-made laws are usually considered violable conventions. Every Bit of Consciousness, however, modifies the Mode of a given entity in a particular way, and this could either narrow the range or widen the range of some Mode associated with the entity. A Bit of Consciousness that is in the direction of ULT, and which allows the perception of greater wholeness and connectedness, widens the range. A Bit of Consciousness with a narrow perspective, and which isolates and disconnects from wholeness, narrows the range. Freedom grows with widening the range and diminishes with narrowing the range.

In this model of $\mathcal{C}$onsciousness, all conceivable possibilities for O^R, O^G, and O^D coexist in ALL. In the state of awareness whose range of possibilities is ALL, freedom is total and unrestricted because all three ranges are unlimited.

12. Unbounded Ability to Change: Omnipotence

Shifting one's awareness from one Bit of Consciousness to another is what change is. To say one has total and unrestricted ability to change means one has the ability to shift one's awareness from any Bit of Consciousness to any other Bit and from any collection of Bits to any other collection of Bits.

Change for any entity can occur only within the range under which this entity is able to operate, defined by O^R, O^G, and O^D. In a limited perspective—under restricted ranges of O^R, O^G, and O^D—there are narrow possibilities of change. If the ranges are less restricted, more change can be produced with greater freedom. The most expansive level of freedom and of ability to change allows any one Bit of Consciousness to follow any other Bit of Consciousness within the unbounded range of ALL possibilities. One can be anything, do anything, and achieve anything instantly. This is infinite freedom and omnipotence. This state is assigned to a Mode or Pattern of Consciousness commonly considered to be of a "divine" nature.

This omnipotence ability, however, does not interfere with any other entity's history or range. It operates within its own range and is independent of anything else. It does not compromise or modify other ranges. In other words, the laws remain the laws and whatever is deterministic for a condition of consciousness is not modified by "divine" intervention as such. In other words, God will not change the laws of the universe to help a thief get away with his theft. The ability to change things, even in a way that might look supernatural, can happen when an individual's awareness fathoms the field of all possibilities. In this state, the individual experiences or evokes a wider range of possibilities than the range he or she has been living under. This opening up of awareness to a higher, more expanded reality of consciousness expands the narrow individual range. This can lead to outcomes that are normally considered improbable, miraculous, or even impossible. Such outcomes depend upon how expansive the consciousness of the observer is, rather than some outside interference (divine or otherwise) attempting to meddle with the laws of nature.

13. Space, Time, Creation, and Evolution

From the above sequential exposition of the emergence of multiplicity, one might assume that there is a time sequence in the emergence of Modes, entities, or Bits of Consciousness. This is not the case according to the present model. The three-in-one structure of $\mathcal{C}$onsciousness is a prerequisite for $\mathcal{C}$onsciousness to be conscious. In the same manner, all diversifications are spontaneous, simultaneous, co-existent modes of $\mathcal{C}$onsciousness. This translates into saying that the full potential of all possible Bits of Consciousness and all entities coexist simultaneously at all times. All objects—physical and material—are part of the dynamics of $\mathcal{C}$onsciousness. They appear as they do, some more concrete, some as energy, and others as thoughts, based on the conditions under which they are observed and on their constituent modes of $\mathcal{C}$onsciousness.

As discussed early in this article, the range of possibilities within $\mathcal{C}$onsciousness extends from infinite fullness to complete emptiness or nothingness. In this range from infinity to a point exist all possible large and small perspectives of $\mathcal{C}$onsciousness. These perspectives themselves become observable entities or Concepts. This is the field of all possibilities always curving back onto itself and generating endless Cascades of Bits of Consciousness, Modes, Patterns, Networks, and other entities. These and their interactions can appear more or less isolated, more or less transparent or opaque to each other, more or less comprehensible by each other. The dynamics between them define the laws that govern their interactions. This is the nature of all that we call objects. If the observer is a man with a microscope, a telescope, or a cyclotron; or if electro-magnetism is being measured rather than gravity; or if we analyze the data classically or quantum-mechanically, with or without concepts of relativity or probability, then different properties and different conclusions and perceptions of the physical world will emerge.

This is how, although all is $\mathcal{C}$onsciousness, each aspect of $\mathcal{C}$onsciousness is different and can appear differently under different conditions.

It will be helpful in our analysis of space, time, and evolution to distinguish between these two viewpoints, by calling one the relative perspective on reality and

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the other the absolute perspective on reality. When we are operating in the realm of apparent differences, disregarding the underlying unity provided by the perspective that everything is nothing but $\mathcal{C}$onsciousness, we say we are operating on the level of *relative* perception or relative understanding. This is the reality perceived in the waking state of consciousness before the rise to higher states of consciousness. This is contrasted with what we call the *absolute* perspective, proposed in this paper, that $\mathcal{C}$onsciousness is all there is and is eternal and unlimited in space and time, which we fully comprehend only in Unity Consciousness.

The phenomena associated with the histories and apparent progressions and evolution of entities and Bits of Consciousness are also subject to this distinction between relative and absolute perspectives. Let us now examine how space and time can be viewed.

Space is a perception of different entities that cannot be superimposed; otherwise the entities would not be different. If two objects were to occupy the exact same space, they would not be two different objects. Because the entities are different, the concept of space emerges. Space is the container of these entities and it must be large enough to contain them. This is accurate on the relative level of perception. On the absolute level of perception, in the present model, the physical is only an appearance and everything is $\mathcal{C}$onsciousness. Space, therefore, appears as real, but is only a point of view. The same is true for time.

How is it that we humans perceive not only objects but also histories of objects; and how can science give us rather precise facts about time and evolution all the way from the Big Bang until the present?

In the cascading emergence of all possibilities, one possibility is for an observer to see the origin and evolution of a particular entity from a perspective that is relevant to the observer's self. This is interpreted as history and progression in time. This interpretation can be totally accurate from that observer's perspective, but the terms used to describe it, and the material reality of it, are only true in relative terms based on that observer's ability to perceive. This just says that every history is always personal and relative rather than absolute.

One way to look at the Big Bang, for example, is to say the following. In the process where the unmanifest infinity of $\mathcal{C}$onsciousness became aware of its own point value, its infinity collapsed to a point. In physical terms, when something is compressed it creates heat. Infinite compression produces infinite heat; this leads to the Big Bang and the emergence of all the subsequent histories. This is a point of view from a perspective requiring time progression, origins and ends, cause and effect.

Seen sequentially, modes of $\mathcal{C}$onsciousness appear to give rise to creation and evolution in time. Each Bit of Consciousness, each possibility, is uniquely different from any other Bit and each is real. What is not real—what is illusory—is perceiving any Bit as separate from $\mathcal{C}$onsciousness; nothing is separate from $\mathcal{C}$onsciousness. $\mathcal{C}$onsciousness is all there is; there is nothing but $\mathcal{C}$onsciousness and its many Bits. The perception that material things are separate from $\mathcal{C}$onsciousness is mistaken from the absolute perspective.

14. Is My Consciousness Like Yours?

Is the color red the same for you as for me? Let's have a look at such questions and their consequences in the light of our model. We start with some basic observations about consciousness.

When a human observer looks at a flower, the interaction could be described by the Bit of Consciousness (O^r, O^g, O^d), where O^r, O^g, and O^d represent combinations of many entities. Every interaction, every experience can be defined by such a triple. Since all possible triples are available simultaneously within $\mathcal{C}$onsciousness, these triples are not separate from $\mathcal{C}$onsciousness and they do not arise sequentially (even though they may appear to us sequentially in time).

In this article, the term consciousness (with lowercase c) is understood in the widest possible sense to mean any coming together of an observer, a process of observing, and an observed. This includes any action or reaction, any transformation, any exchange, and, in fact, any interaction of any sort. This understanding of consciousness takes us beyond what is commonly conceived of as human consciousness. With this broad understanding, from the dynamics of the continuously interacting features of observer, observing, and observed, we could understand the consciousness that is being expressed or experienced. That is to say, the dynamics comprising the features that interact in the experience of a specific Bit of Consciousness would describe the experience.

The problem of whether the color red for you is the same color red for me is solved by comparing the Patterns associated with the two Bits of Consciousness (I, see, the red flower) and (you, see, the same red flower). If you have the same nervous system as I have, if we are in the same universe, if we are in the same place in space and time, and if an object we are observing is the same, then we would have the same conscious experience of the object. The fact that we (the observers) are never completely the same means that our experiences of the object will not be completely the same. But we are so similar that our experiences of the object are broadly the same and that is why we can understand each other and reach agreement about the similarities of our experiences.

When the brain of an individual is damaged or if the brain's structure or function changes for some reason, that individual's experience of consciousness also changes. This fact has led many researchers to conclude that consciousness is a by-product of brain activity. But in our model, it is the other way around. There is nothing physical outside of $\mathcal{C}$onsciousness interacting with itself. Therefore, a change in the brain is just an expression of changes that have occurred in the Patterns or Modes of Consciousness that constitute the brain. Physical changes just reflect changes in Modes of Consciousness, which are simply due to changes in conscious experience.

This is not to say that studying the physical aspects of the brain is not useful. According to our model, when we compare two individuals using biometric markers, we are comparing the Modes and Patterns that constitute these individuals. Thus, knowledge of the physical tells us about the consciousness that constitutes it.

The more we are able to understand the Modes and Patterns that constitute an individual, the more we can say about the state of his or her consciousness: how comprehensive and broad it is. The more we know, the more we can clinically

evaluate the state of consciousness, whether vegetative, coma, restfully alert, or enlightened.

This brings us to a consideration of our model from the viewpoint of complexity and order. Our ability to comprehend the complexity and order, that is, the Modes and Patterns, of any individual, human, horse, or tree, is what allows us to say what level of consciousness it has.

We can even use what the physical world tells us about the consciousness that constitutes it to investigate $\mathcal{C}$onsciousness itself. $\mathcal{C}$onsciousness has within it all possible Modes, all possible Patterns of Consciousness, appearing with anywhere from zero to infinitely many values of Observerhood, Observinghood, and Observedhood, all apparently interacting with each other. These interactions have a high degree of complexity and order. Thus studying, for example, an interaction of enormous complexity and order, such as a fully and properly functioning human nervous system with its enormous number of possible neuronal connections, can provide knowledge of the possibilities inherent in $\mathcal{C}$onsciousness. In future papers, we will explore complexity and order from this point of view.

15. How Is It That We Understand Our Universe?

A source of great wonder (and a principal tool of the modern scientific method) is the correspondence between mathematics and nature. Discoveries such as complementarity and non-locality in quantum theory challenge our confidence that any mathematically described physical theory could ever perfectly correspond to physical reality; nonetheless, developments in mathematical physics have allowed us to understand nature with much greater precision than was available in past centuries and, on that basis, to develop powerfully effective technologies to improve our quality of life. Mathematics apparently is a product purely of the human mind, yet it mirrors the order of nature that seems to lie outside the mind. Why is this so?

According to our model, it is because Patterns of Consciousness construct our minds, our nervous systems, and our universe; all are plays within the one $\mathcal{C}$onsciousness. Thus, what makes sense to our minds inwardly also applies outwardly. Mathematics reflects the universe because the complexities of our minds, our physiologies, and the universe all occur within the one $\mathcal{C}$onsciousness; all are Modes and Patterns of the self-interaction of its three-in-one nature.

Obviously, this correspondence is not restricted only to mathematics. Every branch of the sciences, arts, and humanities—in short, every field of human knowledge and activity—reflects the dynamics of nature's laws. The various structures of human languages, the narratives we tell each other, and our traditional cultural practices—all display the same Patterns of Consciousness expressed in our nervous systems and our universe.

There are those who contend that some ancient traditions stem from a very deep, pure, and innocent level of direct experience of Pure Consciousness by enlightened sages and that these traditions, therefore, give detailed and practical knowledge of the fundamental Patterns of Consciousness. Starting in the 1990s, guided by Maharishi Mahesh Yogi, I conducted research in this field, examining the structures and functions of one such knowledge tradition—Veda and the Vedic literature of India—and comparing them to our modern scientific knowledge of the structures

and functions of human physiology. See, for example, [6, 7, 8]. The strikingly precise and detailed correspondences that I found point in the same direction as the thesis presented in this article: namely, that the patterns of the internal dynamics of the apparent three-in-one nature of $\mathcal{C}$onsciousness, as well as the laws governing these dynamics, appear to us as the structures and activities of our minds, our bodies, and our universe.

16. The Consciousness Model Applied to Problems of Physics

Let us now apply this model to two of the more difficult areas in science, the "collapse" of the wave function in quantum physics, and the "entanglement" of particles at a distance. These phenomena have given rise to a multitude of interpretations in the hundred years since quantum physics was first discovered.

16.1. **Wave or Function?** Quantum mechanics describes the behavior of matter and energy at the atomic and sub-atomic levels. The state of a particle (that is, its position in space and time) is described by a wave function, which is a superposition of many states. Thus, the particle cannot be said to have a fixed position. When an observation takes place, the wave function is said to "collapse"; that is, at the moment of observation or measurement, the particle assumes a certain location rather than a probability distribution as represented by the wave function. It appears to reduce to a single state and the particle's position in space and time is determined precisely for the first time.

This finding, formalized in the 1920s as the Copenhagen Interpretation by Niels Bohr and others and still the most commonly held interpretation, gives rise to many questions. Most of these questions focus on what happens when one generalizes the phenomenon to include everything that is made of particles, which means everything material. The implication of this is that objects have to be observed in order to collapse from nonlocal probabilistic possibilities to the one we observe. Einstein, who did not like the idea, asked in a famous exchange: "Do you really think the moon isn't there if you are not looking at it?" and "Does the moon exist because a mouse looks at it?" Einstein also objected to the idea, implied in the interpretation, that an observer could by free will collapse a wave function and thereby possibly change the course of events. This might imply that the laws of physics do not determine the sequence of events. In a famous letter to Max Born in 1926, Einstein [4] wrote: "I, at any rate, am convinced that He [God] does not throw dice."

Other scientists since then have proposed that the wave function never really collapses—that particles do exist in different places at the same time but in parallel universes. Others simply hold to the idea that the wave function does collapse, that we do have free will, and that's just the way things are. Bohr is reported to have said in response to Einstein, "Don't tell God what to do!" Others have proposed that the observer does collapse the wave function and that the observer does not have to be a human being; the observer could be a photon or any particle interacting with another particle.

One reason why quantum mechanical phenomena are bewildering is that our everyday perception takes place on the macroscopic level, not on the very small, quantum-mechanical level. We perceive objects and people as separate entities that

interact with each other and with the world around them; we don't have direct perception of the fluid, probabilistic reality that quantum mechanics describes. Nobel Laureate Steven Weinberg [13] pointed out that part of Einstein's problem was that he was considering the observer and the measuring apparatus classically and only the particle was being treated quantum mechanically.

16.2. **A solution suggested by our $\mathcal{C}$onsciousness model.** As a general comment, we can say that the often puzzling nature of quantum mechanical phenomena becomes less bewildering when viewed from the perspective of $\mathcal{C}$onsciousness. In the $\mathcal{C}$onsciousness model I propose, it is not non-localized or localized objects that are the issue. It is the idea of the very existence of objects as entities independent of $\mathcal{C}$onsciousness that is the root of the problem. In my model, nothing exists outside the realm of observer, observed, and process of observation. The scientist (or any observer), the instruments (any conditions of observing), and the object (any real or virtual entity) together are inseparable in the one Bit of Consciousness. Any object is only a virtual entity when conceived outside the three-in-one structure of $\mathcal{C}$onsciousness.

In our model, all physical possibilities and all their possible states are virtual entities that can be said to exist only when they are part of a Bit of Consciousness. Under specific circumstances, with a specific observer, and an observed (a virtual entity), one Bit of Consciousness emerges. In the theory of quantum mechanics, it looks like there is a collapse of a wave function when an object is observed. But the wave function itself and the probabilities it defines are also based on a specific observer, circumstances of observing, and an object being considered or observed. The outcome, which is called the collapse of the wave function, is deterministic in that the observer, the circumstances, and the object together create that Bit of Consciousness that is specific to the situation. It is possible that another observer or a slight variation in the circumstances could lead to another outcome. In the theory of quantum mechanics, this is seen as the influence of the observer on the result of the experiment, but in fact it is not a choice on the observer's part. This is because for Observerhood x, Observinghood y, and Observedhood z, there is only one outcome: the triple (x, y, z). Under similar conditions but with another observer, the outcome might be (a, y, z); or, for the same observer with some change in the conditions of observing, (x, b, z).

Every Bit of Consciousness is specific and is different from any other. The observed Observedhood z can be the same virtual object, say Mimi the virtual cat. Yet, under some of these conditions, Mimi the cat may be found alive and well, in others ailing, and in under still other conditions dead. But in our theory, there is no need to try to find Mimi alive in one universe and dead in another. All possibilities are conceptually available for observers here and now. Mimi the cat as such does not exist anywhere. She is a virtual entity actualized only under certain conditions and in a very defined way.

16.3. **Entanglement.** The relativity of space and time (see Section 13) is significant in another problem in physics: Entanglement, or "spooky action at a distance" as ironically described by Einstein. This refers, for example, to particles instantly responding at large distances to each other's change in spin. Experiments seem

to indicate that information travels from one particle to the other at a speed well above the speed of light. This is considered impossible in the universe as we know it. I propose, however, that at the smaller scale of elementary particles space itself is a concept that is not equivalent to space on cosmic or classical levels. Total space on smaller scales is itself smaller. Space in Singularity is non-existent. There would be, therefore, no time to be spent to go from one virtual entity to another. The two particles that seem entangled, yet separate in space, are actually one and not two virtual entities that can appear to exist as two separate entities in two separate spaces to a human observer. The observer can have the illusion of action at a distance but the particles themselves are actually in the same space and there is no action at a distance because there is no distance.

17. The Consciousness Model Applied to Subjectivity and Objectivity

The inseparability of the subject and object in the process of observing has implications for the objective means of investigation critical to science. Conventionally, uncovering truth in science relies on separating the subject (observer) and object of an experiment. Experiments are meant to be designed in such a way that the results of the experiment are, as much as possible, independent of who is carrying out the experiment. However, even the most carefully designed experiment cannot remove the observer (human or otherwise) from the investigation of the object. Thus, complete objectivity is not possible. In our model, an object does not exist independently of the subject or observer and the processes that connect the subject to the object. At the same time, for every subject, object, and process of observation, the outcome is deterministic, a particular Bit of Consciousness. This implies, in our model, that pure objectivity is a fallacy.

On the other hand, our model incorporates the idea of objectivity in science in the following way. The outcome of any experiment done, for example, by different scientists (different observers) but under exactly the same conditions (same process of observing and same object) will depend on the similarities among the scientists. Similar observers should get similar outcomes, that is, similar Bits of Consciousness. This is actually the basis of what is called the objective means of investigation in science. So-called "objectivity" is basically an agreement among a number of observers.

Quantum physics has already revealed the essentially non-material nature of material phenomena. As Werner Heisenberg put it, in experiments about atomic events, "the atoms or elementary particles themselves are not real; they form a world of potentialities or possibilities rather than one of things or facts." [5]

In this article, I hope I have given this perspective a more complete shape by postulating the fundamental reality of $\mathcal{C}$onsciousness beyond time and space. As this $\mathcal{C}$onsciousness, we could say, "bubbles within itself," it generates infinite possibilities of Observerhood (O^r—the measuring or observing role), Observinghood (O^g—the process of observation or measurement), and Observedhood (O^d—the particle of matter whose wave function collapses when measurement occurs). All these are nothing but possibilities within the field of $\mathcal{C}$onsciousness, in other words, different specific values of O^r, O^d, and O^g arising in triples. These possibilities are not separate entities but rather are different aspects of one reality. In other words, they

are different values within one state—different Modes or Patterns of Consciousness at play within $\mathcal{C}$onsciousness as it observes itself from many perspectives.

Any object or entity, say a particle, can exist for infinitely many possible observers, O^r. The observer could be the totality, $\mathcal{C}$onsciousness, where the value of O^r is infinite, it could be a human being (for example, an observing scientist), it could be a tree absorbing the particle, or it could be a molecule reacting with the particle. The perspective of a molecule is necessarily different from that of a big bundle of particles such as a human being. The different perspectives represent different Patterns of Consciousness looking at itself. When, as human beings, we look at ourselves and at others, we are one Pattern or Mode of Consciousness looking at other Modes. There are laws pertaining to each Pattern that define the limitations and possibilities available for each perspective.

Seeing from a limited perspective allows only limited understanding of reality and consequently limited freedom of action. At one extreme is the ultimate, absolute reality, which we call $\mathcal{C}$onsciousness. There are infinitely many relative realities, which are Patterns of this ocean of $\mathcal{C}$onsciousness as it observes itself, from zero consciousness to the tiny consciousness of a particle, to large collections of particles looking at each other, to animals and humans, to the entirety of our universe. Each of these Modes could be described by a specific collection of values of O^r, O^d, and O^g.

18. Topics for Further Study

In future papers, we will develop the following topics more fully in light of our model.

18.1. **Concepts of Good and Bad.** Every Bit of Consciousness that narrows the range of the Mode of an entity goes in the direction of what is considered Bad. All that expands the range is in the direction of what is called Good. This is the simplest basic principle for all good and all bad. Good and Bad are themselves a range of possibilities. One Bit X might be Good in comparison to another Bit Y. But X can be Bad in comparison to Z if Z is a Bit of Consciousness that widens the range more than X does.

18.2. **Evolution.** Evolution is the sequence of Bits of Consciousness that modify the collection of Modes of an entity in the direction of widening its range. The ultimate state of evolution is that in which the range reaches ULT and the possibilities expand in the direction of ALL.

18.3. **States of Consciousness.** As we have seen in Section 7, humans have a wide range of possibilities of consciousness called *states of consciousness*. Within those states of consciousness there can be a wide range of variation from one individual to another. This is what allows us to entertain the concept of an individual being and acting in a more evolutionary way or a less evolutionary way. Examples of familiar states of consciousness that can be placed in the context of triples include waking, dreaming, sleeping, vegetative state, coma, and death. In doing this, we will rely on the principle elaborated at the end of Section 13, that knowledge of states of consciousness can be derived from physical considerations, simply because the physical is nothing but $\mathcal{C}$onsciousness.

18.4. **Sattwa, Rajas, and Tamas.** At the end of Section 6, we described three directions in which the dynamic processes resulting in Networks of Modes can take the Networks: towards greater ability to behold ULT and see the togetherness and unity of ALL (Sattwa), away from the ability to behold ULT and away from seeing the togetherness and unity of ALL (Tamas), or neither, in which these abilities remain more or less the same, even though activity of a restless, unproductive nature occurs (Rajas).

18.5. **Defining the Ways the Subject Observes the Object.** In this paper, the fundamental elements of the theory have been applied to define, with mathematical clarity and precision, many basic philosophical concepts. Similar methods can also be used to add clarity to psychological notions. Such notions include the many ways a subject can observe an object within a real triple. For example, perceiving, detecting, measuring, conceiving, assuming, thinking, contemplating, and so on are terms that are associated with different ways a subject can apprehend an object. In this paper, for simplicity and practical reasons, all of these different processes have been grouped together under the term "to observe." There are, of course, nuances among these different kinds of observations and related concepts. In future articles, we intend to apply the methods of the theory to formulate clear and precise definitions for the nuances inherent in concepts such as attention, detection, appearance, perception, assumption, contemplation, knowledge, and illusion.

19. Summary and Conclusion

Mankind has grappled with understanding the relationship between mind and matter, between consciousness and the physical, since the beginning of recorded history. Aristotle, for instance, thought that "in every case the mind which is actively thinking is the objects which it thinks." (See Book III, Section 7 of Aristotle [1].) Almost 2,000 years later, Descartes expressed another view when he wrote, "Je pense, donc je suis." [I think, therefore I am.] [3] Today the dominant view seems to be that matter is primary and by some means gives rise to consciousness.

This paper takes a different view regarding the problem of the relationship between consciousness and matter, centering it on the idea introduced in the opening section of the paper that consciousness is all there is and that this consciousness can have the appearance of what we consider as matter. As I wrote in Section 17, we could say that $\mathcal{C}$onsciousness "bubbles within itself" generating all possibilities of Observerhood, Observinghood, and Observedhood, all possibilities of life and existence.

As explained, this view is part of the Vedic tradition of knowledge of India most recently revived and reinvigorated by Maharishi Mahesh Yogi. Instead, however, of arguing directly for this relationship between consciousness and matter, I approach the problem from a mathematical perspective.

We do this by stating a number of axioms that describe this particular relationship and by testing a range of outcomes of these axioms. I assert that there are two key conclusions from the idea of $\mathcal{C}$onsciousness and the fundamental axiom or postulate that $\mathcal{C}$onsciousness exists, $\mathcal{C}$onsciousness is all there is, and $\mathcal{C}$onsciousness is conscious. The first conclusion is that by carefully following through on this and successive axioms, especially the assertion that $\mathcal{C}$onsciousness is, in fact, conscious,

we can construct a rich and powerful theory of $\mathcal{C}$onsciousness that is in accord with our experience of the world. This construction is done via the self-interacting dynamics of $\mathcal{C}$onsciousness, whereby $\mathcal{C}$onsciousness, because it is conscious, spontaneously has a three-in-one structure of observer, process of observing, and object of observation.

The second conclusion is that this theory provides a powerful approach to a wide range of classical and modern problems relating to consciousness, enabling them to be resolved with minimal effort. For instance, we are able to distinguish between virtual and real entities: reality requires an observer, a process of observing, and an object of observation. If any of these components is missing, what is left is a virtual entity. Amongst other applications, this resolves the ambiguity related to wave-particle duality: the question of whether the electron is a wave or a particle only has meaning when there is also an observer and a process of observing. Otherwise, the electron is only a virtual entity.

A key feature of the development of this theory is the systematic recognition of different perspectives of $\mathcal{C}$onsciousness arising from the assertion that $\mathcal{C}$onsciousness is conscious. Without the possibility of these perspectives, the initial postulate would be far too simple to be able to build a worthwhile theory. Starting with $\mathcal{C}$onsciousness and its properties introduced in Axiom 1, the first perspective is that there is a non-physical and non-material "singularity" SNG that is $\mathcal{C}$onsciousness. Next, a second perspective emerges when we talk about all possible roles of $\mathcal{C}$onsciousness in terms of its Observerhood, Observinghood, and Observedhood potentials or ranges, the togetherness of which is denoted by ALL. The third perspective is from the standpoint of ULT, the ultimate experience of $\mathcal{C}$onsciousness available to humans, which most closely resembles SNG itself.

The first four sections of the paper set up the general theory, while the remaining sections apply the theory to gain a deeper understanding of and more clarity on a range of problems dealing with consciousness and the interface between consciousness and "consciousness at work" in the "real" world. These topics range from a discussion of higher states of consciousness such as Transcendental Consciousness, Cosmic Consciousness, God Consciousness, and Unity Consciousness, to how the laws of nature are constraints on the values of Observerhood, to an understanding of space, time, creation, and evolution.

In future articles, I will explore the implications of this model for various fields of knowledge. This will include a joint mathematical article [9] giving a rigorous axiomatic treatment of the ideas presented here. Other articles will include implications for several scientific disciplines, as well as ontology, epistemology, and ethics.

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Appendix A. Table of Main Notations

Notation	Section	Description
$\mathcal{C}$onsciousness	1	Pure Consciousness beyond any personal experience of consciousness, the ultimate Singularity
SNG	1	Non-physical, non-material Singularity that is $\mathcal{C}$onsciousness
ALL^R, ALL^G, ALL^D	1	All possible ways to be an observer, to be a process of observation, or to be observed
ALL	1	Aggregate of ALL^R, ALL^G, and ALL^D
O^R, O^G, O^D	1	Observerhood, Observinghood, or Observedhood potential of an entity
O^r, O^g, O^d	1	Expression of Observerhood, Observinghood, or Observedhood in a particular conscious instance
ULT	1	Experience of Pure Consciousness; that is, the experience of Singularity or Pure Consciousness itself
(O^r, O^g, O^d)	2	Bit of Consciousness (each component O^r, O^g, and O^d must not be 0)
$\mathcal{C}_r = (\text{SNG}, 0, 0)$	3	The total or fullest potential of the Observerhood role within $\mathcal{C}$onsciousness
$\mathcal{C}_g = (0, \text{SNG}, 0)$	3	The total or fullest potential of the Observinghood role within $\mathcal{C}$onsciousness
$\mathcal{C}_d = (0, 0, \text{SNG})$	3	The total or fullest potential of the Observedhood role within $\mathcal{C}$onsciousness
$\mathcal{C}_\rho = (\mathcal{C}, \mathcal{C}, \mathcal{C}_r)$	3	$\mathcal{C}$onsciousness observing its Observerhood nature
$\mathcal{C}_\delta = (\mathcal{C}, \mathcal{C}, \mathcal{C}_g)$	3	$\mathcal{C}$onsciousness observing its Observinghood nature
$\mathcal{C}_\gamma = (\mathcal{C}, \mathcal{C}, \mathcal{C}_d)$	3	$\mathcal{C}$onsciousness observing its Observedhood nature
M_b	4	Mode of a Bit of Consciousness b
$\rightarrow$ULT	8	Tendency towards ULT
$\rightarrow$ALL	8	Tendency towards ALL

Appendix B. List of Main Definitions and their Implications

There are a number of fundamental ideas that are at the basis of our theory or that emerge from it. Some new ones such as Observerhood (related to the subject—the observer), Observinghood (related to the process of observation), and

Observedhood (related to the object of observation—the observed) have been discussed in this paper. Others, particularly those that have been commonly used in the general literature of science and philosophy with varying connotations, might benefit from a proper definition in the context of the theory presented in this article. For further clarity, recapitulation, and a comparative summary, we shall define some fundamental terms.

In the following definitions, the letter x will generally (but not always) be used for the observer (subject), y for the process of observation, and z for the observed (object). For simplicity we can describe the triple (x, y, z) as follows: the appearance of object z to observer x under conditions y. The letters u and v are generally used to indicate a number of possibilities rather than a specific observer, process, or observed.

B.1. **Definitions.**

(1) A *Bit of Consciousness* is a triple (x, y, z) with all components present, where x is an observer, y is the process of observation (including all that connects the observer to the object of observation), and z is the object of observation. Components x, y, and z each play their respective roles according to their positions in the triple. If nothing functions in a particular role in a triple, we use the symbol 0 in the corresponding place to indicate that fact. Thus, a Bit of Consciousness is a triple with no components equal to 0. Since $\mathcal{C}$onsciousness is all there is, a Bit of Consciousness is a point of view in which $\mathcal{C}$onsciousness (as a specific observer) interacts in a specific way (process of observation) with itself as a specific object (observed). We also refer to a Bit of Consciousness as a *real entity* or a *real triple*.

(2) *Reality* is the collection of all real triples within a given space-time frame.

(3) A *virtual triple* is a triple with one or two of its components equal to 0. The symbol 0 in a triple means nothing functions in the corresponding role. A virtual triple is not a Bit of Consciousness. Any non-triple entity u can be represented by one of the following three virtual triples: $(u, 0, 0)$, $(0, u, 0)$, and $(0, 0, u)$, depending on the intended role of u. Hence, non-triple entities are also virtual.

(4) A component of a triple that is represented by 0 is *Nothing*. If x equals 0 in (x, y, z), then x is Nothing.

(5) *Nothingness* is represented by the triple $(0, 0, 0)$. Nothingness is not an entity.

(6) *To be* or *is*: In the context of this paper and theory, "to be" means either to be an observer, a process of observation, an object, a virtual triple, a real triple, a Mode, a Pattern, a Network, or any combination thereof. For example, b *is* if b is any component of any triple; thus, for (b, u, v), (u, b, v), or (u, v, b), where b, u, and v can take on any value including 0, we say that b is.

(7) *Being*: The usual definition of "being" is the present participle of the verb "to be." As a noun, the term Being has been used synonymously with Existence, Soul, Spirit, Psyche, Essence, Reality, Actuality, and Living. In the context of this paper and theory, an entity x is a *Being* if there is a Bit of Consciousness of the form (x, y, x). In such a triple, entity x observes

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itself as a Being; the observed x appears to the observer x as existing and since observer and observed are the same, the observed exists for itself and appears to itself to be real—that is why x says "I am," "I exist," "I am real." A *Pure Being* is an entity x for which there is a Bit of Consciousness of the form (x, x, x). Hence, the observed x exists for itself. Also, a Pure Being is conscious of itself independently of any other entity; it exists by itself, that is, by virtue of it itself being the observing process. The *Primary Pure Being* is the object in the triple $(\mathrm{ULT}, \mathrm{ULT}, \mathrm{ULT})$ or, equivalently, it is the object $\mathcal{C}$ in the triple $(\mathcal{C}, \mathcal{C}, \mathcal{C})$.

(8) An *entity* is something that *is*, unless it is equal to 0 or is the triple $(0, 0, 0)$.

(9) An entity is said to *exist with respect to a given observer* if it is an object of observation by the given observer in a Bit of Consciousness. An entity exists for an observer only when it is observed within a Bit of Consciousness. Thus, if none of x, y, and z are equal to 0, then z exists with respect to x in the real triple (x, y, z). The object of a triple exists for the observer in that triple; the object does not exist outside the triple. Note that neither Nothing 0 nor Nothingness $(0, 0, 0)$ is an entity so they cannot exist as objects for any subject.

(10) An entity *exists for a given collection of observers* if the entity exists for each observer in the collection. For example, certain infinite sets exist for some mathematicians but not for others. Gravity has always existed for physical objects, but the modern theory of gravity did not exist for scientists before Galileo Galilei and Sir Isaac Newton.

(11) *Existence with respect to an observer* is the collection of all entities that exist for that observer within a space-time frame.

(12) *Existence with respect to a collection of observers* is the collection of all entities that exist for all observers in that collection of observers within a space-time frame.

(13) We say that an entity *manifests* when it becomes part of a real triple in any one of the three roles within the real triple. For example, a virtual triple manifests when it becomes the object of observation in a real triple. The virtual triple as such remains virtual but manifests as a Concept (see 17 below). To manifest in the role of an object is to exist with respect to an observer. Nothingness $(0, 0, 0)$ cannot manifest since it is not an entity.

(14) *Manifestation* is the collection of all that is manifest within a space-time frame. Reality is different from Manifestation in that the former includes exclusively real triples and the latter also includes virtual triples and entities that are not triples. Existence is a subcollection of Manifestation since existence contains only those entities that are observed within a real triple.

(15) A *relative* entity is an object of observation that can appear differently when the observer or process of observation changes.

(16) An entity is *Absolute* if it does not depend on anything other than itself for its appearance, Being, or existence, and if its characteristics remain unchanged under all circumstances. A virtual object z in the triple $(0, 0, z)$ is Absolute. A Pure Being x in the triple (x, x, x) is Absolute. A Being x

in the triple (x, u, x) is Absolute if the appearance of x (as an object) to x (as an observer) remains the same when u changes.

(17) A *Concept* is a virtual triple z that has the role of an observed in a real triple (x, y, z). In other words, a Concept is a virtual triple z that manifests by some observing process y and appears to exist and to be real for some observer x.

(18) *Memory* is a real triple MEM $= (x, u, b)$ where b is a real triple $b = (x, v, z)$ in which x is the same observer as in MEM. In the triple (x, u, b), object b is x's Memory (under u) of the observation or appearance of z (under v). Note that Memory occurs after the observation and not at the same time. If the observation is at the same time, it is an experience of Witnessing.

(19) *Witnessing* is a Bit of Consciousness in which the observer x is observing a Bit of Consciousness in which the same observer is observing some object; the two Bits occur simultaneously, not one after the other as in the case of Memory.
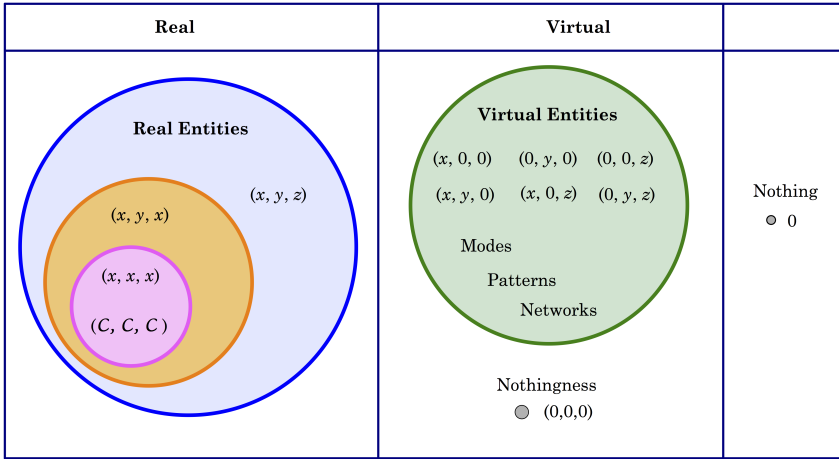
ALL THERE IS

FIGURE 2. This diagram shows the structure of *all there is*. The left rectangle contains all real entities, the center rectangle contains everything that is virtual, and the right rectangle contains Nothing, which is neither real nor virtual. The circle of real entities (x, y, z) contains the circle of real entities of the form (x, y, x) in which the observed x is a Being. This latter circle contains, in turn, all real entities of the form (x, x, x) in which the observed x is a Pure Being, and the triple $(\mathcal{C}, \mathcal{C}, \mathcal{C})$ in which the observed $\mathcal{C}$ is Primary Pure Being. The center rectangle gives examples of virtual entities and shows that Nothingness $(0, 0, 0)$ is virtual but is not a virtual entity.

B.2. **Some Immediate Consequences of the Above Definitions.**

(1) Anything that exists for some observer is.
(2) Not all that is exists for all observers.
(3) Anything that exists for some observer is an entity.
(4) Not all entities exist in and of themselves.
(5) An entity exists for an observer if it is an object for that observer in a Bit of Consciousness.
(6) An entity that exists for one observer u does not necessarily exist for another observer v.
(7) All entities are.
(8) Not all that is, is an entity.
(9) Any Being exists for itself.
(10) Only a Pure Being exists for itself and by its own observing process.
(11) Not all that exists for some observer is a Being.
(12) Not all that exists for some observer is a real triple.
(13) Anything that is a real triple exists for some observer.
(14) Nothing is. We designate Nothing by 0.
(15) Nothingness is. We designate Nothingness by the triple $(0,0,0)$. Nothingness is not an entity nor can it exist for any subject.
(16) A real entity $e = (x, y, z)$ exists for x only if there is a real triple (x, u, e).
(17) A virtual triple is but does not exist in and by itself. All virtual triples, except Nothingness $(0,0,0)$, are entities.
(18) What manifests as an object exists for the corresponding observer.
(19) Real triples are real in and by themselves.

B.3. **Implications of These Definitions in the Context of this Paper.** The model presented in the paper is based on the axiom "$\mathcal{C}$onsciousness is all there is." Pure Consciousness by itself is not a manifest entity. To manifest, even just to itself, $\mathcal{C}$onsciousness has to be conscious, that is, it must be in a real triple.

As described, "to be conscious" is synonymous with "to be a Bit of Consciousness," that is, to be a real triple. The term "real" in this paper and theory is exclusively reserved for triples that have none of their components equal to 0.

Therefore, $\mathcal{C}$onsciousness itself requires a triple in order to be described as real. It has to assume the roles of an observer, a process of observation, and an observed.

$\mathcal{C}$onsciousness shall not be described as real if it does not exercise its nature to be conscious.

Therefore, $\mathcal{C}$onsciousness, when considered as Singularity alone, is virtual and is not real. To be real, Singularity has to be in a real triple such as $(\mathrm{SNG}, \mathrm{SNG}, \mathrm{SNG})$.

However, $\mathcal{C}$onsciousness is all potentiality as a result of its nature to be conscious, which gives it the potential to be conscious in all possible ways. These potential ways of participating in real triples are called virtual entities. The actual ways of being conscious are, of course, what we call real triples. Furthermore, every triple, whether virtual or real, is absolute. Triples do not change. What they are does not depend on anything outside them.

A real triple can seem to be changing; for example, John is sitting and looking at a flower but with new perspectives at each consecutive moment. Rather than the triple changing, it is actually a new triple being generated at every consecutive

instant. It is therefore not the triple that changes but new triples, with similar but slightly different elements, that are being generated one after another.

This means that a real triple is definite and fixed. Reality (life and living included) is a sequence in time of real triples and separate triples existing simultaneously in space.

Real triples are space bound and temporal. They are generated in relative space and time. Two different real triples cannot occupy the same space at the same time. Although absolute, they are elusive and certainly not eternal.

Virtual entities, whether triples or individual elements within triples, however, are absolute and eternal. They are independent of time and space precisely because they are pure potentialities and not real entities.

Reality is the togetherness of all real triples within a space and time frame.

Reality therefore is a fleeting phenomenon of the coming together of virtual entities. While individual instances of reality are specific and in their own right absolute (all triples are fixed and non-changing), reality itself as the togetherness of all real phenomena is never the same. It is always changing.

On the other hand, "to exist" means to be an object in a triple. The entity z exists for x in the triple (x, y, z). An object is said to exist only for the observer in the same real triple that contains the object. Therefore, Nothing exists outside of a real triple. An object is said to exist only from the perspective of the subject in the triple containing it.

Existence can be different for different observers. Existence is personal. It includes all observations by an observer as well as all Memories of the observer's observations.

For example, the observer x within a real triple (x, y, z), in the usual level of awareness in the waking state of consciousness, observes the object within that triple but does not observe the triple itself. Consider the triple (John, sees, flower). Although the triple is real, it cannot be said to exist for John. John sees the flower—but when John sees the flower, the flower fills his consciousness and at the moment of seeing the flower he is aware of the flower but is not aware of the conscious instance of seeing the flower. However, a split-second later, he can become aware of having seen the flower. This is an immediate Memory of the triple; it does not occur simultaneously with the original event. Although the triple (John, sees, flower) is real, in this case, it cannot be said to exist because that triple was not simultaneously an observed in a real triple; but a Memory of it exists: John is aware that he saw the flower.

However, at another level of awareness in the waking state of consciousness, a situation can exist where the observer has a faculty to simultaneously see the flower without being totally overtaken by the flower. A person who is not yet established in Cosmic Consciousness could be alert enough to be aware constantly of what he is doing without knowing his full potential, without knowing that he is Pure Consciousness. For example, I see the flower and simultaneously I am conscious that I am seeing the flower. This is Witnessing in the waking state of consciousness before Cosmic Consciousness; it represents a higher level of awareness in the waking state of consciousness. In this case, the real triple (John, sees, the flower) is said to exist simultaneously with John's perception of it as an observed, that is, (John, is

Term	Is	Entity	Exists	Virtual	Real
Bit of Consciousness (x, y, z)	Yes	Yes	No, but z exists for x in (x, y, z)	No	Yes
Bit of Consciousness $(\mathcal{C}, \mathcal{C}, \mathcal{C})$	Yes	Yes	No, but $\mathcal{C}$ exists for itself and by its own observing process in $(\mathcal{C}, \mathcal{C}, \mathcal{C})$	No	Yes
Being x in (x, y, x)	Yes	Yes	Yes, x exists for itself in (x, y, x)	Yes	No
Pure Being x in (x, x, x)	Yes	Yes	Yes, for itself and by its own observing process	Yes	No
Primary Pure Being $\mathcal{C}$ in $(\mathcal{C}, \mathcal{C}, \mathcal{C})$	Yes	Yes	Yes, for itself and by its own observing process	Yes	No
Pure Consciousness $\mathcal{C}$	Yes	Yes	No	Yes	No
Observer	Yes	Yes	Only when observed within a Bit of Consciousness	Yes	No
Observing Process	Yes	Yes	Only when observed within a Bit of Consciousness	Yes	No
Observed	Yes	Yes	Only when observed within a Bit of Consciousness	Yes	No
Mode	Yes	Yes	Only when observed within a Bit of Consciousness	Yes	No
Pattern	Yes	Yes	Only when observed within a Bit of Consciousness	Yes	No
Network	Yes	Yes	Only when observed within a Bit of Consciousness	Yes	No
Virtual Triple other than $(0, 0, 0)$	Yes	Yes	Only when observed within a Bit of Consciousness	Yes	No
Nothingness $(0, 0, 0)$	Yes	No	No	Yes	No
Nothing 0	Yes	No	No	No	No

FIGURE 3. Summary of Properties of Key Terms

aware of, (John, sees, the flower)). Therefore, real triples can exist for an individual with a higher level of awareness in the waking states of consciousness. To represent this experience of Witnessing in waking state of consciousness, let

$$x = \text{John}$$
$$u = \text{sees}$$
$$v = \text{is aware of}$$
$$z = \text{the flower.}$$

In terms of these symbols, we have the following triples:

$$(x, u, z) = \text{John sees the flower}$$

and

$$(x, v, (x, u, z)) = \text{John is aware of seeing the flower.}$$

The simultaneous dual observation can now be represented by

$$(x, u, z) + (x, v, (x, u, z)).$$

Witnessing in higher states of consciousness has an additional aspect. In Cosmic Consciousness and God Consciousness, John also knows that he is Pure Consciousness and that he is permanently identified with it. Therefore, John not only sees the flower and is simultaneously conscious that he is seeing the flower, he is also aware of himself as Pure Consciousness at the same time. If the triple (x, w, x) represents "John is aware of himself," then this Witnessing experience can be represented by

$$(x, w, x) + (x, u, z) + (x, v, (x, u, z)),$$

which is a simultaneous triple observation.

In a Witnessing experience in waking state of consciousness, Cosmic Consciousness, or God Consciousness, John is not part of what he is observing outside of himself. He is an independent entity that can observe other "outside" entities. However, in established Unity Consciousness, the object of John's perception is not an outside entity. It is his own nature; it is not separate from his Self. Therefore, the term "Witnessing" is not an appropriate description of his perception because there is no "outside" to witness; all of his experiences are within his Self. He experiences simultaneously himself, the flower, and his seeing of the flower, as aspects of his own Self, Pure Consciousness.

Reality cannot be known, that is it does not exist, except to observers in higher states of consciousness. All other observers live in a world of objects. They experience that the objects exist and they conclude that the objects are real. This is an illusion. Objects do not exist in and of themselves. Existence depends on being an object in a triple. It is the triple that is real.

What appears to exist for an observer in a real triple cannot necessarily be said to exist for any observer outside the triple. An observer within a triple may not be able to observe the triple in which it is the observer. Most observers live in a universe of existence, not a universe of reality. An observer in a higher state of consciousness will have his or her own existence and also his or her own reality.

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ADDRESSING THE PROBLEM OF LARGE CARDINALS WITH VEDIC WISDOM

PAUL CORAZZA

ABSTRACT. Shortly after Cantor's discovery of the existence in mathematics of an endless hierarchy of different sizes of infinite sets, a new challenge arose concerning the nature of infinity in mathematics. Enormous infinities, known as large cardinals, have turned out to be the key to solving many mainstream problems in mathematics, but because of their extraordinarily strong properties, large cardinals cannot be proven to exist at all. The Problem of Large Cardinals is to find a natural way to enrich the standard axioms of set theory so that large cardinals can be derived. To accomplish this goal, a much deeper intuition about the nature of the infinite than has been available so far is needed. We suggest that precisely such intuition can be extracted from the eternal Vedic wisdom. We formulate a new axiom of set theory, strongly motivated both by this ancient wisdom and by mathematical considerations, which provides a solution to the Problem of Large Cardinals.

One theme of research that has developed in the recent history of mathematics is the study of the infinite. In mathematics, the notion of the infinite is approached by studying sets having infinitely many members. The evolution of the mathematical investigation of the infinite has uncovered a fundamental question—known as the Problem of Large Cardinals—for which the usual tools and techniques of mathematics no longer seem to be adequate. A deeper insight into the structure of the mathematical universe itself seems to be necessary to provide a solution. This article discusses how Maharishi Vedic Science[1] has been used to provide the necessary insight, leading to a solution to the Problem of Large Cardinals—a solution that has appeared recently in the mathematics literature.[2]

1. The Classical Theory

The classical theory of the infinite began about 150 years ago. Progress in the classical theory is indicated by three significant milestones.

1.1. Milestone #1: The Discovery That Infinity Exists.
Prior to the second half of the nineteenth century, the subject of infinite sets was a forbidden topic. It was believed, for example, that, although we can imagine the natural numbers $1, 2, 3, \ldots$ continuing on indefinitely, any notion of a *single, completed set* containing

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[1]Maharishi Vedic Science is Maharishi Mahesh Yogi's systematic presentation, both theoretical and practical, of the Veda and Vedic Literature. An introduction to Maharishi Vedic Science can be found in [7].

[2]The present work was presented at the Symposium *Maharishi Vedic Science: Illuminating the Cutting Edge of Modern Science*, April 27–29, 2012, Maharishi University of Management, Fairfield, Iowa, 52557. This article summarizes the work in [4] and updates [5].

all the natural numbers must be viewed as fanciful, lying outside the domain of rigorous mathematics.

There were many reasons for this taboo (see [8]). First, as Aristotle observed nearly two thousand years ago in his *Metaphysics* [1, Book 9, Chapter 6], we don't find completed infinities in nature (for instance, seasons return year after year, but at no point can it be said that "infinitely many seasons have passed," even though they could potentially continue forever), so one would not expect such a notion to make sense in mathematics either. A second reason had to do with theological beliefs: one objection [8, p. 13] asserted that a study of a completed infinity amounts to a study of God; but God cannot be bound by the mathematical conclusions of man. A third reason was that analysis of completed infinities seems to lead to paradoxes. For example, the infinite sum $1 - 1 + 1 - 1 + \cdots$ appears to have two values, depending on how parentheses are inserted:

$$(1 - 1) + (1 - 1) + (1 - 1) + (1 - 1) + \cdots = 0$$
$$1 + (-1 + 1) + (-1 + 1) + (-1 + 1) + \cdots = 1.$$

The work of Georg Cantor (1845–1918) and other pioneers working during this time dispelled these doubts. Cantor not only addressed the mathematical issues, but also wrote extensive rebuttals to all philosophical and theological doubts that had been raised. In response to the long-held argument of Aristotle, Cantor observed that the long "potentially" infinite sequence $1, 2, 3, \ldots$ of natural numbers *presupposes* that all the natural numbers already exist as a completed collection, an "actual" infinite:

> ...in truth the potentially infinite has only a borrowed reality,
> insofar as a potentially infinite concept always points towards
> a logically prior actually infinite concept whose existence
> it depends on [22, p. 3].

Cantor and other researchers of that period resolved the apparent mathematical paradoxes that had been put forth. For instance, the problem about computing the sum of the terms $1-1+1-1+\cdots$ was resolved some years before Cantor's campaign by observing that, while some infinite summations like this do indeed have a value—a *sum*—others do not. We would not expect the summation $1 + 2 + 3 + 4 + \cdots$ to have a particular natural number value because *every natural number* is already a term in the series, so the "sum" would have to be bigger than any number. Such summations, like the series $1 - 1 + 1 - 1 + \cdots$, are said to *diverge*, to have no final sum. The precise notion of *convergence*, originated by A.L. Cauchy (1789–1857) in the first half of the nineteenth century, which put to rest this paradox, is now a core element of calculus and higher mathematics.

Cantor also addressed, in several ways, theological and philosophical concerns about studying completed infinities. One of his key arguments, which eventually transformed how mathematics was understood, was that mathematics is not inherently tied to any of the ways in which it is interpreted or applied. A large bulk of the problems that have been researched in mathematics have arisen from the sciences: the use of mathematical models to understand and predict nature's behavior has suggested hundreds of mathematical problems and has motivated significant

advances in mathematics itself. But the mathematics in such cases, Cantor argued, is a *description* of natural phenomena, not the phenomena themselves. This separation of mathematics from its applications freed mathematics from irrelevant restrictions on the allowed topics of mathematical study, and, in particular, from non-mathematical views about non-mathematical notions of "the infinite."

Cantor's heroic efforts to argue the case for the mathematical infinite did not bear fruit, however, until a very practical need at the foundation of the mathematics of the day loomed large and was recognized as solvable only through the use of completed infinities. In Cantor's time, the basic tenets or "theorems" of calculus—the same calculus that is studied in mathematics curricula today—were well-understood but could not be rigorously proven using the tools available at the time. The difficulty, as Cantor and Dedekind observed, could be traced to an imprecise understanding of the idea of a "real number," a quantified mathematical point on a line. It was discovered that giving a precise definition of the real numbers *required* completed infinities (this point is familiar even in high school mathematics today: to represent a number like π precisely as a decimal requires infinitely many decimal places).

With the recognition that completed infinities are necessary in mathematics, the first milestone in the classical era was achieved. With this discovery in place, Cantor went on to unveil another surprise about the infinite.

1.2. Milestone #2: There is an endless hierarchy of infinite sizes.

Allowing the mathematical study of infinite *sets* gave the mathematician freedom to perform all the operations upon infinite sets that are ordinarily performed on finite sets. One such operation is the formation of the *power set* of a given set.

We can illustrate the power set operation with a simple example. Consider the set $S = \{1, 3, 4\}$. The set S has three elements. The subsets of S are $\{1\}, \{3\}, \{4\}, \{1, 3\}, \{1, 4\}, \{3, 4\}, \{1, 3, 4\}$, and the empty set, denoted $\emptyset$. These subsets can be arranged into a new set, denoted $\mathcal{P}(S)$, called the *power set* of S:

$$\mathcal{P}(S) = \{\emptyset, \{1\}, \{3\}, \{4\}, \{1, 3\}, \{1, 4\}, \{3, 4\}, \{1, 3, 4\}\}.$$

The set $\mathcal{P}(S)$ has *eight* elements, and so is larger than the set S that we started with. In Cantor's time, it was well known that the power set of any finite set is always bigger than the original set: for any *finite* set $S, \mathcal{P}(S) > S$.

Cantor's surprising discovery was that the same could be said about *infinite* sets: for any set, finite or infinite, the power set must always be bigger.

The natural question, raised vigorously by Cantor's contemporaries (and perhaps equally vigorously by students even today) is: How can one infinite set be "bigger than" another?

Cantor was able to answer this question by developing a rigorous theory of infinite sets, which provided a precise definition of what it means for two sets to have the *same size*. Roughly speaking, two sets are said to have the same size if their elements can be matched up one for one. For instance, the set $\mathbb{N} = \{1, 2, 3, 4, \ldots\}$ of natural numbers is shown to have the same size as the set $\mathbb{W} = \{0, 1, 2, 3, 4, \ldots\}$ of whole numbers by matching the elements of $\mathbb{N}$ with those of $\mathbb{W}$ as shown in Figure 1.

Cantor then showed, with very clever reasoning, that, for any (infinite) set S, it is *impossible* for there to be a one-to-one correspondence between the elements of

$$
\begin{array}{ccc}
\underline{\mathbb{N}} & & \underline{\mathbb{W}} \\
1 & \to & 0 \\
2 & \to & 1 \\
3 & \to & 2 \\
. & & . \\
. & & . \\
. & & .
\end{array}
$$

FIGURE 1. A one-to-one correspondence between the natural numbers $\mathbb{N}$ and the whole numbers $\mathbb{W}$.

S and the elements of its power set. Therefore, in particular, the power set $\mathcal{P}(\mathbb{N})$ of the infinite set $\mathbb{N}$ of natural numbers represents a *bigger* size of infinity than that of $\mathbb{N}$ itself. And his reasoning opens the door to yet bigger infinite sizes, since one can then apply the power set operation to $\mathcal{P}(\mathbb{N})$ to obtain a still larger infinite set. In fact, there is an infinite hierarchy of ever larger infinite sizes:

$$\mathbb{N} < \mathcal{P}(\mathbb{N}) < \mathcal{P}(\mathcal{P}(\mathbb{N})) < \dots.$$

The discovery that for any set—even any *infinite* set—its power set is always bigger is known today as *Cantor's Theorem*. Cantor's Theorem marks the second big milestone in the classical theory of the infinite. From this second milestone we learn that not only does the mathematical infinite *exist*, but it also has a nature, a texture, an internal multiplicity, and even its own internal transformational dynamics.

Cantor's discoveries brought a long-sought sense of completion to the business of pure mathematics. Yet, soon after this sense of completion and balance had taken hold, a flaw was discovered—a flaw that would surprise even Cantor. To correct the problem, the foundations of mathematics were led to the third major milestone of this classical period.

1.3. Milestone #3: To understand the very idea of a set, it is necessary to understand wholeness, the ultimate infinite.
As Cantor developed his theory of infinite sets, he apparently did not think to examine too closely his own definition of the concept of a *set*. Like most students of mathematics (and even many mathematicians today), he simply assumed that the meaning was obvious: a set is simply a collection of objects. At the turn of the century, Bertrand Russell [23] and others noticed, however, that this imprecise definition is flawed and leads to paradoxes that undermine the consistency of mathematics itself: using Cantor's naive notion of a set, Russell demonstrated that a certain paradoxical set T must exist. This set T is defined to be the "set" consisting of all sets that are not members of themselves. What makes T paradoxical is that one can prove that it has the following property:

T *is a member of itself if and only if T is not a member of itself.*

If a set with an inconsistent property such as this were allowed into the mathematical universe, it would lead to an inconsistent mathematics, making it possible to prove absolutely anything.

To resolve the paradox, the approach was to return to Cantor's vision of the infinite. Cantor had not only shown that there is an endless hierarchy of infinite sizes—or infinite *cardinals* as they are called—but also declared [8, p. 42] that this multiplicity of infinite sizes in no way represents the *ultimate* infinite. For Cantor, the *Absolute Infinite*—the totality of all possible mathematics, beyond the possibility of increase or diminution, and beyond all mathematical determination—was the ultimate infinite, and provided the context in which mathematics should be done. Using Cantor's Absolute Infinite and a number of its properties as a guiding intuition, early set theorists developed an intuitive model for the universe of mathematics, the *universe of sets*, denoted V. The idea was that the legitimate sets, the sets that are to be used in mathematics, belong to V; but paradoxical sets would not appear in V.

With this intuitive model V, researchers formulated a collection of axioms that express the essential characteristics of V. The axioms describe which sets exist and how to obtain new sets from already existing sets. The axioms that were developed in this way, now known as the Zermelo-Fraenkel axioms with the Axiom of Choice, or ZFC, were sufficiently complete to support the formal construction of the stages of V, transforming the stages of V from the realm of motivating intuition into formal, rigorously defined mathematical structures.

The construction of V is simple and elegant; it is built in stages, $V_0, V_1, V_2, \ldots$. Then, V itself is obtained by putting together all the stages, by forming the union of these stages. Stage V_0 is just the empty set $\emptyset$. Then, each successive stage is obtained from the previous stage by taking the power set of the previous stage; it follows that each successive stage *includes* all previous stages. This strategy leads to the following construction:

$$V_0 = \emptyset, \quad V_1 = \mathcal{P}(V_0) = \{\emptyset\}, \quad V_2 = \mathcal{P}(V_1) = \{\emptyset, \{\emptyset\}\} \ldots.$$

Basing their intuition on long years of experience with sets, coupled with the properties of sets that could be seen to hold in the universe V, the fathers of modern set theory formulated the axioms of ZFC. Below is a sampling of some of these axioms.

- *Axiom of Pairing.* If A and B are sets, there is another set C whose only elements are A and B; in other words, there is a set $C = \{A, B\}$.
- *Power Set Axiom.* If A is a set, then the collection $\mathcal{P}(A)$ of all subsets of A is also set.
- *Axiom of Infinity.* There is an infinite set.

The ZFC axioms, together with their natural model V, have provided a powerful unification of all areas of mathematics. This is because

(1) Every mathematical notion can be represented as a set.[3]
(2) Every set that is used in mathematics belongs to V.

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[3]There are mathematical notions that entail collections that are too big to be sets; the category of all groups, for example, is such a notion. However, set theorists have devised ways of handling such collections as if they were sets.

(3) Every mathematical theorem in any known field of mathematics can be formulated in the language of sets and derived directly from the ZFC axioms.

In hindsight, the fact that so much emerged from the simple question "What is a set?" is surprising. One might have expected that a more careful definition of the notion of a set would have solved the problem. Instead, the notion of "set" never was defined at all; in fact, in the solution we have outlined, a set is now to be understood as a *primitive*, an undefined notion, whose meaning emerges from the ZFC axioms. Another way to express this point is to say that a set is any member of the universe V. This means that the basic unit of all mathematics, the "point value" from which everything else is built—the notion of a set—can only be understood with reference to wholeness, with reference to the totality to which it belongs.[4]
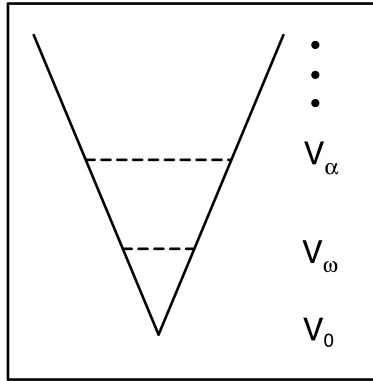

FIGURE 2. The universe of sets V.

The universe V, illustrated in Figure 2, represents the wholeness of all of mathematics, at least from the historical perspective that we have been discussing so far. It is in fact a concrete realization of Cantor's own vision of wholeness, of his Absolute Infinite: V contains all mathematical constructions; it is bigger than any conceivable infinite size; it is not subject to increase or decrease in size (that is, one cannot perform an operation on V to produce something bigger or smaller). Most of these characteristics follow from the simple fact that V itself is *not a set!* It is too big to be a set. One way to see this is to consider what would happen if V were a set—if it were, then we could apply the power set operation to it to produce an even bigger set $\mathcal{P}(V)$—a set that would have to be bigger than the universe itself, which already contains everything! The impossibility of such a consequence leads to the conclusion that V is, with respect to sets, *bigger than the biggest*, and therefore not a set.

In this way, the effort to provide a rigorous formulation of the notion of "set" resulted in the discovery of the biggest infinity of them all, the totality V, together

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[4]The principle behind this phenomenon is expressed in [20, p. 538]: "Without reference to the transcendental basis of life all knowledge of life always remains incomplete—without reference to wholeness, parts will always remain undefined."

with the laws that govern the unfoldment of sets within V—the ZFC axioms. This achievement marked the accomplishment of the third milestone in the classical theory of the infinite.

2. The Modern Era

Just as it seemed that the nature of the universe, the extent of mathematics, and the nature of the infinite were all beginning to be well understood, a new kind of infinity appeared. Certain combinations of the properties of the different infinite sizes—called *infinite cardinals*—were found to produce very strong notions of infinity, so strong that the ZFC axioms could not derive the existence of such infinities. Yet, these notions of enormous infinities started turning up as key elements in solutions to well-known research problems in analysis, topology, and algebra. These infinities have come to be known as *large cardinals*.

2.1. **Aleph Fixed Points.** To give a sense of the enormity of large cardinals, we spend a moment here considering one property that all large cardinals have in common. We begin with notation for infinite cardinals. Just as the familiar whole numbers $0, 1, 2, 3, \ldots$ are used to denote the sizes of finite sets (for instance, the size of the set $\{2, 9, 17\}$ is 3), likewise the sizes of infinite sets are specified using *infinite cardinal numbers*. Some of these infinite cardinals are

$$\omega_0, \omega_1, \omega_2, \omega_3, \ldots.$$

The smallest infinite size, ω_0 (read "omega-zero", also denoted simply ω), is the size of the set $\mathbb{N}$ of natural numbers (and is also the size of the sets of whole numbers, of integers, of rationals, and of algebraic numbers). The bigger cardinals, which come after ω_0, represent sizes of much bigger sets. One well-known set of the bigger variety is the set $\mathbb{R}$ of real numbers. Though it is impossible to determine exactly which of the cardinals $\omega_1, \omega_2, \omega_3, \ldots$ is the exact size of $\mathbb{R}$, it can be shown that the size of $\mathbb{R}$ must lie among these; the size of $\mathbb{R}$ is at least bigger than ω_0.

An easily observed feature of the list of infinite cardinals displayed above is that, at least at the beginning of the list, we find that the *index* of a cardinal is always smaller than the cardinal itself. For instance the index of ω_0 is 0, and certainly 0 is smaller than ω_0. Likewise, the index of ω_1 is 1, and 1 is smaller than ω_1. This obvious pattern continues far into the endless list of infinite cardinals. However, eventually, something new appears. Eventually, one arrives at a cardinal whose index is equal to the cardinal itself.[5] In other words, there must exist a cardinal ω_κ with the property that

$$\kappa = \omega_\kappa.$$

Such a cardinal is called an *aleph fixed point*.

Certainly this is an extraordinary property of infinite cardinals, and it is one that belongs to every large cardinal. However, the first aleph fixed point that one encounters on the list is not big enough to be a large cardinal. Nor is the second or

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[5]The least such cardinal κ can be obtained as the supremum of the countable sequence $\omega, \omega_\omega, \omega_{\omega_\omega}, \ldots$. Note that the form of this supremum is ω_κ, where

$$\kappa = \omega_{\omega_{\omega_{\cdot_{\cdot_\cdot}}}}.$$

A moment's reflection reveals that $\kappa = \omega_\kappa$.

third or even the ω_0th. In fact, no conceivable mathematical procedure[6] could ever result in a precise specification of a large cardinal. And this limitation is not simply the result of lack of persistence or skill on the part of mathematicians. Rather, this limitation is a provable theoretical result: *It is impossible to prove from ZFC that any large cardinal exists at all.*[7]

Why, then, may we not conclude that such "large cardinals" simply don't exist? Strangely enough, large cardinals do appear as key elements in the solutions of quite a number of significant mathematical problems that have arisen in the past century, so they cannot be dismissed so easily.

We list below some of the most widely used large cardinals (see [9]), in increasing order of strength, and then give two examples of well-known mathematical problems whose solutions do depend on large cardinals.

2.2. **Some Common Large Cardinals.**

- Inaccessible
- Mahlo
- Weakly Compact
- Ramsey
- Measurable
- Strong
- Woodin
- Supercompact
- Extendible
- Huge
- Superhuge
- Super-n-huge for every natural number n

2.3. **Two Examples of Theorems That Depend on Large Cardinals.** The many examples of mathematical theorems that are tied to large cardinals have the unfortunate characteristic of being difficult to understand for the non-expert. For the sake of the mathematically experienced reader, we take a short detour to examine two such examples. The reader who does not wish to follow this detour may safely skip to the next section.

1. *The Normal Moore Space Conjecture.* A *metric space* is a set that admits a metric or distance function. A familiar example is the real line $\mathbb{R}$ whose distance function d is defined using absolute value: the distance between reals x and y is the

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[6]By "conceivable" we mean "formalizable in ZFC."

[7]This is a direct consequence of Kurt Gödel's celebrated *Second Incompleteness Theorem*, which states that no reasonable formulation of set theory (such as ZFC) can prove its own consistency, unless the set theory is itself inconsistent. Stated another way, no construction of a universe of sets can be carried out in its entirety using only the axioms themselves as the basis for the construction (unless the set of axioms is inconsistent); here, by "universe of sets" we mean a collection, something like V, in which all the axioms hold true. Now assume for the moment that ZFC is consistent and that we could derive from ZFC the existence of a large cardinal κ. It can be shown that the κth stage V_κ of the universe, viewed as a mini-universe, satisfies all the axioms of set theory. We would therefore have proven from ZFC that ZFC is consistent, in violation of the Second Incompleteness Theorem. For more on this topic, see [9].

absolute value of their difference: $d(x, y) = |x - y|$. The Pythagorean Theorem is used to obtain the usual distance function for the plane $\mathbb{R} \times \mathbb{R}$: the distance between points (x, y) and (u, v) in the plane is the square root of $(x - u)^2 + (y - v)^2$. And there are many other more advanced examples.

Metric spaces have a number of very nice properties that make them easier to work with than more general topological spaces. One such property is *normality*: in any metric space, disjoint closed sets can be separated by disjoint open sets.

A generalization of metric spaces, called *Moore spaces*, named after their inventor R.L. Moore (1882–1974), replaced the use of the metric in a topological space with a countable sequence of covers of the space (called a *development*) having special separation properties. A Moore space is defined to be a developable, regular[8] Hausdorff space.

Many of the nice properties of metric spaces also hold in Moore spaces, but Moore spaces are more general: many examples of nonmetrizable Moore spaces are known (a topological space X is *metrizable* if a metric can be defined on X that is compatible with the topology on X). Moreover, as of the mid-twentieth century, all the known examples of nonmetrizable Moore spaces were also non-normal. In this context, the question arose: Is every normal Moore space metrizable? The conjecture that this is indeed the case is called the *Normal Moore Space Conjecture (NMSC)*.

The conjecture was settled through the use of advanced techniques in set theory. There are many aspects of the solution, but the result we wish to mention here is that the truth of NMSC is intimately tied to the existence (or at least the consistency) of large cardinals. More precisely:

Theorem 2.1 (Nyikos, Fleissner)**.**

(1) *Assuming there is a strongly compact cardinal, there is a model of set theory (a universe of mathematics) in which NMSC holds.*
(2) *If NMSC is true, then there is a model of set theory in which there is a measurable cardinal.*

The conclusion is that if NMSC is true, then large cardinals must be lurking in at least some of the universes of set theory, and, conversely, if there exists a sufficiently strong large cardinal, then NMSC must hold in at least some of the universes of set theory. For a detailed discussion on NMSC with references, see [12].

2. *Determinacy of Analytic Games.* An *infinite game* based on a subset A of the unit interval $[0, 1]$ involves two players, Player I and Player II, who take turns picking elements of the two-element set $\{0,1\}$. Their successive plays result in an infinite sequence of 0s and 1s, which we denote $s = s_1 s_2 s_3 \cdots$. Player I wins the game if the sum

$$\frac{s_1}{2} + \frac{s_2}{4} + \frac{s_3}{8} + \cdots$$

lies in A; otherwise Player II wins. The set A is said to be *determined* if one of the two players has a winning strategy.

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[8]A topological space is *regular* if, for each closed subset C and each point p not in C, there are disjoint open sets separating C and p.

The natural question that arises in this context is whether *every* subset of $[0, 1]$ is determined. The Axiom of Choice shows that the answer is "no," but there are other related questions for which a positive answer does not conflict with AC.

To arrive at these related questions, we consider "nicely defined" subsets of $[0, 1]$. These nice sets are called the *Borel* sets; they are obtained by beginning with the closed subsets of $[0, 1]$, then considering all possible countable unions of closed sets, then all countable intersections of these, all countable unions of these, and so forth. After the process is repeated ω_1 times, no more new sets can be obtained by this procedure; the sets that are obtained in this way are the Borel sets. One can obtain a somewhat larger class than the Borel sets—a class that also has many nice properties—by considering *continuous images* of Borel sets. The class of all continuous images of Borel sets is called the class of *analytic sets*.

Two questions that relate the notion of determinacy with these classes of sets of reals are:

1. Is every Borel set determined?
2. Is every analytic set determined?

The work of set theorists D.A. Martin and L.A. Harrington established the following:

Theorem 2.2 (Martin, Harrington).

(1) *Every Borel set is determined.*
(2) *If there is a measurable cardinal, every analytic set is determined.*
(3) *If every analytic set is determined, there is a model of set theory in which there is a proper class of weakly compact cardinals.*

This theorem demonstrates, perhaps even more dramatically than the results on NMSC, how large cardinals can be inextricably tied to the solution of a research problem in mathematics. For a fuller discussion of determinacy, with references, see Jech [9].

3. Where Do Large Cardinals Come From?

In the 1960s, many new kinds of large cardinals began to emerge from various quarters. At this time, a more pressing need was felt in the set-theoretic community to come to terms with this phenomenon. Reactions to the challenge varied among researchers. Among those who participated in moving toward a solution, some hoped to "debunk" large cardinals, while others sought to provide a foundational basis for them. Some in the former category—including some of the brightest set theorists of the time—dedicated many years in an attempt to prove that some or all large cardinals are inconsistent with ZFC. And, although many deep results in set theory emerged in these research projects, none of them resulted in a proof that any large cardinal, big or small, is inconsistent.

The view of the other group of researchers was that some or all large cardinals should indeed be thought of as an authentic part of the mathematical universe. To travel this course required answers to the following questions.

1. Which large cardinals are *legitimate*? It is possible that some may have arisen in such an arbitrary and ill-motivated way that there is no justification for them.

2. How can those large cardinals that are considered legitimate be derived from the foundational axioms? Certainly ZFC is not strong enough to derive any large cardinal, but can we find an axiom (or possibly several) that expresses some intuitively clear truth about the universe and, at the same time, is strong enough to provide a proof of the existence of these large cardinals?

These are the central questions of the *Problem of Large Cardinals*. To address these questions, many researchers in the field turned to Cantor's original vision of the universe V as a guide to intuition—what is it about the structure of V that would suggest that large cardinals should really exist?

One approach was to recognize that V itself represents the "ultimate infinite," and an intuition that emerged was that large cardinals are "reflections" of that totality into the realm of ordinary sets. Large cardinal properties that seemed to hold true of V itself were thereby legitimized, and the result was that some of the smaller large cardinals, such as inaccessible and Mahlo cardinals, found a high degree of acceptance.

Another approach was the observation that many large cardinal properties happen to belong to the smallest infinite cardinal, ω_0, the size of the set of natural numbers. Being the least among the infinite cardinals $\omega_0, \omega_1, \omega_2, \omega_3, \ldots$, the cardinal ω_0 cannot actually be a large cardinal (for example, it is not an aleph fixed point). Nevertheless, the cardinal ω_0 does possess many large cardinal characteristics, which, were they to belong to any cardinal λ bigger than ω_0, would cause λ to be a *bona fide* large cardinal. It is accurate to say that ω_0 is to the world of the finite what large cardinals are to the world of the infinite; indeed, to the world of the finite, ω_0 appears to be a "large cardinal."[9] It is for this reason, one can argue, that ω_0 exhibits so many large cardinal characteristics. In any case, the fact that these properties belong to one infinite cardinal was used as a justification for the belief that *other* infinite cardinals should have the same properties.

The logic for this justification again comes from Cantor; in Cantor's vision, the landscape of infinite cardinals exhibits a certain *uniformity*: properties found to hold for one infinite cardinal should be found in other cardinals throughout the universe. Justifying large cardinals on the basis of properties found to hold for ω_0 is known as *generalization*. Generalization was used to legitimize several large cardinals, such as weakly compact and measurable cardinals.[10]

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[9]The "world of the finite" is captured by the axiom system $\text{ZFC} - \text{Infinity}$ (that is, standard set theory ZFC with the Axiom of Infinity removed). A universe built from this set of axioms may or may not contain an infinite set. For instance, the stage V_ω, obtained as the union of all the finite stages of the universe ($V_\omega = V_0 \cup V_1 \cup V_2 \cup \cdots$), satisfies all the axioms of $\text{ZFC} - \text{Infinity}$, and it contains no infinite set. On the other hand, the usual ZFC universe V, which also satisfies the axioms of $\text{ZFC} - \text{Infinity}$, does contain infinite sets. From the perspective of the "ZFC world," it is obvious that infinite sets exist, but this perspective is not available in the $\text{ZFC} - \text{Infinity}$ world because the axiom system is not rich enough; in that world, it "might be" the case that infinite sets exist, but it is impossible to determine the truth of the matter. The question of the existence of large cardinals is, we suggest, similar: from a certain vantage point (a vantage point we attempt to articulate in this article, in which the ZFC axioms are supplemented with additional axioms), it is "obvious" that large cardinals exist, but from ZFC alone, this perspective is not available because the axiom system is not rich enough.

[10]A discussion can be found in [10].

Efforts to justify large cardinals using such heuristics have met with limited success. The really big and often complex large cardinals, such as supercompact and superhuge cardinals, could not be justified using these approaches. Cantor's vision has been able to carry us only so far in our understanding of the structure of the universe V—a fact that should not be surprising since Cantor himself was entirely unaware of the phenomenon of large cardinals.

To make further progress toward a solution to the Problem of Large Cardinals, the following questions present themselves:

1. Beyond Cantor's vision of the wholeness of the universe V, what source of intuition can we draw upon to decide which large cardinals really do belong in the universe?

2. Can we draw upon this new source of intuition to help in the formulation of a new axiom for set theory, which would provide an axiomatic basis for these large cardinals?

4. Insights from Maharishi Vedic Science[SM]

A natural approach to consider in addressing these questions is Maharishi Vedic Science. A Vedic mathematician's hunch, using this approach, might be something like this:[11]

> *Everything to do with the infinite arises from*
> *the self-interacting dynamics of wholeness.*

In attempting to use this apparently non-mathematical principle as an intuitive guideline that could provide insight into the structure of the universe and even possibly a new axiom of set theory, we need to identify the mathematical analogues to the notions of "wholeness" and "self-interacting dynamics."

We have already seen that, from the mathematical point of view, V already naturally represents a kind of wholeness for mathematics. Examining its properties further, we can see even more clearly that it is a natural analogue to the notion of wholeness in Maharishi Vedic Science.[12] The universe V is the source and container of all sets, and yet is not itself a set; since it is not a set, and therefore cannot be directly referred to in the formal theory, it exhibits the property of being *unmanifest*. Also, being bigger than any possible set, it exhibits the properties of being *unbounded* and *bigger than the biggest*; and, being the container of all possible mathematical structures from any area of mathematics, it exhibits the quality of

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[11]For example, consider the following quote from *Maharishi's Absolute Theory of Defence* [20, p. 626]: "Vedic Mathematics starts from the total reality of the Absolute Number, which is defined as that which functions from within itself and thereby accounts for the world of infinities—the world of the Absolute—because there are many infinities, and these cannot be expressed by finite numbers." Also, "This is how everything in the objective world is the expression of wholeness. This presents to us the need for an Absolute Number in the field of Mathematics, a number that can help us to account for the infinite number of wholenesses within the universe—a number that will help us to account for the theme of creation and evolution in terms of wholeness" [20, p. 611].

[12]Over the years, on the basis of both experience and an analysis of the Vedic Literature, Maharishi formulated a large number of *qualities of pure consciousness*—distinctive properties that characterize this field of existence. A list of these can be found in [20, pp. 602–605]. Among these are the qualities of *bigger than the biggest* [21, pp. 16], *unmanifest, unboundedness, total potential of natural law, omnipresence,* and *self-sufficiency*, which we mention in this article.

omnipresence. In addition, V can be considered to be the *total potential of natural law* in the sense that the laws that govern the unfoldment of sets—the ZFC axioms—occur in V coded as sets[13]; moreover, V can regenerate its own stages using its own internally coded ZFC axioms, thereby expressing its *self-sufficient* quality.[14]

Next, to represent transformational dynamics in a mathematical way, it is natural to consider the mathematical concept of a *function*. A function from one collection A to another collection B is a rule that uniquely associates to each element of A an element of B. As a simple example, if one were to take a straight piece of wire and bend it so that it forms a circle, one could represent this transformation with a function that assigns to the position of each point on the wire in its starting position the corresponding position of that same point after the wire has been bent; such a function gives a meaningful and precise description of the physical change applied to the wire. In a similar way, all types of transformation in the sciences are represented by functions.

With these analogies in mind, we can now ask whether the universe V, as it is presently understood in set theory, comes equipped with some kind of function that transforms V to V and mirrors essential features of the dynamics of wholeness described in Maharishi Vedic Science. If we can locate such a function, we can examine it closely and see whether it provides hints about the origin of large cardinals.

To narrow the search somewhat and to aim for the fullest use of Maharishi Vedic Science, we will attempt to find a function j transforming V to V that has some additional characteristics. The dynamics represented by j should

(1) transform wholeness and yet leave wholeness unchanged by the transformation;

(2) be unmanifest;

(3) be present at each point in the universe.

To meet the first requirement (1), the function j must, as much as possible, preserve the integrity of the structure of V.[15] Structure-preserving functions are a key notion in nearly every field of mathematics: Continuous functions preserve limits of sequences. Homomorphisms preserve the operations of an algebraic structure. Order-morphisms preserve the relation of an ordered structure. Likewise, whatever relationships exist within the structure of V should be preserved by j. At the same time, j must do *something*—one could mistakenly let j be simply the identity

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[13]This encoding is described in [5, pp. 141–142].

[14]More precisely, the axioms of ZFC are rich enough to build each of the stages $V_0, V_1, V_2, \ldots$ of V, but not rich enough to establish the existence of V itself. This limitation is a consequence of Gödel's Second Incompleteness Theorem, and is discussed later in this article.

[15]This requirement is expressed in Maharishi Vedic Science in the following way: "The essential and ultimate constituent of creation is the absolute state of Being or the state of pure consciousness. This absolute state of pure consciousness is of unmanifested nature which is ever maintained as that by virtue of the never-changing cosmic law. Pure consciousness, pure Being, is maintained as pure consciousness and pure Being all the time, and yet it is transformed into all the different forms and phenomena. Here is the cosmic law, one law which never changes and which never allows absolute Being to change. Absolute Being remains absolute Being throughout, although it is found in changed qualities here and there in all the different strata" [14, p. 12].

function that has no transforming effect at all. The identity function *id* is the function that assigns to each set x the value x itself: $id(x) = x$. Certainly the identity function preserves all relationships in V, but no transformation occurs either. So, we require j to be a *non-trivial*, structure-preserving function: there must be some x for which $j(x) \neq x$.

For the second point (2), the idea that j should be *unmanifest* also has a reasonable mathematical analogue. To make this point, we begin with the observation that a function from V to V has such enormous scope, it cannot be considered a function in the ordinary sense. The usual functions in mathematics are actually members of V (represented in a standard way as sets of ordered pairs). But a function defined on all of V cannot be represented as a set (since V itself is not a set). A usual maneuver to get a handle on such enormous transformations in set theory is to consider whether such a transformation is *definable*. Definability of such a function allows one to say things about the function almost as if it were an actual set. Requiring our function to be *unmanifest* can then be done by insisting that it *not* be definable. The Vedic Science perspective suggests that the transformational dynamics represented by j are hidden from ordinary view[16] and therefore, mathematically speaking, undefinable.

Finally, to address (3), we wish to ensure that the behavior of our function j, being undefinable, is not divorced from the reality of sets in V; j needs to be somehow "present" everywhere within V.[17] This requirement is realized by declaring that the *restriction*[18] of j to any set in V also belongs to V. The function j itself does not belong to V; it is not even definable in V. But we require that every restriction of j to a set belongs to V.

Summarizing these requirements, we can say that we are looking for some evidence of a naturally occurring function $j\colon V \to V$ with these characteristics:

(1) j preserves the internal structure of V;
(2) j is undefinable in V;
(3) the restriction $j \restriction X$ of j to any set X in V must itself belong to V.

5. Locating the Seed for a Solution to the Problem of Large Cardinals

In the 1960s, William Lawvere [13] observed that the usual Axiom of Infinity is actually *equivalent* to the existence of a certain very interesting function $j\colon V \to V$.

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[16]For instance, Maharishi remarks, "The self-referral state of consciousness is that one element in nature on the ground of which the infinite variety of creation is continuously emerging, growing, and dissolving. The whole field of change emerges from this field of non-change, from this self-referral, immortal state of consciousness" [16, p. 25]. He goes on to say, "This state of consciousness is completely self-sufficient. How it emerges from within its own self-referral performance, which is going on eternally at the unmanifest basis of all creation, is Vedic Science" [16, p. 26].

[17]The parallel with Maharishi Vedic Science is described by Maharishi as follows: "The deepest level of every grain of creation is the self-referral field, the transcendental level of pure intelligence, the self-referral state of Unity—pure wakefulness, pure intelligence—*Chiti Shaktiriti*—as expressed by the last *Yog-Sūtra*—that self-referral intelligence which is the common basis of all expressions of Natural Law" [20, p. 425].

[18]If $h : A \to C$ is a function and $B \subseteq A$, the *restriction of h to B*, denoted $h \restriction B$, is the function having domain B that acts on elements of B in the same way as h; that is, for all $b \in B$, $(h \restriction B)(b) = h(b)$.

This j is obtained as the composition of two functors F and G which have a highly coherent relationship with each other (they are *adjoint functors*):

$$j = G \circ F.$$

A *functor* is a certain kind of function that exhibits special characteristics when it is applied to other *functions*; it is perfectly legitimate here to think of functors as just another kind of function. Because of the adjoint relationship between G and F, both exhibit strong preservation properties: relationships in the domains of each of the functors are preserved by these functors. In the language of category theory, F preserves all *limits* and G preserves all *colimits*. This gives a hint that even the existence of an infinite set implies that certain truth-preserving dynamics are at work within the wholeness of V.

We shall refer to j as the *Lawvere functor*. The Lawvere functor suggests an alternative form of the Axiom of Infinity:

> *Lawvere Axiom of Infinity.* There is a functor $j : V \to V$ that factors as $j = G \circ F$, where G is the forgetful functor from the category of self-maps[19] on sets to the category of sets, and F is left adjoint to G.

It is important to keep in mind that this j has a special status among functions that one could define from V to V. The function j is special because its existence is *equivalent* to the Axiom of Infinity. The Axiom of Infinity simply states that there is an infinite set—asserting nothing more than the existence of $\mathbb{N}$, the set of natural numbers. This is a very localized phenomenon: a single set is declared to exist someplace in the universe. On the other hand, this particular j provides transformational dynamics of the entire universe, exhibiting important structure-preserving characteristics. The fact that the existence of j is equivalent to the Axiom of Infinity tells us that the presence of a companion transformation $j : V \to V$, with its structure-preserving characteristics, is an essential characteristic of the universe V. The seed of the vision of wholeness from the cognition of the ancient seers seems therefore to be already present in the design of the universe V.

When we look at the properties exhibited by the Lawvere functor j through the eyes of a Vedic mathematician, however, we notice that something about j seems amiss. To be a full expression of the transformational dynamics that belong to wholeness, as understood in Maharishi Vedic Science, we expect j to have more fully developed properties. In particular, it would be reasonable to expect that j itself, rather than just its factors F and G, should exhibit strong preservation properties. This gap between what we expect to find based on our guiding intuition and what we actually find suggests a direction for improvement.

We are expecting that, by implementing principles of Vedic Science in a mathematical context, motivation for large cardinals will naturally appear. What we have now discovered is that our candidate for giving mathematical expression to the dynamics of wholeness is missing some desirable characteristics. A reasonable hope is

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[19]A *self-map on a set* A is simply a function $f : A \to A$; in other words, the domain and codomain of a self-map are equal. Such self-maps can be collected together to form a category. The forgetful functor G on this category acts on a self-map $f : A \to A$ by stripping away its structure: $G(f) = A$.

that if we attempt to strengthen[20] the axiomatic properties of j, we will strengthen the ZFC Axiom of Infinity in such a way that deeper properties of wholeness can be brought to light and illuminate the issue of large cardinals.

6. Enhancing the Preservation Properties of j

In the 1970s, Blass and Trnková [2] took the step we have just been discussing. They asked what happens if a functor $j\colon V \to V$ is required to have essentially the same preservation properties as those of the *factors F and G* of the Lawvere functor j. Such a function, in precise mathematical terms, is called an *exact functor*; an exact functor preserves all *finite* limits and colimits. Blass and Trnková were able to prove the following interesting theorem.

Theorem 6.1 (Blass, Trnková)**.** *The following are equivalent:*
  (1) *There is a nontrivial exact functor $j\colon V \to V$.*
  (2) *There is a measurable cardinal.*

The theorem shows that our program of axiomatically enhancing the Lawvere functor so that it exhibits more preservation properties is on the right track. The Blass-Trnková functor is already a much fuller expression of the functional dynamics we are seeking. If we replace the Lawvere Axiom of Infinity that we stated before with this new Blass-Trnková version,

<p style="text-align:center">"There is a nontrivial exact functor $j\colon V \to V$,"</p>

then we have as an immediate and perfectly natural consequence that the universe must contain a measurable cardinal.

7. The Wholeness Axiom

Taking the next step, we can ask: Can the preservation properties of the Blass-Trnková functor be enhanced even further so that j preserves *all* properties of V? Can we even require that j have the added characteristics, in accordance with properties (2) and (3) mentioned earlier, that it is undefinable but its restrictions to sets belong to V?

In the language of set theory, the way to require a function to preserve *all* properties is to make it an *elementary embedding*.[21] Therefore, the requirements on a

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[20]To clarify a possibly confusing point, we explain a bit more what we mean by "strengthening the properties of j." We have found an equivalent axiomatic formulation of the Axiom of Infinity that asserts the existence of a function $j : V \to V$ having certain properties, namely, Lawvere's Axiom of Infinity. We wish to construct new, stronger axioms that also assert the existence of a $j : V \to V$. These new axioms will be stronger because of the stronger properties that the function j will be declared to have. Therefore, when we say that we wish to strengthen the axiomatic properties of j, what we mean is that we wish to find another axiom, involving the notion of $j : V \to V$, so that the declared properties of j render the new axiom stronger than previous versions of the axiom. Note that the kinds of new properties we will ask the j of the axiom to have will be guided by the principles of Maharishi Vedic Science that we described earlier.

[21]Formally, to say that $j : V \to V$ is an elementary embedding means that for every formula $\phi(x_1, x_2, \ldots, x_n)$ (where the free variables of ϕ are precisely $x_1, x_2, \ldots, x_n$) in the language of set theory, and for all sets $a_1, a_2, \ldots, a_n$, the formula $\phi[a_1, a_2, \ldots, a_n]$ (obtained by substituting each a_i for x_i) holds true in V if and only if the formula $\phi[j(a_1), j(a_2), \ldots, j(a_n)]$ holds true in V. Speaking more intuitively, to say that j is an elementary embedding means that it preserves all

function from V to V mentioned above will be met if we require, axiomatically, that j be an undefinable elementary embedding whose restrictions lie in V. Below, we give the statement of the *Wholeness Axiom*, which asserts the existence of such an elementary embedding; the Wholeness Axiom represents a kind of "ultimate" enhancement of the Axiom of Infinity. Following the statement of the axiom, we examine the new features of wholeness that are brought to light by adding the axiom to the standard set theory axioms, ZFC.

> **Wholeness Axiom (WA)**. There is a nontrivial elementary embedding $j\colon V \to V$ with the property that for every set X, the restriction $j \upharpoonright X$ is also a set.

Notice that the requirement that j should be undefinable has not been mentioned in the definition of the Wholeness Axiom. The reason is that undefinability of j actually can be *proven*: it follows from a theorem by K. Kunen [11] that if such an embedding exists at all, it cannot be definable.

Also notice that we have required j to be *nontrivial*. This means that for some set x, $j(x) \neq x$; we say that j *moves* x. In fact, it can be shown that some *infinite cardinal* is moved by j. The *least* cardinal moved by j is called the *critical point* of j and is usually denoted by the Greek letter κ (read "kappa"). It can be shown that j moves κ to another infinite cardinal $j(\kappa)$ that is bigger than κ; that is, $j(\kappa) > \kappa$.
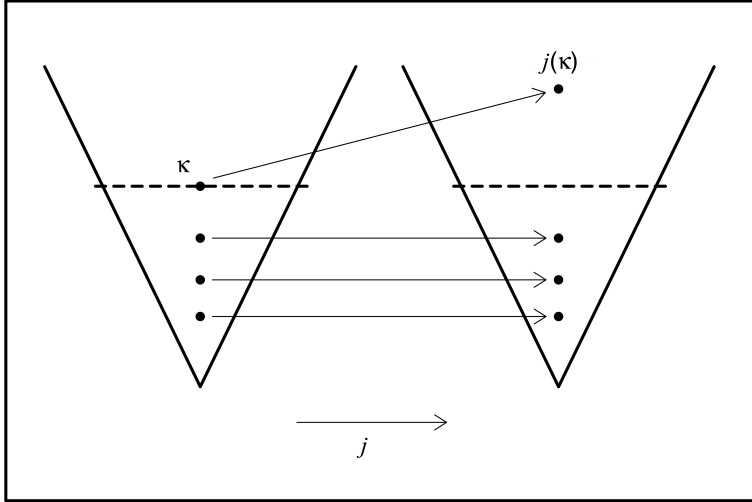

FIGURE 3. The non-trivial elementary embedding j.

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possible finitary relationships among sets (more precisely, those relationships that are first-order expressible using the membership relation). Note that if j is an elementary embedding, it must be a functor. To illustrate one step of the verification of this fact, suppose $1_A : A \to A$ is the identity map on a set A. We check that $j(1_A)$ is the identity map $j(A) \to j(A)$. First note that $j(1_A) : j(A) \to j(A)$ is a function, since, applying j to the formula $\forall x \in A \, \exists! y \, 1_A(x) = y$ yields $\forall x \in j(A) \, \exists! y \, j(1_A)(x) = y$. Next, observe that applying j to the formula $\forall x \in A \, 1_A(x) = x$ yields $\forall x \in j(A) \, j(1_A)(x) = x$, from which it follows that $j(1_A)$ is the identity map on $j(A)$.

We can now state the main result of this article, which shows that our efforts to provide a solution to the Problem of Large Cardinals have been successful.

Theorem 7.1 ([3]). *Assume WA and let $j: V \to V$ denote the WA-embedding. Let κ be the first cardinal moved by j. Then κ is the κth cardinal that is super-n-huge for every n in $\mathbb{N}$. In particular, the critical point κ has virtually all large cardinal properties.*

The theorem tells us where large cardinals come from: in the transformational dynamics of the wholeness V, large cardinal properties arise as the characteristics of the first point that is moved under the transformation. At the precise moment when complete silence, represented by the behavior of j as simply the identity function below κ, changes to dynamism—in that first impulse of activity, represented by and concentrated at κ—we find that κ is filled with a powerful dynamism, evidenced by the fact that it has essentially all known large cardinal properties.

In fact, it is accurate to say that κ acquires the status of a point in the universe which stands as a *representative* of the totality of V. This is seen by the fact that the stage V_κ of the universe indicated and coded[22] by κ is in fact an *elementary submodel* of V.[23] This means that all the relationships that hold inside V also hold inside V_κ.[24] It also means that V_κ knows all there is to know about the wholeness V. Truly, κ can declare "I am wholeness."

These dynamics closely parallel the way in which the unbounded nature of wholeness, as described in Maharishi Vedic Science, collapses to its own point value in the emergence of manifest existence. Maharishi explains that manifest existence arises from the Veda, which can be seen as an unmanifest blueprint for the manifest world, giving rise to everything by way of its own self-interacting dynamics.[25] Moreover, the Veda describes, in one of its own verses (Ṛk Veda I.164.39), how the Veda itself arises. The verse states, "The verses of the Veda exist in the collapse of fullness (the *kshara* of अ (A)) in the transcendental field, in which reside all the *Devas*, the impulses of Creative Intelligence, the Laws of Nature responsible for the whole manifest universe" [21, pp. 52–53]. Maharishi explains that this collapse of fullness is represented by the very first syllable of Ṛk Veda, *AK*. In the syllable AK, the letter 'A' represents fullness (pronounced without restriction in intonation), while 'K' represents a *stop*, uttered with a closed throat.[26] Being the focal point of the

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[22]In the sense that there is a bijection between κ and V_κ.

[23]See, for example, [3].

[24]Formally, this implies that for any sentence σ of set theory, σ holds true in V if and only if σ holds true in V_κ.

[25]Citing Maharishi, R.K. Wallace [24, p. 218] writes, "Maharishi describes the four Vedas as 'a beautiful, sequentially available script of nature in its own unmanifest state, eternally functioning within itself, and, on that basis of self-interaction, creating the whole universe and governing it.'"

[26]"The pronunciation of अ (A) requires full opening of the mouth, indicating that अ (A) is the expression of the total value of speech. अ (A) presents unbounded totality, अ (A) is the total potential of speech. Pronunciation of क् (K) requires complete closing of the channels of speech (the throat). अ (A) fully opens the channels of speech; क् (K) closes the channels of speech. Full opening followed by full closing displays the phenomenon of collapse of the unbounded field (of speech) to the point value (of speech). The whole range of speech is in this collapse; all sounds are contained in this collapse, and all the mechanics of transformation of one sound into the other are also contained in this collapse" [18, pp. 171, 354].

collapse of the unbounded totality, 'K' represents a point of infinite dynamism, all possibilities, that can burst forth into the diversity of creation.[27] Therefore, the syllable AK, he says, embodies in seed form the entire transformational dynamics of the unfoldment of the Veda, which in turn gives rise to manifest life.[28]

Analogously, we have seen that the set-theoretic universe V is a natural analogue for wholeness, and its transformational dynamics $j : V \to V$, characterized by the Wholeness Axiom, bring into view a special point, the *critical point* of j, denoted κ. As we have seen, κ has essentially all large cardinal properties and is so "infused" with the properties of the wholeness V that the stage V_κ can be said to know all there is to know about V. We see a parallel between the wholeness indicated by 'A' and the mathematical wholeness V, and also between the point 'K' of infinite dynamism and the critical point κ, which encodes all first-order properties of V.

The analogy goes considerably further. Just as from the syllable AK, the Veda emerges, which in turn gives rise to manifest creation, so likewise we find that the "collapse" of V to κ gives rise to a kind of blueprint for the sets of V. This blueprint is known to mathematicians as a *Laver sequence* and arises in the following way. From $j : V \to V$, there arises a class $\mathcal{E}$ of *extendible embeddings*, which are elementary embeddings of the form $i : V_\alpha \to V_\beta$, all with critical point κ; the class $\mathcal{E}$ can be viewed as a class of approximations to j. These extendible embeddings code up a Laver sequence S, which can be used to locate every set in the universe.[29] Indeed, if

$$S = \langle s_0, s_1, s_2, \ldots, s_\alpha, \ldots \rangle_{\alpha < \kappa}$$

is the Laver sequence that is obtained from j and its derived extendible embeddings, then, for any set X in V, there is an extendible embedding i with the property that the κth term of the expanded sequence $i(S)$ must be X itself. These dynamics

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[27]Maharishi explains, "It is interesting to observe that अ (A) in its continuum stands for the continuum of silence, and the collapse of this infinite value onto its point value generates dynamism within the nature of silence, and this silent dynamism is the lively home of all the Laws of Nature from where specific Laws of Nature emerge within the wholeness of the total potential of Natural Law in अ (A)—eternal silence" [20, p. 620]. This "point value," as he explains elsewhere, is represented by 'K': "The total potential of अ (A) is available between the infinity of अ (A) and its point, क् (K). The liveliness of the inner structure of अ (A), the liveliness of the Constitution of the Universe, is represented by अक् (Ak). क् (K), the point of the Constitution of the Universe, is the total Constitution of the Universe concentrated at the point of WHOLENESS, अ (A)" [19, p. 454].

[28]On this point, Maharishi remarks, "Ṛk Veda says, 'All the verses of Veda are within अक् (Ak), the first syllable of Ṛk Veda, and all the *Devas* (the administering intelligence of the universe) are lively within अक् (Ak)—the universe is lively within अक् (Ak)—the entire dynamism of the Veda and Vedic Literature, and the corresponding expression of the Veda and Vedic Literature in terms of the physical expression within the unmanifest structure of self-referral consciousness, presents the self-referral ocean of consciousness as the invincible Cosmic Catalyst (*Purusha*) of the entire ever-expanding universe'" [20, p. 545].

[29]We outline the definition of S: define a function $f : \kappa \to V_\kappa$ recursively as follows:

$$f(\alpha) = \begin{cases} \emptyset \text{ if } f \restriction \alpha \text{ is Laver at } \alpha, \text{ or } \alpha \text{ is not a cardinal} \\ x \text{ otherwise, where } x \text{ is a counterexample for Laver-ness of } f \restriction \alpha \end{cases}$$

Then letting $s_\alpha = f(\alpha)$ for $0 \le \alpha < \kappa$, it can be shown (assuming the Wholeness Axiom) that $S = \langle s_\alpha \mid \alpha < \kappa \rangle$ is a Laver sequence. See [4] for details.

parallel the sequential unfoldment of the Veda from AK, giving rise, in turn, to all of creation. We can summarize these results as follows:

Theorem 7.2 ([3]). *Assume WA. Let j be the WA-embedding and let κ denote the critical point of j. Then there is a κ-sequence $S = \langle s_0, s_1, s_2, \ldots, s_a, \ldots \rangle_{\alpha < \kappa}$ of elements of V_κ with the following property: for every set X, there is an extendible embedding i with critical point κ such that if $i(S)$ denotes the sequence obtained by elementarily[30] expanding S by i, then X occurs as the κth term of $i(S)$; that is,*

$$X = i(S)_\kappa$$

As a final point of interest, once the existence of a WA-embedding is known, the structure of the universe V is seen in a new way. Whereas before, even the existence of a single large cardinal—even an inaccessible cardinal—was cause for doubt, now in the presence of a WA-embedding, *almost all cardinals in the universe are large cardinals!* This phenomenon is formulated precisely in the following theorem:

Theorem 7.3 ([3]). *Assume WA and let j denote the WA-embedding. The sequence $\kappa, j(\kappa), j(j(\kappa)), \ldots$ is unbounded in V and each term is a WA-cardinal.[31] Moreover, each of these cardinals λ admits a normal measure[32] with the property that the set of cardinals less than λ that are super-n-huge for every n has normal measure 1. More succinctly, almost all cardinals in the universe are super-n-huge for every n.*

8. Conclusion

In this article, we have reviewed the evolution of the mathematical analysis of the infinite. The classical period in this history achieved important milestones, including the initial recognition that infinitely many objects could be collected together into a single set; that there are many different sizes of infinite sets; and that all of mathematics can be viewed as taking place within—indeed, *originating* within—a vast wholeness V, beyond the limits of any particular set or infinite size. The modern era of this analysis began with the discovery of large cardinals and their underivability from the axioms of set theory. A persistent theme in this period has been the quest to provide an axiomatic account for the presence of large cardinals in the universe.

We found that Cantor's vision of the universe of mathematics as an embodiment of the Absolute Infinite was able to guide the mathematical formulation of the axioms of ZFC and even provided techniques for justifying many of the smaller large cardinals. However, the need for a deeper insight into the structure of the wholeness V led us to seek a deepening of the intuition offered by Cantor.

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[30]When i acts on S, it produces a longer sequence, of length $i(\kappa)$, whose first κ terms are those of the original sequence S.

[31]A *WA-embedding* is a map $j : V \to V$ for which $(V, \in, j)$ is a model of ZFC + WA. A *WA-cardinal* is the critical point of a WA-embedding. The statement that each of the elements of $\{\kappa, j(\kappa), j(j(\kappa)), \ldots\}$ is a WA-cardinal can be formalized in the first-order language of WA [4].

[32]A normal measure on a cardinal λ partitions the subsets of λ into two collections X and Y, where X is the collection of "big" subsets of λ, with the property that every set in X has *measure 1*, and Y is the collection of "small" subsets of λ with the property that every set in Y has *measure 0*. In mathematical parlance, one says a normal measure 1 subset of λ contains *almost all* elements of λ.

Our proposed approach to address this need has been to make use of the principles of Maharishi Vedic Science. Maharishi Vedic Science identifies qualities and dynamics of wholeness itself—the wholeness of life and of consciousness. We have applied these to formulate a strategy for locating in the mathematical wholeness V heretofore unrecognized characteristics that could provide natural justification for large cardinals.

In this effort, we discovered, in Lawvere's equivalent formulation of the Axiom of Infinity, the beginnings of a natural parallel to the self-interacting dynamics of wholeness. Refining Lawvere's results to their logical conclusion, aiming toward the fullest possible representation of Maharishi Vedic Science principles within this context, we were led to the formulation of the Wholeness Axiom. The Wholeness Axiom asserts, in a precise mathematical way, that the wholeness V has at its unmanifest basis transformational dynamics (represented by j) which preserve the internal structure of V and which are present at every point within the universe.

From the Wholeness Axiom, we were able to derive a solution to the Problem of Large Cardinals. The solution shows that large cardinal properties arise as special properties that appear in the first impulse of change arising in the transformational dynamics embodied in j; in particular, that all large cardinal properties arise as properties of the first cardinal κ moved by j. Further examination of the interactions that occur between j and κ led to the observation that a certain sequence S of sets—known as a Laver sequence—naturally arises within the κth stage of the universe. This sequence has the special property that it encodes all sets in the universe. In particular, all sets in the universe can be seen to emerge through the interaction of j, κ, and S. These dynamics provide a strong analogy to the dynamics of wholeness described in Maharishi Vedic Science according to which wholeness, represented by the first letter 'A' of Ṛk Veda, collapses to its point, 'K' (the second letter), in the sequential unfoldment of the entire Veda, which in turn, through its own self-referral dynamics, gives rise to all manifest existence.

The evolution of mathematical insight about the infinite suggests another parallel, a parallel between the quest for the Infinite in mathematics and in the life of the individual. When the quest begins, the "infinite" seems to be an unrealistic fairy tale. In the mathematical world, actual infinities were barred from the mainstream for centuries; and later, in the modern era, large cardinals were viewed with great skepticism for many decades after their initial discovery. So likewise in the life of the individual there is often an initial skepticism at the prospect that something as grandiose as the "Infinite" could really exist, really be experienced.

Then, after a taste of the Infinite, a change occurs. In mathematics, once the infinite was recognized as a reality, the *nature* of the infinite was found to be vast and textured, and its unfolding dynamics were found to be contained in a wholeness vaster than even the biggest notion of "infinity." And then in the modern era, as more attention was paid to the phenomenon of large cardinals and certainty of their validity grew, they became a central tool in contemporary foundational research. In a similar way, once an individual has tasted the Infinite and its influence in life, the doorway to a clear perception of the nature and hidden dynamics of the Infinite gradually starts to open.

Finally, there is a deeper realization. In the world of mathematics, a notion of infinity that seemed hardly possible or imaginable is finally seen to be nearly omnipresent: under the Wholeness Axiom, nearly all cardinals are discovered to have essentially all large cardinal properties. And in the life of the individual, the tall tale of the "Infinite," once ignored and pushed aside, at last is seen to be the truest of all realities, awake and present in every aspect of experience.

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International Journal of Mathematics and Consciousness

In recent centuries, scientists have found that many phenomena in nature obey physical laws that can be expressed precisely in the language of mathematics. Their successes have led scientific inquiry beyond the physical world to include what was previously considered metaphysical or non-material. Today, an increasing number of scientists are examining the nature of consciousness and its relationship to the human brain.

While most models of consciousness propose that it is a product of chemical and electrical behavior within the brain, no current theory resolves the so-called "hard problem of consciousness"—how physical processes in the nervous system give rise to subjective experiences such as experiencing, thinking, feeling, analyzing, and creating. At the same time, it is undeniable that without awareness—without consciousness—we cannot think, perceive, dream, or love. On this basis alone, a scientific journal dedicated to exploring the nature of consciousness is timely and appropriate.

While consciousness can be studied within a variety of disciplines, mathematics especially lends itself to examine the relationship between consciousness and physical phenomena. Mathematics is precise and rigorous in its methodology, giving symbolic expression to abstract patterns and relationships. Although developed subjectively, using intuition along with the intellect and logical reasoning, mathematics allows us to make sense of our outer physical universe. Mathematics is the most scientific representation of subjective human intelligence and thought, formalizing how individual human awareness perceives, discriminates, organizes, and expresses itself.

The scientific consideration of consciousness by itself is a formidable challenge, for consciousness is a purely abstract reality. But the study of what we might call "consciousness at work"— how consciousness expresses itself in our daily activity of thinking, analyzing, creating, theorizing, and feeling—is inherently more accessible. For this exploration also, mathematics is the ideal tool, because its ability to express patterns of abstract human awareness helps us make sense of our physical universe. One could in fact argue that mathematics is the most scientifically reliable tool for the exploration of the dynamics of consciousness, for it alone can be seen as the symbolic representation of "consciousness at work."

The International Journal of Mathematics and Consciousness will help to fulfill the need for a forum of research and discussion of consciousness and its expressions. The editors invite mathematicians, scientists, and other thinkers to present their theories of consciousness without restriction to proposed axioms and postulates, with the stipulation only that such theories follow strict logical argumentation and respect proven facts and observations. Articles that use factual or logical counterarguments to challenge commonly believed but not fully established facts and observations are also welcome.