Beyond Matter and Spirit to an Objective Spirituality through the Totality Axiom

Paul P. Budnik Jr.

Abstract

Science has rendered the matter and spirit conceptual framework obsolete. This paper advocates its replacement with structure (what we can understand through science) and essence (what we experience in stream of consciousness). The Totality Axiom is introduced to integrate structure and essence and thus provide a starting point for integrating scientific understanding with spiritual intuition. Using this axiom, the paper shows how the mathematical result known as Gödel's Incompleteness Theorem can be applied to the evolution of consciousness giving substance to spiritual intuitions. This is an important example of how the Totality Axiom lays the groundwork for an objective spirituality with the potential to develop at a rate adequate to cope with the enormous power that science and technology is creating through the objective guidance of experiment.

1 Introduction

In the West during the middle ages there was a unified view of the physical and spiritual domains. God was active in all of creation. This changed as experiments increasing came to guide human understanding of nature. The physical world seemed to be animated by simple understandable laws and not by the will of an all powerful being. Spirit and matter seemed to be different realities.

This split was not just conceptual. The objective guidance of experiments accelerated the development of science and led to enormous power to manipulate the physical world through technology. There was no comparable objective guide to the development of spirituality and values. As a result we have enormous power and limited wisdom to use that power. We may destroy ourselves and much of life on this planet unless we can develop our spirituality and values at a rate adequate to cope with the accelerating development of science and technology.

This paper aims to begin to repair the split in world views and to lay the groundwork for developing an objective spirituality. This requires a new conceptual framework and that makes it difficult to communicate. What is the nature of the physical world and what is the nature of our internal stream of consciousness? How are these connected? These questions are so fundamental that our world view is built around the answers we give. This is true even if we never ask such questions. There are implicit answers in

how we think about ourselves and the larger world. Those implicit answers are part of the organizing principles of our thought. It can be difficult to suspend these principles to consider different possibilities. That is what the reader must do to understand this paper.

The conceptual framework described here is based on structure and essence. Science aims to understand the structure of physical entities. Essence exists in the stream of consciousness we experience. Science analyzes the blue sky as light of various frequencies. We see the blue sky and have a particular, definite and irreducible experience. That experience has an essential nature that cannot be explained by science or reduced to simpler structures. It just is. Structure and essence are not different realities but different ways of viewing what exists. The Totality Axiom connects these in a unified world view. That axiom is the center point of this paper. The first half develops the background for introducing the axiom. The second part develops its implications and in doing so lays the groundwork for an objective spirituality.

This development begins with an explanation of how and why mathematics has become purely structural. There is no essence or essential nature in mathematical objects. Concepts like numbers, points and lines are defined using the single primitive entity of the empty set in set theory. All branches of mathematics can be formulated in the language of set theory and derived from its axioms. Similarly physics has become totally abstract and mathematical. The digitization of media (sound recording, still images and movies) is a prime example of structure devoid of essence. A DVD contains a sequence of numbers that describes the structure of sounds and images and from which those sounds and images can be generated. The numbers on the DVD contain nothing of the experience of the movie but all of the structural information needed to recreate the experience.

The following section explores essence as the intrinsic nature inherent in immediate conscious experience. It briefly considers the scientifically understood correlations of brain structures with conscious experience. It emphasizes that conscious experience exists on a continuum of complexity and can be independent of language and memory. Human consciousness evolves as a fertilized egg grows to become an adult. Consciousness gradually fade in the tragedy of Alzheimer's disease. All of this suggests that consciousness can exist in many forms different from normal adult stream of consciousness.

The next section develops the Totality Axiom. That axiom states that the essence and totality of the existence of physical structure is immediate experience in some form and that physical structure is the only aspect of immediate experience that can be communicated. This is a strong form of panpsychism or the view that the physical universe is conscious. It also asserts the importance of structure as the aspect of experience we can communicate.

The section on the Totality Axiom describes a number of contemporary views of panpsychism that are similar to that advocated in this paper. The Totality Axiom is justified as the simplest possible assumption consistent

with what we know to be true. This is the same justification used for the fundamental laws of physics. It is the best we can do in developing the fundamental assumptions not derivable from more basic ones.

The remainder of the paper focuses on the implications of the Totality Axiom. This begins with a section on the creative nature of mathematical truth implied by Gödel's Incompleteness Theorem. The next section applies this mathematics to the evolution of consciousness. This section shows that the unbounded evolution of consciousness requires ever expanding diversity. In this context the ethical implications of the Totality Axiom are discussed. This leads to a spirituality in which God is the expanding creative evolution of consciousness. God is a journey not a destination. Finally, the spiritual world view that emerges from this approach is connected to existing religious and spiritual traditions.

2 Mathematics, physics and structure

This section examines how and why mathematics and physics have become purely structural. There are no fundamental entities with an intrinsic nature in these disciplines. The digitization of media is an example of how one can divorce structure from essence. The numbers on an audio CD describe the structure of a musical experience but have nothing of its essence.

Structure describes how a complex object is made out of simpler ones. For example, the structure of a house includes a foundation, walls and a roof. It would seem that when we examine the structure of an object we must ultimately come to some irreducible components that have an essence or intrinsic nature. For example we might consider the lumber, nails, concrete foundation and roofing shingles as being among the fundamental components of a house. Newtonian physics was constructed like this. All matter was ultimately composed of billiard ball like particles that had an intrinsic nature from which many of the laws of physics could be derived.

Contemporary physics has no such primitive entities. It is entirely mathematical as explained later in this section. Contemporary mathematics has deliberately and systematically purged itself of any objects with an intrinsic nature. Mathematicians did this because starting with objects that had an intrinsic nature, like lines, led them to make false assumptions. That story shows the value of separating structure form essence in mathematics.

For centuries, the parallel postulate of Euclid was considered to be a self evident truth. Two lines are parallel if they are both perpendicular to a third line. For example the legs of a well made table are parallel because they are perpendicular to the table top. No matter how far one extends the legs they will never meet. This is the parallel postulate. It seems self evident.

Now consider the laws of geometry on the surface of the earth. Sailors determine their location in the ocean by latitude and longitude. These are imaginary lines this circle the earth. Lines of latitude are parallel to the equator. Lines of longitude are perpendicular to the lines of latitude. Thus

all lines of longitude are parallel with each other. However, if you look at a globe with the major lines of latitude and longitude marked, you will see that all the lines of longitude intersect at the north and south poles.

The surface of a sphere does not conform to our intuitive notions about parallel lines. We call geometries that obey the parallel postulate Euclidean. Many important geometries are not Euclidean including the surface of our planet. General relativity defines the geometry of our universe in contemporary physics. It too is not Euclidean.

Mathematicians wanted to avoid making assumptions that are not universally true like the parallel postulate. To that end they removed any fundamental entities like lines, planes or points from the formulation of mathematics. They invented set theory. In set theory there is a single primitive entity, the empty set, and a single primitive relationship, set membership. The only objects are the empty set and things constructed from the empty set. For example the number one is the set containing the empty set. The number two is the set containing the number one and the empty set. Thus the number two has two members. In general the number N contains the empty set and all numbers less than N. Of course the number 0 is the empty set.

This is an awkward way to do mathematics. Defining a line starting with the empty set is complicated. You need to define a topology of points. You do this with numbers but you need real numbers like 32.25, $\frac{5}{3}$ and even π. Mathematicians do not necessarily think or work in terms of sets. But they know how to formulate the work they do in those terms. All existing branches of mathematics can be formulated in the language of set theory and all widely accepted mathematical theorems can be derived from the axioms known as Zermello Frankel Set Theory plus the Axiom of Choice or ZFC. These axioms can be easily written on a single page.

Set theory is a pure study of structure. When you complete the analysis of an object in set theory you wind up with the single irreducible entity of the empty set. This is not an object with an intrinsic nature. It is nothing at all. It is as clear a symbol as one could imagine that there is no essence in mathematics.

Just as mathematics has become completely abstract physics has become purely mathematical. The only connection between the mathematical formulas of physics and human experience is experimental technique. There still exist fundamental particles as in Newtonian physics but these are defined with mathematical formulas. They behave strangely and do not always have an individual identity. For example light consists of particles called photons. These seem to precipitate out of an intense beam of light like rain drops precipitating out of a cloud. The raindrops did not exist as individual entities when they were part of the cloud. Photons do not exist as individual entities in an intense beam.

A discussion like the above is at best a metaphor. Contemporary physics provides no model of what is "really happening". It only describes how prob-

abilities evolve between observations. If we observe a particle at a particular location and time then quantum mechanics allows us to predict how likely we are to observe it at a different location and later time. Quantum mechanics says nothing about a particle traveling from one location to the next. Most attempts to fill in the blanks between observations have led to theories that make wrong predictions. Those that do not, like Bohm's[4], must be inconsistent with special relativity or quantum mechanics[2] and those discrepancies cannot be experimentally detectable with existing technology.

No other theory has come remotely close to the accuracy that quantum mechanics is capable of. Quantum mechanics allows us to build postage stamp size computer chips that do billions of calculations in a second. The theory accomplishes all this, yet it is more abstract than set theory. It does not model the structure of the physical world. It models only the evolution of probabilities.

The intuitive idea that complex structures have fundamental components with an intrinsic nature is not true in contemporary mathematics and physics. Mathematics builds everything from the empty set or nothing at all. Physics is pure mathematics and does not even model the structure of physical reality but only the evolution of probabilities.

The divorce between structure and essence in our scientific understanding is clearly illustrated in the digitization of media. Everything we see and hear can be encoded as a sequence of numbers on a CD of DVD. These sequences preserve the structure of the sound or image. In the case of a CD the numbers represent sound pressure level at a given instant. By recreating the sequence of sound pressure level we recreate the original sound. That is what a audio system does with the numbers on a CD. Similarly for images the numbers represent the intensity of the three primary colors, at a given point in an image and instant in time. Recreate the intensity levels of these colors at the correct location and time and you recreate the image. That is what a DVD player connected to a television does.

Digitization has its roots in information theory. Shannon defined information as that which allows us to reduce the number of states a system may be in. For example suppose we know that a flag must be red, blue, green or yellow. Then it can be in any of four states where each state corresponds to a different color. If we are now told the flag is green we have reduced the four possible states to a single state. The amount of information transferred is that needed to reduce four states to one state. This requires a number between one and four.

This measure of information is universal. It applies equally to color, sound, a page of text etc. Shannon's definition applies to *everything* we can communicate. We can *always measure* the information communicated in terms of how much we have reduced the number of possible states. We can always communicate that information as a number that selects possible states as long as both the sender and receiver have the same map between numbers and states.

We ordinarily communicate through sight and sound. The map that translates pressure waves in our ears or light waves in our eyes to sounds and images is in our nervous system and brain. This translation happens automatically. We have no sense of creating sounds or images in our heads like we do of projecting them on a movie screen. But we know a great deal about this mapping process and that knowledge allows us to explain the many ways in which our vision and hearing can be misled.

Recognizing that all information can be represented by numbers that select states was an important step in the removal of fundamental entities with an essential nature from science and mathematics. Shannon's concept of information and the set theory based notion of structure in this paper are close. One can assign a unique integer to every finite set. Thus gives a measure of the information needed to describe any finite structure. Every structure contains information and every structure can be fully described with information.

The separation of essence from structure in science and mathematics was an extraordinarily valuable achievement. It removed any intuitive notions from the fundamental elements in mathematics and physics. Of course intuition is essential in developing scientific theories and mathematical understanding. But at the end of the day one does not want to have ill defined intuitive ideas at the root of science and mathematics. The power of these disciplines comes in part from their precision. By leaving nothing undefined beyond the empty set, mathematics achieves the precision it needs. By becoming purely mathematical physics achieves the same result. By reducing information to the selection of states, the foundation of the Internet and the digital revolution was laid.

These achievements create a philosophical problem. What does it mean for a physical object to exist if it is not constructed out of components with an intrinsic character? What is the intrinsic nature (the greenness of green, the smell of a rose) that is so evident and pervasive in our stream of consciousness? The next section completes the groundwork for addressing that question by exploring the nature of immediate experience.

3 Immediate experience

> As regards the world in general, both physical and mental, everything that we know of its intrinsic character is derived from the mental side, and almost everything that we know of its causal laws is derived from the physical side. But from the standpoint of philosophy the distinction between physical and mental is superficial and unreal[14, p. 402].

Bertrand Russel may have been the fist to recognize the split between structure and essence that was still developing in science and mathematic in 1927 when he published the above quote. "Causal laws" is a less general term

then structure but Russell was thinking in the direction this paper goes. Our "mental" stream of consciousness has an "intrinsic character" or essence and that is no where to be found in science. In the next section this "superficial and unreal" distinction is eliminated with the Totality Axiom.

This section completes the groundwork for that axiom by examining the nature of immediate experience. First it briefly explores the scientific evidence that correlates immediate experience with brain structures. Next it shows that immediate experience is not necessarily connected to memory and language. Driving or walking while ones conscious attention is focused elsewhere is used as an example of having immediate awareness which one cannot remember or report. Surprisingly the phenomena of "blind sight" provides an example of the opposite where one can have knowledge of something and be able to report about it even though one is not conscious of that knowledge. Having immediate awareness of something and being able to report about it are independent of each other. This and the correlation between brain structures and conscious experience suggest that brain structures not connected to memory and language have immediate experience. Finally that possibility is expanded to all physical structure by considering the hierarchy of immediate experience using as examples the evolution of consciousness as an embryo develops into an adult and the gradual dimming of consciousness in Alzheimer's disease.

The study of consciousness is becoming a respectable scientific field because we are developing tools to scan the living brain. In a limited way scientists can see consciousness as they see what regions of the brain become active during certain kinds of mental activities. This research is in its early stages but it strongly suggests that all immediate conscious experience involves physical brain structures and that in time we will have a detailed map of the physical transformations of the brain that correspond to particular experiences.

One example of this research involves phantom limbs. A person with an arm amputated can still experience sensation in the limb because the brain regions that process signals from the missing limb is still active. When such a massive loss of sensory input occurs the brain makes new connections to use the newly idle region of the brain[10]. These connections are made to active neighboring regions. There is a homonuculus or "little man" in the somatosensory cortex that receives signals for tactile stimulation. This little man is not shaped like the physical body. The lower part of the face is next to the arm. The result is that individuals with an arm amputated often feel stimulation of the lower face as stimulation in their phantom limb.

Even religious and mystical experiences seen to be connected with regions in the brain. It is possible to induce an out of body experience by stimulating a particular region in the brain[3]. There have been many other studies of physical states of the brain correlated with spiritual experience. A recent *Newsweek* cover story summarized this work[1]. That spiritual experiences are correlated with physical brain structures does not mean that spiritual

experience are those brain structures, but it does suggest that possibility.

We naturally associate immediate experience with what we can report through language and what we remember, but consciousness is not necessarily connected to either language or memory. Some people can report what they see even when they have no conscious awareness of it. Injuries to the brain can produce "blind sight". A person so afflicted has no visual perception. Yet they can correctly answer questions like: is the apple in the upper or lower box? This is possible because there are two brain centers for processing visual information. The higher level center that developed later is responsible for visual perception. The more primitive center controls reflex reactions that must come faster than is possible with conscious deliberation. When a large rock is falling toward someone they need to move immediately, not think about their options. If this center is functioning, then one can "see things" and have knowledge about what one sees without knowing that one sees them. The person being asked about the apple thinks they are just guessing. Yet their answers are mostly correct.

Just as one can have knowledge about something one perceives without having immediate awareness of it, one can have immediate awareness of something without having knowledge about it. At times one functions on auto pilot. You might drive or walk for half an hour without being able to remember anything along the way. You were conscious and did not drive into a ditch or walk into a tree. But you were not paying attention to what you saw. Some lower level processing in your brain kept you safe and going where you intended. Conscious attention was focused on other things. You remember what you pay attention to, not everything you are conscious of.

Immediate experience is not only independent of language and memory but it also seems to exist on a continuum. A baby has experience but it is simpler than that of a normal adult. There is no reason to think that consciousness begins at birth. At what stage does a developing embryo begin to have immediate experience? Does it take a billion neurons, a million or only one? Does it take any neurons at all? Can a single cell have immediate awareness in some form? What about the gradual fading of consciousness in the tragedy of Alzheimer's disease? Immediate awareness never seems to end completely as the much of the brain becomes dysfunctional. Does immediate awareness end only at death? Does it end with death? As crazy as it may sound, several prominent thinkers from a variety of fields believe immediate awayness in some form is universal in all that exists physically. Some of these comments are in the next section.

Essence exists in our immediate experience but it is nowhere to be found in our scientific understanding. We are increasingly able to correlate particular forms of experience including spiritual experience with brain structures but we can never get essence from structure. We can explain why someone with blue-green color blindness can perceive some patterns but miss others. but we cannot explain why the color green appears the way it does or why it appears as anything at all. Robots with no conscious awareness could be

programmed to have both normal color vision and blue-green color blindness. They would give the same report as we do about what patterns they can see. But they would have no awareness of green or blue. So how do we bridge what has been called the explanatory gap[12]. How do we explain the experience of the color blue? How could such a marvelous reality come into being from the matter in our brains and bodies? the Totality Axiom turns the explanatory gap on its head. It asserts that structure only exists as an aspect of immediate experience.

4 The Totality Axiom

Michael Tye has argued that the explanatory gap is a cognitive illusion[15]. The consciousness we experience is what it means for certain physical structures in us to exist. There can be no explanatory gap because there is nothing subject to explanation. The Totality Axiom implies Tye's position but goes beyond it to say that immediate experience in some form is what it means for *any* physical structure to exist. Reported conscious experience is of necessity connected to language and memory. Parts of the brain like those involved in blind sight, have only a fragmentary connection to memory and language. Does this mean they lack consciousness? We do not know any more than we *know* if another person is conscious. We assume they are because it is the simplest and most plausible assumption. What is the simplest assumption about the consciousness of matter in general? That is the question the Totality Axiom addresses.

The Totality Axiom asserts that the essence and totality of the existence physical structure is immediate experience in some form and that physical structure is the only aspect of immediate experience that can be communicated. This section begins the argument for the Totality Axiom with a discussion of panpsychism. This is the belief that all that exists is conscious. Panpsychism is an implication of the Totality Axiom but not vice versa. Next the Totality Axiom is justified as the simplest assumption consistent with what we know of the world. Then the assertion that all communication is structural is discussed. This section ends with some implications of the Totality Axiom some of which are developed in the remainder of the paper.

Panpsychism. in earlier forms, attributed human like motivations to all of nature including inanimate effects like the weather and volcanoes. We can only explain things in terms that we are familiar with and primitive man was most familiar with his own psyche and the psyche of those he was close to. The idea that the universe is animated through conscious intention has fallen into disfavor in the light of scientific understanding. The laws of physics are nothing like the laws of the psyche.

Yet the idea remains alive in a more abstract form as suggested by Ray Kurzweil.

> So we could say that the universe —"all that is"— is indeed per-

> sonal, is conscious in some way that we cannot fully comprehend. This is no more unreasonable an assumption or belief than believing that another person is conscious. Personally, I do feel this is the case. But this does not require me to go beyond the "mere" "material" world and its transcendent patterns. The world that is, is profound enough[11, p. 215].

Kurzweil sees a spiritual dimension to the evolution of consciousness without assuming anything beyond the material world.

Joseph Campbell has a similar sense of the universality of consciousness.

> It is part of the Cartesian mode to think of consciousness as being something peculiar to the head, that the head is the organ originating consciousness. It isn't. The head is an organ that inflects consciousness in a certain direction or to a certain set of purposes. But there is consciousness here in the body. The whole living world is informed by consciousness.
>
> I have a feeling that consciousness and energy are the same thing somehow. Where you really see life energy there is consciousness. Certainly the vegetable world is conscious. And when you live in the woods as I did as a kid, you can see all these different consciousnesses relating to themselves. There is a plant consciousness and there is an animal consciousness, and we share both these things. You eat certain foods, and the bile knows whether there's something to go to work on. The whole process is consciousness. Trying to interpret it in simply mechanistic terms won't work[5, p. 18].

Campbell is not saying that energy produces consciousness. He is saying that energy is consciousness and consciousness is energy. We know from relativity that all that exists physically is energy. Thus Campbell's view and the Totality Axiom lead in the same direction.

David Chalmers has proposed a tentative theory of consciousness based on information. In context Chalmer's information is almost a synonym for structure. Every structure contains information and and any structure can be fully described using information. After outlining his ideas he observes that information is ubiquitous. He does not shrink from the conclusion that experience must also be ubiquitous.

> If this [experience is ubiquitous] is correct then experience is associated with even very simple systems. This idea is often regarded as outrageous, or even crazy. But I think it deserves a close examination. It is not so *obvious* to me that the idea is misguided, and in some ways it has a certain appeal[7, p. 293].

The Totality Axiom goes beyond panpsychism in denying any aspect of existence except immediate conscious experience. A conscious universe that

reflects the structure of the physical world is all that is needed to explain what we know of internal and external reality. It is unclear what it would mean for a physical object devoid of immediate experience to exist. We can imagine such an object because we can imagine our immediate experience of it. But what does it mean for an object to exist if there is no experience of it? What is the reality, substance or essence of it?

The answers to ultimate questions like the nature of existence must be approached as we do the fundamental laws of physics. These laws cannot be derived from other assumptions. The best that can be done is to look for the simplest assumptions consistent with what is known. In physics this means developing simple mathematical models that agree with as wide a range of experimental observations as possible. In asking about the nature of existence the corresponding approach is to look for the simplest assumptions that can deal with both our scientific understanding of the physical universe and our internal conscious experience. The Totality Axiom meets this condition and it is hard to imagine how anything simpler could.

Physical structure and conscious experience are not different existential categories. They are how an individual perceives the world relative to their brain and body. They are important practical distinctions created by evolution. As one broadens ones sense of self these distinctions do not disappear, but their arbitrary relative nature becomes apparent.

Seeing the world in this way is more than a philosophical theory. It has practical testable implications. It implies that we can expand human consciousness by changing biological structures and by tightly integrating manufactured components to the human neural network. It implies that sufficiently advanced robots that claim to be conscious will be telling the truth. It implies that the Internet, as the nervous system of the planet, could evolve into a worldwide conscious sentient being that all humanity participates in.

The remainder of this paper focuses on the implications of the Totality Axiom for the evolution of consciousness. Many spiritual practitioners see this is a personal and internal journey mediated by discipline and spiritual practice. While such personal transformations are essential they are also limited. The processes that played the dominant rule in the evolution of consciousness is biological evolution. It has created beings capable of spiritual transformation.

Personal transformations of consciousness are limited by the biological structure of the brain. Personal spiritual practice must be supplemented by a spiritual approach to the evolution of physical structure and thus consciousness. This requires science and technology. The future evolution of consciousness on this planet will come less through the random mutations of biologic evolution and more through the conscious intentions of sentient beings using the tools of technology. There is no reason to think that the evolution of conscious is near or even has an end. The realization of that unlimited potential requires the development of science, technology and an

objective spirituality with the depth to guide us in this greatest of human challenges.

This is a time of great opportunity and enormous risk. Consciously controlling evolution requires an understanding of the boundary conditions that permit unlimited creativity. Gödel's Incompleteness Theorem is essential for understanding these boundary conditions, as explained in the next section. This application of Gödel's result is an illustration of the power of an objective spirituality. The Totality Axiom allows mathematics to be applied to the most challenging of spiritual questions.

5 Creative mathematics and Gödel

"Creative mathematics" sounds like an oxymoron. Mathematics is about those truths that are logically determined by assumptions. These assumptions are called axioms in formal mathematics. The classic example of a logical deduction is the syllogism about Socrates.

> All men are mortal.
> Socrates is a man.
> Therefore Socrates is mortal.

If all men share a common property and Socrates is a man then he must have that property. Logic at this level is self evident. But whether or not an object has a particular property such as being mortal is not always so easy to decide even if we *know* it is logically determined by our assumptions. Gödel proved that there are outcomes logically determined by a set of axioms that cannot be proved from those axioms. Without realizing it he established the creative nature of mathematics with important implications for the creative evolution of consciousness.

This section begins with a practical example of the kind of problem that Gödel proved could not be decided. This is intended to make Gödel's abstract mathematical result concrete and to show its relevance to human experience. Next is a brief history and statement of Gödel's result and an explanation of how the result relates to practical problems. The following section applies this mathematics to the evolution of consciousness.

Most of us have been frustrated by a computer that suddenly stops responding. Gödel's result implies that there can exist no general method to determine if the computer will eventually start responding or if you must reboot and loose the work you were doing. For some cases one can figure this out, but no method will work for every case. This is true even though one can determine exactly what the computer will do at any time. Its fate is determined by the computer design and the programs it is running. Of course real computers can act erratically because of a hardware failure, but the assumption here is that the hardware is working correctly.

The inability to predict if a computer will ever do something is at the root of mathematical creativity. The existence of unsolvable problems that have a logically determined outcome was discovered by Kurt Gödel in the 1930s. Around 1900 Hilbert, a famous mathematician, posed a challenge to the mathematical community. He presented a list of problems that included finding a method for deciding all well posed mathematical problems. Thirty years later Gödel proved this was impossible[8]. He showed that any mathematical system that was strong enough to include the primitive recursive functions could not prove its own consistency unless it was inconsistent. The primitive recursive functions are those that can be defined with elementary induction described later in this section. They are powerful enough to model the execution of all possible computer programs. A formal system is inconsistent if one can derive a statement and the negation of the same statement from the axioms of the system. A formal system that included the following axioms would be inconsistent.

All men are mortal.
Socrates is a man.
Socrates is not mortal.

The problem of knowing if a computer will ever accept more user input is equivalent to the problem of determining if a formal mathematical system is consistent[1]. For any problem of one type one can construct a problem of the other type such that the two problems have the same answer. The computer will eventually accept input if and only if the formal system is inconsistent. This is possible because a formal mathematical system is a precise set of rules for deducing theorems. One can think of it as a computer program for generating theorems. So all one has to do to see if the system is consistent is to generate every theorem and check each one against all previous theorems to see if the new theorem is the logical negation of any previous theorem. If one finds such a contradiction the process accepts user input. If no contradiction is found the process will run forever without ever accepting input.

What is the relevance of Gödel's result? To gain insight into this we need to understand a little about the hierarchy of mathematical truth developed as a consequence of Gödel's result. This starts with understanding laws of induction beginning with elementary induction. A mathematical system must have this level of induction for Gödel's proof to work. Using elementary induction one can prove that something is true for every integer without testing every case. The first step is to prove the property is true of the number 0. The next step is to prove that if it is true for *any* number n it must be true for $n+1$. If one can show this than one knows how to prove the

[1] Technically Gödel's result is more general because it applies to formal systems that have an infinite number of axioms and thus cannot have their behavior modeled by a finite computer program. However, for formal systems that finite mathematicians can write down and use as opposed to philosophize about, the results are equivalent.

property for any integer. Start at 0 and work up to the desired number by iterating the second step. If we can prove the property holds for any integer, it must be true for all integers. The Appendix gives an example of proof by induction.

One way to extend induction is to operate not on the integers but on properties of integers. One can go higher and consider induction on methods for generating properties[2]. One can always go to higher levels of abstraction. There is no finite way to characterize this hierarchy. Nor is there any single path of development that can fully explore it. Limiting culture to a single mathematical system inevitably limits the power of mathematics to an infinitesimal fragment of what it could be. Mathematicians do not necessarily think that these very high levels of induction are that important. With the rarest of exceptions practical mathematics gets along quite well with a fragment of the power of induction of ZFC (defined in Section 5).

Godel's result was a shock to the mathematical community at the time and the result has yet to be fully digested. There can be no general method for determining mathematical truth. Any method that follows a single path may continue to make progress into an unbounded future, but all that path will accomplish over infinity is fully embodied in a single finite higher level axiom of induction. Every single or finite path process has such a limiting axiom that the process can never discover.

The only way to explore the full richness of this hierarchy is with an ever increasing number of schools of mathematics following mutually inconsistent mathematical systems. The is no way to know which school is true although some schools will prove to be false, but the total number of active schools must increase without limit. One can easily prove this. By exploring an ever increasing number of mathematical systems one can explore all possible formal mathematical systems. Of course one can be more selective than that, but it is clear that exploring every possible system is a way to consider every true axiom of induction.

Gödel's result has fundamentally altered the *technical* development of mathematics. New fields like Recursive Function Theory are founded upon it. But it has not altered the view that mathematical truth is absolute. Higher levels of induction are not needed for existing science and technology or normal mathematics. Is this proof of their irrelevance or a limitation of the level of evolutionary development that humans have reached? That is

[2] Set theory uses the concept of an ordinal to characterize all levels of induction and does not explicitly construct a hierarchy of levels of abstraction. The power of a system is determined by the strength of the ordinals defined in the system. *Principia Mathematica*[16] developed mathematics by explicitly giving a hierarchy of levels of abstraction. These are each equivalent to an ordinal in set theory. Set theory implicitly defines much larger ordinals than those derivable from the explicit hierarchy in *Principia*. It accomplishes this on a single page in contrast to the three large volumes of *Principia*. However I suspect that at some point we will only be able to extend mathematics by understanding the explicit hierarchy of types implicitly defined in set theory. With the aid of computers that project is vastly easier than at the time of *Principia*.

the subject of the next section.

6 The creative universe

Inanimate matter has evolved to reproducing molecules, to single cells made of trillions of molecules, to complex organisms composed of trillions of cells, to the broad spectrum and extraordinary richness of human experience. One can only gasp in dumbfounded wonder at the miracle of it all!

The astounding history of the creativity of evolution is the most compelling argument for the expansion of creativity in the future. It makes no more sense to see humanity as the end point of this process than it does to see the earth as the center of the universe. The essence of this creativity resides in conscious experience. Meaning and value is created as experience with an intrinsic nature is created. It is only the structural aspect of immediate experience that we can approach with intellectual understanding, but that is adequate to extrapolate from the historical record with the aid of mathematics.

That is the subject of this section. It starts with a discussion of why the higher levels of induction that mathematicians do not consider that important may be crucial to the future evolution of consciousness. Central to this issue is the way in which evolution creates its own environment and meaning that is dependent on that environment. This section ends with some speculation about genetic engineering and the future of evolution.

Few mathematicians see the need for a creative approach to mathematical truth in the light of Gödel. Higher levels of induction beyond those derivable in ZFC are not needed for practical problems or 'normal' mathematics[9]. Does this stem from the limitations of the human mind and imagination or the nature of mathematical truth? Two aspects of evolution are central to addressing this question. First is the observation that evolution creates its own environment. This is most obvious in the oxygen atmosphere of the earth. Because oxygen reacts with so many elements it cannot persist in an atmosphere unless there is a process that continually replenishes it. It requires a living planet to maintain this atmosphere. More subtly much of what is characteristically human only has meaning in a cultural environment. A baby that is never held or fondled dies. We are designed to exist only in a human culture that is an extraordinarily complex product of evolutionary creativity.

The other aspect of evolution that is important to understanding the relevance of higher levels of induction is the creation of meaning and values. We can explain the evolution of a mother's love for her child from the vulnerability of the human infant for an extended period of time. But the feelings of the mother are a primary irreducible reality that is incomprehensible and meaningless at lower levels of evolution and consciousness..

It is in this context that one must consider the relevance of Gödel's result. The ever increasing diversity needed to explore all mathematical truth is

important because the evolutionary processes that can explore these truths create meaning. At no point in the evolutionary process can one understand the nature of higher levels yet to be created. What could an insect make of human values? We cannot understand higher levels of abstraction but we can extrapolate from the history of evolution to see they may have profound meaning and value in the contexts in which they evolve.

How can such creativity function? How can a Darwinian struggle for survival between creatures at a low level of evolution lead to levels so radically advanced? How can the human mind evolve from single celled animals? Perhaps the best example of the creative potential in a low level Darwinian struggle is the evolution of sexual reproduction. There is substantial evidence that going to the trouble to find a mate to reproduce is not worth it from the standpoint of Darwinian survival except in environments that are infested with pathogens[13]. What is perhaps the single most creative force in evolution did not evolve as a creative force but to stay in place by running as fast as possible in the lethal evolutionary struggle against infection.

Is there a relationship between the richness of evolution and the structural possibilities inherent in the levels of mathematical truth? The level of induction in a formal mathematical system determines what mathematical structures are definable in that system. The Totality Axiom suggests that this is also true of conscious experience. The degree of abstraction or iteration a being is capable of imposes a limit on the richness and depth of their experience. In mathematics, if one has strong enough axioms of induction, one can construct any mathematical object. Similarly if a mind is capable of a sufficiently high level of abstraction it can embed simpler structures and thus have (or more correctly be) the simpler experience.

Levels of induction or abstraction set boundary conditions on what is possible. They are nothing like a complete measure of this richness of structure or the richness of conscious experience. There are many other dimensions to structure. The most obvious is size measured by the number of bits it takes to describe the structure. This dimension equally limits what structures can be embedded in a mind. A single linear scale such as the ordinal numbers that characterize the level of induction in a mathematical system are a limited aspect of structure. Such a scale can do little to characterize the richness of mathematical structure but it can define limits on what is possible. The ordinal numbers do that for mathematics. The Totality Axiom suggests they do the same for conscious experience.

It would be wrong to think that we are at or even remotely near an end to the creative evolution of consciousness meaning and values. But we are at a unique time in evolutionary history. As a species we are dramatically altering the environment of the planet and we are acquiring the technology to consciously control our own future evolution. If we survive the multiple crises that this situation creates future evolution will in large measure be a matter of conscious choice.

Genetic manipulation will begin with efforts to cure or eliminate horrible

genetic diseases. Few will quarrel with developing such technology. Once the technology exists, it will inevitably be used more widely. We will in the next few decades be able to create intelligent conscious robots. We will begin to directly interface technology to our nervous system expanding our senses and consciousness. Deciding how to use this enormous power is the fundamental problem facing humanity today. The next section suggests an approach.

7 Ethics and Spirituality

The Totality Axiom gives meaning to the valueless structures of science. The only source of *ultimate* meaning and value is immediate experience. A universe of zombies that acted intelligently but were devoid of consciousness or immediate experience would be meaningless and valueless. The universe implied by the Totality Axiom in which all transformations of matter and energy are transformations of consciousness has potential meaning in all that exists.

Ethics based on the idea that an all powerful father figure created the universe and the rules of ethics seems absurd from even a casual study of history. The immense cruelty in the world would be a reason for utter despair if one thought it the result of the design of an all powerful being. Attempts to create ethical systems without reference to the creative nature of the universe like Utilitarianism fail to connect with the spiritual instincts that play an essential role in ethical feelings and thought. The Totality Axiom suggests an ethical approach similar to Utilitarianism aimed at maximizing happiness. But the Totality Axiom and Gödel's result imply that the capacity for experience is continually expanding. We need not only to make the world less cruel and more joyful. We need to support evolution of beings whose experience of joy is beyond anything we can imagine. We need to recognize that God is the creative evolution of consciousness. She is not a ultimate being, final goal or destination but an ever expanding creative process.

The cruelty of evolution including the evolution of culture that dominates the world stage today is an inevitable part of a creative evolutionary process that is *not* directed or designed by a higher intelligence. Consciousness has evolved through a random and cruel struggle for survival. In the process values were created that can lead us into a less cruel more joyful future. The Totality Axiom is a starting point for integrating our evolved values with an objective view of the universe. We can create an ethics that strives not just to minimize suffering and maximize happiness but also to extend the capacity for joy through the creative evolution of consciousness. Ethics in tune with the full range of human instincts must have a spiritual vision.

The spiritual vision suggested by the philosophy expressed here can be summarized as follows. God is the creative universe. She does not have a further explanation or creator. God is not an ultimate being or final destination. She is the unbounded evolution of consciousness. God is infinite in potential but not in actuality. For any conscious experience to exist it must

be particular and definite and cannot be infinite. You can add things to an infinite set without changing it but you cannot add something to a conscious gestalt without changing it. As the highest form of consciousness on this planet, we are the eyes of God with the power to create the world. We are at a unique stage in the evolution of God's consciousness. Through us she has become conscious of herself and her creative potential and is acquiring the ability to consciously direct her future evolution.

This view of spirituality has parallels with Buddhism, which sees our kinship with all sentient beings. Ultimately it sees all such beings as one. All that exists is an evolution of consciousness and this forms an indivisible whole. There is no unique soul that defines one's individuality. We are not ultimately separate from the rest of humanity or the rest of the physical world. Our soul is the world soul with its ever evolving consciousness.

Traditionally Buddhism seeks enlightenment as a final or ultimate goal although many contemporary Buddhist thinkers see it more as a process with no end point[6]. There is no ultimate goal in the framework described here. There is only a continual striving for a higher level of consciousness. By treating Buddhist philosophy as metaphor we can speculate about how enlightenment can be reinterpreted.

The cells in the human body do not compete for survival as do single celled animals. They have a steady supply of food and nearly ideal living conditions. The price they pay for this is to loose their freedom to reproduce independently of the needs of the body they are part of. If they renege on that bargain and become cancer cells they may destroy the environment that gives them life.

One can argue that cells in an evolved animal have reached a form of enlightenment. They have not eliminated the problems of survival but they have pushed those problems to a new level. As long as the organism they comprise survives they live in a protected environment.

One cannot end all suffering or all attachment but one can to a large degree push these to a higher level. Enlightenment is not an ultimate achievement but a continual progression.

Christian notions of heaven can be connected to this sense of enlightenment. We have or are developing the technology to create something approaching heaven on earth. We can eliminate most forms of suffering and it seems likely that we will learn to greatly extend human life beyond its natural span. Much of what one may imagine in heaven may become a practical reality. Even the sense of communion with God that is central to Christian dogma is obtainable. Understanding and *feeling* that we are an integral part of an unbounded creative process is communion with the great mystery and power of existence.

Like the cell we will pay a price in limiting our reproductive potential. A stable ordered world can only support a finite population although probably one far greater than exists today or in the foreseeable future. We can use our understanding of mathematical creativity to minimize the limitations

that a finite planet imposes on the evolution of consciousness but we cannot eliminate those restrictions. It is likely that we will start to reproduce as an entire world sending unmanned probes into space with enough technology and biological material to create new civilizations on worlds in which life has not evolved. We will be somewhat like the cells in an organism. We will live in a protected environment but we will still be creative individuals striving to expand our own consciousness and that of future generations. We will want to seed the galaxy and universe with evolving creative life. We will have reached the heaven of Christianity but see it as a single stepping stone on an endless unbounded divergent path.

If we get beyond the current crises and figure out out how to live together in peace and cooperation on this tiny planet than we will push much of the strife that has dominated the history of mankind to a new level. Our galaxy and certainly our universe is likely to have more than one reproducing world. We will be competing with them to seed the universe and we will also be 'mating' with them to accelerate the creative process. Any civilization that reaches that level of development will understand the implications of Gödel's Incompleteness Theorem for the evolution of consciousness and structure. This should instill a respect for all possible paths of development and limit the desire to dominate the universe.

8 Concluding summary

As science is increasingly able to explain the structure of human experience in physical terms the concept of a spiritual soul and physical body grows obsolete. Yet this scientific progress in dealing with structure does nothing to explain the essential nature of our immediate experience. The divorce between structure and essence is made explicit in mathematics where the only primitive entity is the empty set. It is made equally clear in Shannon's definition of information as something that allows us to limit the possible states a system may be in.

From the standpoint or mathematics and physics everything we understand can be represented by numbers. The digital revolution that stems from Shannon's idea of information has made this a practical reality. Digitizing media (which means representing information be a sequence of numbers) allows for essentially flawless transmission and preservation of sounds and images. But where is the experience of a Bach sonata or of a wave crashing into a rocky beach on a DVD or CD? How do the numbers in a digital recording come to life in the experience of watching a movie?

This is a fundamental question about the nature of existence. It can only be approached as we do the fundamental laws of physics. One must look for the simplest possible assumptions consistent with what one knows to be true. The Totality Axiom is proposed as this simplest assumption. That axiom states that the essence and totality of the existence of physical structure is

immediate experience in some form and that structure is the only aspect of experience that can be communicated.

The second part of he Totality Axiom is essentially a restatement of Shannon's definition of information. The first part connects structure with essence implying that the whole universe is the transformation of consciousness and nothing but the transformation of consciousness. As such it is a form of panpsychism similar to the views of a number of contemporary thinkers. The power of this axiom lies in connecting physical structure to conscious experience so that one can begin to apply the objective tools of mathematics and science to spiritual questions.

Gödel's Incompleteness Theorem is an important example of this. It has lead to a hierarchy of mathematical truth that involves higher levels of abstraction or iteration. Our ability to think abstractly, indirectly and iteratively is a defining characteristic of human consciousness. Gödel's result implies that such structures can only evolve without limit in a nondeterministic process like biological evolution that follows an ever increasing number of paths. In the case of evolution these paths are sequences of species that are descendant one from the other.

The level of mathematical truth that a given mathematical system embodies determines what structures can be defined in that system. The Totality Axiom suggests that the level of abstraction a mind is capable of limits the conscious experience that mind is capable of. In this context one can understand some spiritual intuitions in a less metaphorical way. Buddhist enlightenment and Christian heaven can both be seen as relative states. At a higher levels of evolution the struggle and pain of lower levels can be largely eliminated. For example the cells in an animal live in a cooperative enlightened and nearly ideal environment as long as the organism they are a part of is healthy. For them the struggle for survival has moved to the level of the organism.

This leads to a spiritual vision in which God is the unbounded creative evolution of consciousness. As the highest level of consciousness on this planet we are the eyes of God with the power to create the world. We are developing the tools to direct future evolution on this planet and to reproduce as an entire world seeding our region of the galaxy with evolving life. We need to understand the boundary conditions that do not limit future evolution if we are to perform our role as facilitators of the future evolution of consciousness. The Totality Axiom and Gödel's proof are a starting point for that understanding.

A Appendix: Proof by induction

Proof that the sum of all integers less than or equal to k is $\frac{k\times(k+1)}{2}$.

1. Proof for 0: $\frac{0\times(0+1)}{2} = 0$.
2. Proof that if it is true for n it must be true for $n+1$.
   (a) Assume we have for any n that that the sum of all integers less than n is $\frac{n\times(n+1)}{2}$.
   (b) Then the sum of all integers less than $n+1$ must be $n+1+\frac{n\times(n+1)}{2}$.
   (c) Put the $n+1$ in the numerator of the fraction producing $\frac{2\times(n+1)+n\times(n+1)}{2}$.
   (d) Simplify using the common factor $n+1$ to get $\frac{(n+2)\times(n+1)}{2}$.
   (e) Substituting k for $n+1$ in the above equation yields $\frac{k\times(k+1)}{2}$.
3. This completes the proof that if the equation is true for n it must be true for $n+1$ and that completes the proof by induction.

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B About the author

Paul Budnik was an Acting Assistant Professor at UCLA before completing his PhD. in computer science from the University of Illinois. Since then he has been a computer consultant in the areas of digital signal processing and systems on a chip for a variety of companies including Cadence Design Systems and Zoran. He passionately pursues ideas on consciousness, evolution, physics and mathematics seeing a single story that can only be approached if all perspectives are recognized and integrated.