

Being and Time: Toward a Post-Standard Model Noetic Reality

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Being Here: Life After the Standard Model.

We human beings have a burning desire to know our origin, our identity, and our destiny. Where did I come from; who am I; where am I going? Perhaps these three can be pragmatically reduced to the critical, ultimate question, the "who" question: "who am I"? Who is it that desires to know, and to be happy? Who is it that is born, lives and dies? Who is it that shines through the mind and abides at the heart of all human beings?

What then is this vast reality, and this precious life we've been given? Where did we come from, and where are we going? We need to know. Therefore all cultures have a cosmology. Cosmologies have physical, mental and spiritual facets.

Western physical cosmology is empirical yet inherently speculative, and becoming more so. Good. That is the very non-objective nature of this inquiry. Post-Standard Model cosmology has radically departed Standard Model Concordance Cosmology (Λ -CDM or Λ CDM) with its small constraints on non-empirical modes and methods. That said, the Concordance Model dark sector assumes highly speculative, almost mystical entities, namely, dark matter and dark energy.

But radical (all real change is radical) "post-empirical" cosmology (supersymmetrical/SUSY) superstrings, M theory and especially the multiverse) has caused a philosophical schism between new paradigm cosmologists and philosophers of cosmology who favor weaker or more relaxed empirical testability criteria, and orthodox cosmologists (the Popperazzi) who still believe that we need a stringent Popperian (after Karl Popper) "falsification principle". This dichotomous principle states that, because no theory can be completely true, any hypothesis must be testable, refutable, disprovable, or falsifiable. On this accord, if a theory is falsifiable, whether true or not, it is scientific; if not, it is unscientific. Here we must be able to conceive of an observation which will deductively prove a hypothesis or theory to be false. In short, a theory must be empirically testable. This solution to the vexing "problem of demarcation"—what is scientific and what is unscientific—seems rather arbitrary, even extreme. It is no longer considered a viable candidate as a demarcation criterion.

Yet the cosmological orthodoxy seems to fear that more relaxed, post-empirical test criteria is a slippery slope that will lead us astray from our uncomfortable comfort zones of established objectivist Scientific Realism and Scientific Materialism. Could it be that conservative Kuhnian "normal science" practitioners sense a "paradigm shift" that may cause a "crisis" that portends the next scientific/cultural "revolution"? If so, the now retrograde grasping at positivist, objectivist theory is understandable.

The physics and cosmology of Western culture recognizes only the physical/material aspect of being in time. The ideology of the ontology (what there is; being itself) of monistic Scientific Materialism upon which our cosmology is based reduces mental, emotional and spiritual cognition to mere physical/chemical brain states. Under sway of such a view we are not open to reality beyond the physical; the subjective aspects of mind, and the arising realities it experiences and attempts to understand.

Our deep cultural background Western epistemology (how we *know* what there is) is Platonic realism, metaphysical realism. Here, appearing reality is purely objective and observer-independent and theory-independent—a "real world out there" (RWOT), separate from the consciousness of a participating observer. Such habitual, self-constrained cognition makes it very difficult to understand how it is that we, and all of this, are body/mind/spirit instantiations participating in the primordial unbounded whole—by whatever name—in which (or in whom) this all arises. Wholes necessarily embrace and subsume their parts. Parts participate in their greater whole.

This, our rather ontically and epistemically confined cosmology is called the Standard Model of Big Bang cosmology, or the Concordance Model, or Λ CDM (Lambda-CDM Model, where lambda Λ is dark energy, and CDM is cold dark matter). Here dark energy represents about 70 percent of the total visible universe, dark matter about 25 percent, and less than 5 percent is the atomic/baryonic ordinary matter that we are made of. Nice to know; but 96 percent of the cosmos is missing! Λ CDM is a cosmic extension—utilizing Einstein's General Relativity—of the prodigious physics of the Standard Model of particles and forces, the world of the very small, which utilizes the quantum theory. And yet, our universe of space, time and energy is scarcely understood at all. Particle physicists and cosmologists all know that this Standard Concordance Model of cosmology is wrong!

We shall herein explore what this amazing conceptual model, this "new physics" post-Standard Model conjecture required to understand the dark sector, viewed holistically, might contribute to our understanding of who we actually are, our identity, even our supreme identity—physically, mentally, and spiritually. All of this is, after all, interdependently related, is it not?

We have reached the end of our venerable Standard Model of particles and forces and its aged Big Bang cosmology. Thomas Kuhn's unresolved "puzzles" (The Structure of Scientific Revolutions 1961, 1998) of this ever evolving metaphysical model portend a new "paradigm shift" in our current understanding of the actual nature of appearing reality—its structure, its origin and aim. The prodigious Big Bang Standard Model is our Western scientific and cultural creation myth, the cognitive lens through which we view and understand our worlds.

Clearly, we are now entering a brave new world of post-Standard Model physics, and the socio-cultural consequences that follow there from. We are experiencing a crisis in Western science and culture. We are on the cusp of the next scientific/cultural revolution. Objective Scientific Realism and Scientific Materialism with their dualistic Cartesian, Modernist/Enlightenment idolatry of reason and objectivity is no longer seen, at least by the thinking classes, as an adequate worldview. Obsessive reason and the Postmodern reaction to this Modernist worldview has produced a tyranny of anti-science subjectivity that only exacerbates the destructive bipolar subject/object, spirit/matter split in human consciousness; and denies the astounding "progress" and the mixed bag of benefits that Modern Science has bestowed upon us. Yet science and the culture of science with its fundamentalist proto-religion, known

to its critics as Scientism, has alienated us from that of us that is not objective and physical—ethics and the wisdom of kindness; spirituality and religion. How shall we understand this?

The noble Standard Model of physics and cosmology is incomplete, "unnatural", inelegant and entirely *ad hoc*. It is vexed with contradictions and paradoxes. It fails to explain its two primary epistemic pillars, namely the gravity of General Relativity, and the inherent subjectivity of the quantum theory; and why these two "perfect" theories are utterly mathematically incompatible. It cannot explain the host of problems arising from its impossible, extremely low entropy Big Bang cosmogenesis; the values of the masses of its particles; its 18 universal physical constants; the Higgs mechanism; the three and curiously, only three generations of matter; the failure of these matter particles to account for dark matter; dark energy and the absurd value of the cosmological constant Λ , our new friend λ of the Λ CDM cold dark matter Concordance Model of the cosmos.

According to the Concordance Model this dark sector comprises over 95 percent of the matter/energy of the visible universe! The remaining 5 percent that is baryonic (good old protons and neutrons) "ordinary matter" is the realm of the patriarchal Standard Model that we have come to know and love. Again, 95 percent of the universe is a complete mystery! (European Space Agency's Planck Probe map of the cosmic microwave background (CMB) 2013 release reveals that the present universe is 4.9 percent ordinary matter; 26.8 percent dark matter; and 68.3 percent dark energy, with an age of 13.77 billion years.) This Λ CDM Model explanation is admittedly highly "unnatural". It is entirely *ad hoc*, and makes very little common sense. Indeed, this would seem to be an explanatory model that explains very little. Might we then refer to this greatest human intellectual accomplishment as the Substandard Model of reality? But wait.

Not surprisingly, most quantum cosmologists support the evolution of physical theory toward something more inclusive, and as the quantum theory, in all of its various explanatory garments, has definitively demonstrated, such a theory must account for our physical instruments of measurement, as well as the non-physical consciousness of a human observer interpreting such measurement (the infamous quantum "measurement problem"). More on this below.

As to the "5 sigma certainty" discovery of a mystical Higgs boson (CERN 2012), if it cannot be confirmed as *the* Higgs boson, then the prodigious Standard Model paradigm with its inflationary Big Bang cosmogenesis and nucleosynthesis—which is theoretically, mathematically linked to the Higgs Field—is in big trouble. Physics' current Standard Model inflationary Big Bang creation myth will then be gradually subsumed by more inclusive theories, especially non-objectivist non-creationist "multiple universe" or "multiverse" theories.

In the widening gyre of this quasi-physical, purely speculative mindscape it is hypothesized that the arising dance of geometry is a vast ensemble of parallel universes (inflationary, cyclic, brane, quantum, holographic, etc.) cosmically participating in the great expanse of an "ultimate universe", each universe with its own big bang or "big bounce" cosmic "creations"; and probably its own laws of physics (Brian Green, *The Hidden Reality*). Thus does the post-

Standard Model, post-quantum new physics paradigm continue to evolve (Super-symmetrical Superstring/M-Theory, Loop Quantum Gravity, etc.), as we shall see.

Indeed, Roger Penrose, Sean Carroll, Brian Green, Max Tegmark, Alex Vilenkin, Andrei Linde and many others believe, or have suggested that the possible recent discovery (BICEP2 March 2014) of primordial inflationary gravitational wave polarization signals in the cosmic microwave background (CMB) are evidence of long sought gravity waves, even gravitons! Then, alas such hopes were turned to dust; in this case cosmic dust which skewed the data. Such waves would suggest that an initial Big Bang inflationary field is eternal and the cosmos that we participate in is part of a timeless multiverse that subsumes an infinite aggregate of cyclic prior parallel universes. (A requiem for steady Fred Hoyle's Steady State Theory?) Let's conceptually unpack this a bit.

Such an ultimate multiverse exceeds, by definition, our visual and causal-conceptual horizons. At the light speed limit c , light signals from such universes have not "had time" to reach us. We can have no information from such cosmic epochs, and cannot, even in principle, ever receive signals and thus conceptually know of the existence of parallel universes. Nor can we prove or falsify hypotheses about any such causally separate, or "non-local" universe (although COBE, WMAP, ESA's Planck Probe and BICEP2 have greatly enhanced our theories; p. 16 below). Here our understanding of reality departs, as ultimately it must, the empirical domain of the purely physical observer-independent reality of material science, that is to say, an objectively "real world out there" (RWOT) existing independently of any sentient observer.

This aspect of the truth of *ontological relativity* (p. 21 below)—that most of quantum and post-quantum physics, including these speculative multiverse cosmologies remain necessarily beyond the domain of objective, empirical and experimental scientific theory—has been a cause of much cognitive dissonance for cosmologists, steeped as many of them are in a pervasive ideological, objectivist realist/materialist ontology. It is clear, as philosophers of physics and cosmology have shown, that anthropic and multiverse cosmologies cannot be empirically approached by science, but are rather, "post-empirical", philosophical issues. Well and good.

Ontological relativity is the truth that reality is ultimately theory-dependent and observer-dependent, that is, our appearing realities are dependent upon our perceptual and semiotic/linguistic imputation and designation, our pre-consciously reified, intersubjective deep cultural background conceptual "web of belief" (Quine); in short, an observer consciousness. Such ontologically relative thinking is the view of Bohr's and Heisenberg's prevailing Copenhagen Interpretation of the quantum theory. It is also the view of 20th century radically empiricist logician and philosopher of science W.V.O. Quine, and now many current philosophers of physics and cosmology, if not physics practitioners themselves. Moreover, it parallels the foundation of the middle way *Madhyamaka* and *Vajrayana* Buddhist views, as we shall see.

Will this ontologically relative noetic (objective matter/subjective mind spirit unity) imperative of the 21st century new cosmology paradigm prevail? Shall we encourage physics and cosmology to continue this exploration beyond the mere relative, objective physical/conceptual dimension of Scientific Realism and Scientific Materialism orthodoxy into a

brave new world of the ultimately subjective trans-conceptual, even contemplative dimensions of an all-embracing ultimate reality? Such a reality subsumes the relative-conventional dimensions of our prosaic, "common sense" observer-independent realities. Again, the non-objectivity of the quantum theory, along with our perennial "Two Truths" epistemology—the duality of these two ontic dimensions, relative observer-independent objective reality, and observer-dependent ultimately subjective reality of *Madhyamaka* Buddhism and *Dzogchen*—has well prepared us for such a voyage. Our choiceless choice is to enter, in fear and trembling, this new post-objectivist, post-empirical noetic paradigm, and see.

Now back to the present uncomfortable comfort zone of this seemingly objective, purely physical, observer-independent universe that we have habitually embraced. Many cosmologists believe, in spite of what appears in the popular science press, that the empirically and logically impossible metaphysical *ex nihilo* creation singularity of our 60 year old Standard Model, and more recent lambda- Λ CDM model Big Bang orthodoxy is on the wane, as occurs with all great theories as they are transcended, yet included in that next ever more inclusive, yet ever incomplete theory (Kuhn 1961). The theory of the multiverse, or variations on this theme, is such an incipient theory, and has captured the assent of most recent cosmologists, as we shall see.

However, as the cosmic coherence or "global stability" in the evolution of the physical theory and cosmology of the old materialist paradigm auspiciously demonstrates, in contradistinction to Thomas Kuhn's historical/sociological view, an ever so gradual continuity of scientific "progress" in the physical, biological and social sciences has been accomplished. Is not such a process a cognitive prelude to the evolution of a much more inclusive view that may even include the transpersonal noetic/contemplative technology data points of our new science of consciousness? Indeed, this is our next scientific revolution that will, in due course, unify Λ (dark energy) with CDM (cold dark matter)—the Λ CDM model—with Relativistic Quantum Field Theory (QFT) through a new noetic theory of consciousness.

Rush to the Higgs?

Physics' Standard Model of particles and forces desperately needs the theoretical boost of an objectively "real," physical Higgs boson. The recent "5 sigma" certainty "discovery" of a heavy, unstable, electrically neutral "Higgs-like boson" at about 125–126 GeV is no doubt a new boson that is consistent with the long sought Higgs boson. Wonder of wonders in march of 2013 both CERN's CMS and ATLAS teams have claimed definitively that it is indeed physics' grand desideratum: *the* Higgs boson. It's a new boson yes, but is it *the* Higgs boson? After all, post-Standard Model super-symmetry theory (SUSY) predicts five Higgs bosons! An embarrassment of riches.

Is the recent discovery of this Quixotic "Higgs-like" particle (CERN, July 2012) indeed the advent of the putative holy grail that is the omnipresent diaphanous "God particle" (Leon Lederman) which finally "proves" the existence of the mystical Higgs Field? It is hoped that this long sought physical mechanism for electroweak symmetry breaking (EWSB) bestows

mass upon the little particles (fields) that we are; these ostensibly purely physical entities that are to become the sentient consciousness, then human consciousness, then enlightened consciousness (Buddha mind) that experiences, and has the potential to understand all of this arising phenomena, our relative-conventional spacetime experience, and its trans-conceptual primordial ground in which, or in whom this all arises.

As is usually the case with oracular pronouncements, much more work must be done to determine whether the characteristics of the new particle are consistent with all of the ostensible Higgs parameters as predicted by Steven Weinberg's definitive 1967 paper ("A Model of Leptons" (PhysRevLett, 19:20), which, with Glashow and Salam accomplished the final unification of the electromagnetic and weak forces as the electroweak force (for which they received the Nobel Prize).

Does the Higgs have the requisite zero spin, zero charge and even (as opposed to odd) parity? Is it truly elementary, or is it composite? And most importantly, does it decay into the requisite particles in the correct proportions? Have all these parameters really been engaged? Any statistically significant deviation from these predicted decay parameters excludes this new particle from the Standard Model orthodoxy, thus continuing the move toward a new post-Standard Model physics and cosmology (more on the Higgs below).

Gravity Behaving Badly: Quantum Gravity and Dark Energy

Gravity is the creator and destroyer of worlds. Einstein's General Relativity Theory (1916) subsumed, but did not replace Newton's three laws of gravity (which got us to the moon and back). Newton's G works just fine on the scale of the solar system, but GR with its non-Euclidean elliptic geometry is required at galactic scales, for example the physics of "black holes" that abide at the centers of most, if not all galaxies (probably including the two irregular "dwarf galaxies", the Magellanic Clouds of our own Milky Way Galaxy). However, GR is apparently inadequate on cosmological scales. Einstein (and his friend Grossmann and mentor Ernst Mach) introduced the tensor calculus of Riemann (the Riemann [**R**]) to the four dimensional spacetime of Minkowski to produce Einstein's sublime gravity field equation. Then in 1917 he added a further term, the *cosmological constant* Λ to "hold back gravity" and prevent the dynamic expansion of the cosmos that his original 1915 field equation predicted. Einstein believed in a static universe, regardless of what his mathematics told. More on this below.

The quantity Ω_Λ represents dark energy density. This energy density parameter Ω is the ratio of the currently observed density ρ to the critical density ρ_c . (Critical density is believed to be about five hydrogen atoms per cubic meter of space.)

This ratio dictates the geometry of the present universe. Where the observed or actual density and the critical density are equal, the universe is Euclidian, or flat, as the CMB indicates that it is. If mass energy is greater than the critical density value $\Omega > 1$, where $\Lambda = 0$, gravity will halt cosmic expansion and contract into a "Big Crunch". Where Ω is less than this, the universe is open and expands eternally. Dark energy thickens the plot. Cosmic "anti-

gravitational" dark energy accelerates the expansion of the universe resulting in such an infinite expansion, and ultimately, a spooky "Big Chill, or worse, a speedy "Big Rip" wherein the very atoms of matter/energy are torn asunder. Bad for the origin and evolution of species.

So dark energy (about 68 percent of the universe) is probably the cosmological constant Λ that exerts a repulsive force against the contracting force of gravity, accelerating the expansion of space and its galactic contents in an already expanding universe. The ultimate fate of this universe—open and infinitely expanding; flat; or closed and infinitely contracting—depends upon these two variables, gravity and anti-gravitational cosmic dark energy density $\Omega\Lambda$.

As to inflation/expansion, it is not that galaxies are "moving away", but that space itself is expanding, with all of the furniture of physical reality on board. And according to Hubble's Law (H) the more distant a galaxy is from us, the faster it *appears* to be "moving away", that is, the faster space is expanding. According to Hubble, $\Lambda = Hd$, where Λ is galactic recessional velocity, d is galactic distance, and H is Hubble's constant.

Dark matter (about 25 percent of the universe) is not electromagnetic, moves slowly and does not readily interact so it is not hot matter. It has to be a non-Standard Model entirely new kind of particle. This "cold dark matter" is hypothesized to explain why the total matter density of the universe far exceeds what we calculate that it should be by counting and weighing its ordinary baryonic (protons and neutrons) visible matter. Such common ordinary matter is by hypothesis less than 5 percent of the universe! Jan Oort first hypothesized dark matter in 1933. In 1974 Vera Ruben found it in the rotation of remote galaxies. Like dark energy, no one has a clue as to what it is. The leading candidate for this mysterious stuff is "weakly interacting massive particles", or WIMPS. Other candidates are axions and Kaluza-Klein particles. The probable post-Standard Model model for dark matter WIMPS is Supersymmetry (SUSY). The lightest of the SUSY particles is the LSP, a prime WIMP candidate. More on SUSY below.

Adding insight to injury, yes, the cosmos is expanding, which may result, in the fullness of time, in a chilly max entropy "heat death" or "Big Chill" as large scale structure—galaxy clusters and super clusters—burns out. In the titanic cosmic struggle between contracting gravity and expanding dark energy, should gravity win, the great expansion of this universe will eventually reverse resulting in a "Big Crunch", perhaps followed by a Big Bounce, then another Big Bang in an endless cycle, just as the hoary Vedas, and Buddhist *Abidharma* have told. If dark energy wins, then a turbocharged "Big Rip" is in store for whatever physical or non-physical intelligence may abide in the cosmos a trillion years hence, as the universe expands exponentially fast. Again, the very atoms of spacetime are here ripped apart. The smart money is on expansive dark energy.

Or might we even imagine a monstrously reflexive "Big Gulp" wherein a viciously vindictive cosmic sized black hole gobbles itself up in a *kosmic karmageddon*, and along with it any extant intelligence. (Einstein once quipped : "There are but two things in the universe that are truly infinite; space, and the capacity of human intelligence to delude itself. And I am not

so sure about space".) To be sure, any of the above cosmic results would be bad for the economy.

Maxwell's (1860) electromagnetism and Dirac's (1928) equations explain most of the interactions of our ostensibly purely physical reality. (Einstein was Maxwell's biggest fan.) In 1928 Paul Dirac, in an equally astounding display of mathematical virtuosity unified Einstein's Special Relativity with the quantum theory of Bohr and Heisenberg to produce Relativistic Quantum Field Theory (QFT). This, through the magic pixie dust called "renormalization" resulted in 1948 in quantum electrodynamics (QED) of Feynman, Tomonaga and Schwinger, which bestowed upon us the mixed bag of the laser, the computer, and the hydrogen bomb.

However, what was not yet explained in 1948 was the strong and weak nuclear forces, and the gravity "force". (Einstein's gravity is not a "force", like Newton's G , but rather the three dimensional curved geometry of spacetime.) These strong and weak nuclear interactions are the forces that cause the stars to be born and shine; and when stars die as supernovae their carbon, oxygen, nitrogen and other heavier elements are spewed into space so that carbon 12 based anthropic star stuff like us may evolve a consciousness to ponder it all, and one may hope, in due course, an enlightened consciousness to actually understand that life is a spacetime instantiation of the primordial ground of this great Promethean process that is great gravity itself. Yes, gravity is the creator and destroyer of worlds.

In 1967 the weak nuclear force was unified by Weinberg, Glashow and Salam with Maxwell's (1860) electromagnetic force/interaction to create the electroweak force. The strong nuclear force or color force has yet (2015), to be mathematically unified with the electroweak force. Rather, the strong force is governed by quantum chromodynamics theory, or the QCD of David Gross and Gerard 't Hooft. QED/SU(2) and QCD/SU(3), but not yet elusive gravity, now constitute our venerable Standard Model of particles and forces. The Standard Model does not include gravity. GR cannot explain Planck's quantum of action. Nor can QFT, QED and QCD explain Einstein's gravity. Clearly, a unified theory of quantum gravity is needed to complete the whole theoretical shebang.

General Relativity implies a closed, finite universe with a beginning and an end, but fails to explain the Big Bang singularity where quantum effects prevail. Thus GR must be quantized by a quantum gravity theory. Or QFT, which according to Penrose (2004 30.1) is incomplete, must be "improved" such that the inherently vexed quantum measurement problem, or "measurement paradox" connects to the equivalence principle of GR. How? Enter post-Standard Model Supersymmetry, M Theory, and Loop Quantum Gravity Theory.

Post-Standard Model supersymmetric (SUSY) superstring/M Theory is a revolutionary modification of a timeless GR (the (t) variable is suppressed) called "supergravity" which addresses gravity and provides a possible aperture to a quantum field theory of gravity. SUSY assumes a symmetry between fermions (atomic matter particles) and bosons (particles that transmit forces between fermions). For SUSY, matter particles and force particles are inherently interchangeable—a very speculative hypothesis. In supersymmetry every particle of the Standard Model, fermions and bosons, has a heavier or more massive super partner; just

as every particle has an anti-particle. Unfortunately, SUSY's super-particles (scalar "sparticles") should be detectable in CERN's LHC but have not shown up. Perhaps with this year's (2015) higher energies. Absence of evidence is not evidence of absence, but the pressure is on for SUSY.

As to the proverbial Big Bang: what banged?; why did it bang? what happened before it banged? Plenty. M Theory envisions a pre-big bang universe wherein the Big Bang singularity was not a unique creation event, but is actually a "Big Bounce" transition from a prior contracting universe. Here time had no beginning, nor has it an end. Time, if it can be presumed to objectively exist at all, existed before the putative Big Bang of the Standard Model of particles and forces. Here, the universe may have begun nearly empty (DeSitter space), then grew into such a "bangian" Big Bounce. For M theory time is relative, not absolute. Thus does M Theory require a radically post-empirical, post-cosmocentric infinite Multiverse.

Now in M Theory, nature's 18 to 20 fixed constants—including our old friends c , G , h , and α —have no fixed values, but occur as fields, like the electromagnetic field, that may change their values dynamically in different cosmic epochs. Even in the current epoch these not-so-constant constants may vary slightly. In other, parallel universes these constants of nature may not obtain at all.

In M theory it is the strength of the hypothesized "dilaton field" that governs the strengths of all physical interactions and their forces, our much beloved four forces of nature. Strangely, the prodigiously difficult mathematics of the string theory dilaton field require not four dimensions—three of space and one of time—but a total of eleven dimensions! These purported plank length (10^{-33} meters) sized strings of reality allow us to dodge the vexing "problem of infinities" because they are not reducible to the infinitely tiny point-like particles of Relativistic Quantum Field Theory (QFT). (Brian Green, *The Elegant Universe*, 2000)

Lee Smolin's Loop Quantum Gravity maintains GR as per Einstein's field equations, but also posits the Big Bang as a "Big Bounce". Before this bang-like bounce event, the universe was rapidly contracting. Unlike Superstring/M Theory, LQG is background independent, developing spacetime, matter and energy as a part of the theory, much like GR. As with M Theory, time existed before the Big Bang, but is relative, not absolute. Relative time and its realities emerge from a prior timeless dimension. LQG views spacetime, like matter, not as Aristotle and Newton would have it—absolute, smooth and continuous—but as relative, granular, and discrete. Smolin tells us that LQG is a quantum theory of gravity because it makes no additional assumptions beyond the basic tenets of GR and of QFT (*Three Roads to Quantum Gravity*, Lee Smolin, 2002).

Moreover, other mathematical tweaks to General Relativity (e.g. Milgrom's MOND theory) have yet to subdue the chaotic inflationary dragon that is dark energy; nor have tweaks to the prevailing Copenhagen Interpretation of the quantum theory; nor have its various and sundry other interpretations fared any better. *Therefore, Relativistic Quantum Field Theory has been unable to unify the gravity of General Relativity with the other two forces of nature, namely the strong force, and the electroweak force of the Standard Model, precluding for now our*

hunger and thirst after a propitious Grand Unified Theory (GUT) that unifies all the forces of nature, except gravity. This improbable inclusion of spacetime curvature that is Einstein's gravity into the GUT, is audaciously termed "The Theory of Everything" (TOE); as if human reason could penetrate the very "mind of God" (Nagel).

The cognitive dissonance inherent in our ignorance in this regard, not to mention the irony, is a real cosmic bummer. Something's got to give.

The dreadfully complex mathematics of Superstring/M-Theory (super-symmetric string theory or SUSY) is generally considered our materialist/physicalist current best hope for that next more inclusive theory, a theory that will unify GR gravity with Relativistic Quantum Field Theory (QFT), and it is hoped beyond hope that this shall result in, at best, a logically impossible (Gödel's Incompleteness below) TOE; indeed, the theory consummation devoutly to be wished.

What shall we make of this super-hyped, super hope for supersymmetric unification? Roger Penrose offers sobering advice. "I have found myself totally unconvinced...observations certainly do not provide much support—and probably none at all—for the claims of supersymmetry" (Penrose 2004).

We have seen that M Theory is an attempt to explain all of nature's particles and forces as vibrations of super-symmetric strings about the size of the Planck length (10^{-33} cm), as small as it gets. SUSY explains dark matter because, by hypothesis, every known particle has a cozy heavier super-partner, which, it is hoped would explain all that extra matter in the universe.

Perhaps in 2015 with the refurbished LHC at CERN heavy SUSY super particles will make an appearance. The most proximate threat to SUSY is that such particles stay away in droves. Will this kill SUSY? Not likely. Perhaps it should, but SUSY's fans have too much time and treasure invested to go apostatical so easily. Should SUSY miss the party, they will simply claim that SUSY's super partner particles are too heavy to be revealed, even by the upgraded LHC. And they may be correct. Time, if there is any, will tell.

About Time

Brief ontic excursus. Being is time. Human consciousness is being in time, participating in the vast expanse of all inclusive consciousness/being itself, the unbounded whole in which, or in whom personal consciousness is necessarily instantiated. Such being in time requires presence, a present sentient consciousness. In the absence of consciousness there is no being or time. Being in time is our being here in relationship with the prior unity of the "three times", a personal past, present and future. Being happens only in this present moment now; but being bestows meaning for us only in the fluent context of our past and future. To lose the moment now is to lose reality itself; but to deny our past and future is to lose the *meaning* of reality itself. The three times are one; displayed simultaneously; a perfectly subjective unity. Time is the actual nature of being in the world. Time is not an entity that contains the world. Time arises because being happens. Being is inherently temporal and spacial. Being in time is the

continuity of interdependent, impermanence; change arising in this primordial matrix ground, this vast unbroken whole that is being itself. Change rides the breath of instantiated spacetime embodied consciousness. The direct, luminous, nondual primordial awareness of this great process, moment to moment, is good. The indirect, objective conceptual understanding of this great process is good. The subjective feeling awareness, at the Heart, of this great process is good. These three are always, already an ontic prior unity.

A very brief history of the history of time. The nature of time, the problem and opportunity of time, undergirds all philosophical, quantum and cosmological questions. It is key to resolving the perennial conundrums of ontology—being in the world—and epistemology, knowing that, and knowing about this being. It is key to quantization of the gravity of General Relativity, that is to say, the unification of GR's gravity, the realm of the very large, with Relativistic Quantum Field Theory (QFT), the realm of the very small. As being in spacetime is quantum in nature, a unified quantum understanding of gravity, "Einstein's Dream", is most essential.

Is time observer-dependent, theory-dependent and thus ontologically relative (Bohr, Quine, Smolin, Carroll), or is it observer-independent, theory-independent and absolute, as the purely physicalist ideology of Newtonian Scientific Realism/Materialism would have it to be, (or neither, or both)? Let us then explore the principal physical and philosophical theories on offer to see what benefit to our understanding may arise.

For most recent cosmologists time is subjective and illusory. For Pythagoras, Plato (middle Dialogues), and for Einstein and theorists working with GR toward "Einstein's Dream" of unification—physical spacetime reality is essentially timeless. Here, in opposition to Newton's absolute objective scientific realist view of time and of space, our experience of time is subjective, an illusion. The apparent flow of time, entropy, the thermodynamic arrow of time—past, present, future—are equally real, or equally unreal. Our sense of the now, the present, is but an illusion arising from our ontologically relative, linguistic, inter-subjective culture based reification of an objective separate self over against an objective, observer-independent "real world out there" (RWOT). In short, the proverbial dualist subject-object split is the cognitive cause of the illusion of relative time. How shall we understand this?

The wisdom traditions of our species generally view human beings as having evolved (or as inherently possessing) three aspects of awareness, three modes of cognition: ordinary direct perception, discursive conceptualization, and trans-conceptual or trans-rational noetic-contemplative cognition.

On the accord of the reflexive, ontologically relative middle way *Madhyamaka* (*Prasangika*) Buddhist epistemology—the view of the Two Truths, relative and ultimate—and the nondual *Dzogchen* view that is based upon it, binary, dualistic subject-object conceptual cognition is, unhappily, nearly instantly habitually superimposed upon our natural, pre-conceptual, pristine direct perception (Garfield 2011 on Dōgen's "Being-Time" p. 77).

Because discursive, conceptual cognitive operations are abstractions of this direct perceptual experience, such secondary cognition is, on this view, inherently misleading. We

"miss the mark" or "forget" the essential direct, ultimate ground state of reality—"bare attention" or "naked awareness"—just as it is given now, and mistake this "ultimate truth" for a relative-conventional conceptual abstraction of it. That is to say, we grasp at, reify and concretize the objects of spacetime "relative truth"—scientific objectivity—while ignoring (*avidya*) that all-embracing perfectly subjective "ultimate truth"—the very ground of *That*—in which this all arises and participates.

Can "Science" abandon its objectivist/physicalist bias and consider the unbounded trans-conceptual, nondual prior unity of the appearing duality of objective and subjective cognition? Is not such non-discursive cognition requisite to knowing both the objective and subjective voices of our experience of this great unbounded whole (*mahabindu*) that embraces everything?

As we penetrate this ignorance (*avidya*, *ajanana*, *hamartia*/sin) through trans-conceptual, contemplative cognition, we begin to see the truth of the matter. Here, the separative, destructive duality between a knowing subject and all those "other" objects arising in "being-time" begins to fall away and we can directly perceive the prior unity of the ultimate whole, by whatever scientific or sacred name, that is the ontologically prior ultimate identity of perceiver and perceived; of self and other.

As Nobel laureate Richard Feynman told, "The entire universe is present in a glass of wine, if we look closely enough". If we taste, and see. *We must consider the cosmos/kosmos as if it were utterly empty of any intrinsic material or mental existence in relative-conventional time; as if time were emergent from mind, merely relative to our habitual concept/belief observer-independent measurement systems, including a perceiving consciousness.* Thus will observer-independent, theory-independent materialist/physicalist cosmologies enter in a subtler more inclusive observer-dependent (dependent upon or relative to the consciousness of an observer) noetic (body/mind/spirit) view of time. Thus shall we respond anew to the miracle of our being here (*Dasein*) in this vast inter-subjective reality that transcends yet embraces our ontologically relative inter-objective perceptions and conceptions of space and time.

Human consciousness is historically, culturally steeped in notions of timelessness, even eternity. For Plato, our ideas of goodness, beauty, truth, justice, virtue, mathematical truths (number), indeed, all "universals" or abstract objects are divine, objectively real, *independent* entities abiding in the timeless/changeless realm of his essential "Forms" or "Ideas". We have seen that these Platonic Forms are the metaphysical foundation upon which our prevailing Western Platonic Metaphysical Realism and monistic Scientific Materialism are based. Scientific Realism and its cohort "Common Sense Realism" (Russell's "metaphysics of the stone age") is the unhappy result.

The Forms are today, thanks to Plato, viewed as eternal truths, abiding absolutely, beyond relative conventional time. A late dialogue of Plato, the great *Timaeus*, was to become incorporated into the Neoplatonist, eternalist cosmology of the early Christian Church through the exegesis of St. Augustine (354-430). Herein lies a paradigm case of our profound, if dualistic perennial wisdom Two Truths (relative and ultimate) ontology. Let us then consider

that these necessary Two Truths might be subsumed and embraced in a yet more inclusive, even timeless nondual understanding. More on this below.

Yes, we live and act in relative, conventional time, but our ultimate reality is usually seen to be eternal and timeless. By the lights of Buddhist *Prasangika*, relative conventional phenomenal spacetime reality is *emergent* from this timeless ground. The merely conceptual Two Truths are instantiations this nondual primordial base, source or ground. We live in a sometimes all too "real" physical/mental spacetime reality; yet we conceptually idealize such a timeless perfectly subjective ground as substantial, eternal, and absolutely, independently existing "out there". This is the metaphysic of foundational Realism, both in the East and the West. It is this objectivist knowledge foundation that has been profoundly shaken by the inherent ontological relativity, the reflexive subjectivity of the quantum theory. "All that can be shaken shall be shaken" (Dōgen Zenji).

We may contrast this view of Metaphysical Realism with Eastern and Western philosophical or Metaphysical Idealism; appearing reality is but an unreal merely mental illusion.

It is useful to understand that this duality, this deep cultural background intellectual tension between the two faces of our two cognitive dimensions, these Two Truths—relative and ultimate—of our wisdom traditions are, ultimately, a prior ontic unity. And both of these *concepts* are subsumed by the trans-conceptual, nondual one truth (*aletheia*) that is the vast unbounded whole itself (*mahabindu*). This one all-embracing truth is invariant, and present throughout all cognitive reference frames—outer, conceptual, objective, exoteric; and inner, transconceptual, subjective, esoteric, nondual. On this view, spacetime is *relative* foreground, arising within its *ultimate* timeless deep background, the unbroken whole which is the nondual, trans-conceptual primordial ground of everything, by whatever name. Is it humanly possible to know such a timeless non-conceptual ground? Let's see.

For Einstein, the *ultimate* universe is such a timeless unity. *Relative* time—past, present, future—(the "three times" of Buddhist Mahayana) is but a dimension of space. Following Leibniz, but not Newton, Einstein's time is ontologically relative, that is to say, it is a product of human semiotic linguistic inter-subjectivity. Here time cannot be absolute, nor is it non-existent. Rather, time is relative, dynamic, changing and evolving, and observer-dependent. Although he was an inveterate scientific realist, time is not, for Einstein, as it was for Newton, an absolute observer-independent reality, existing "out there", from its own side.

For Leibnitz (1646-1716), arguably the most subtle Western mind ever, ultimate reality resides not merely objectively in spacetime, but as well in an inter-subjective, interpretive matrix or nexus of relationship, of prior causes and conditions. Newton seems to have missed this great truth of ontological relativity entirely. Such relationship is dynamic and evolutionary. For Leibnitz, unlike Newton, there is no absolutely existing objective time. *Madhyamaka* Buddhists, especially the *Prasangika*, and the Zen tradition's Dōgen would agree. (Visit Dōgen's profound *Uji*, or Being-Time, in *Being the Whole: Toward the Emerging Noetic Revolution*, 2013, p 69, www.davidpaulboaz.org).

Spacetime in Newton, Leibniz and Kant. The philosophical foundations of recent Big Bang cosmology are embedded in the 18th century spacetime notions of Newton, Leibniz and Kant. Let us then unpack this a bit.

At the beginning of the 18th century, the two greatest intellectual giants "ever to adorn the species" (Hume), Leibniz and Newton, with their followers, vigorously debated the nature of space and time (the prodigious Leibniz-Clarke correspondence). Newton defended the "absolutist" or "mathematical" view; Leibniz argued the paradigmatically opposite "relationalist" or, as Leibniz preferred, the "relativist" position. The absolutist view of Newton is a classically realist view. Space and time exist absolutely as observer-independent, theory-independent, particulars, or substances in a "real world out there" (RWOT), even in the absence of spacetime relations among bodies. This view is then substantialist, physicalist/materialist, and objectivist. The relativist view of Leibniz is relational, and observer-dependent, that is, appearing reality is dependent upon and relative to the consciousness of an observer. Space and time do not exist absolutely, as independent substances, but merely through spatiotemporal relationships among material bodies. The relativist view then, is relational, subjectivist, and ontologically relative, and possibly idealist. Enter Kant.

It was in the context of this early debate, and the systematic interpretation of Leibniz' work by Christian Wolff, that Kant (1724-1804) developed his view of space and time as it appears in his *The Critique of Pure Reason* (1781; 2nd ed., 1789), arguably the most influential philosophical treatise ever written. Kant was, in his "pre-critical period" (pre-*Critique*), disposed to Leibniz' relativist understanding; but by 1770 he had changed his mind. In the *Inaugural Dissertation* (1770) Kant states:

Space is not objectively real, nor a substance, nor an accident, nor a relation; instead it is subjective and ideal, and originates from the mind's nature in accord with a stable law as a schema for coordinating everything sensed externally (Ak 2: 403).

Clearly, Kant accepts neither Newton's objectivist proto-Scientific Realism and Materialism, nor Leibniz' quasi-subjectivist ontological relativity. For ten years Kant prepared this argument that appeared in his "first *Critique*" (*The Critique of Pure Reason*): that space and time, and everything that arises therein "belong only to the form of the intuition, and therefore to the subjective constitution of our mind..." (B 37-38). In other words, Kant believed that human "intuition" could provide a priori knowledge, supported by God; and human beings can attain such a priori knowledge of space and time only because these forms are naturally imprinted by the mind upon our experience. Space and time are a subjectively based "schema", "a constant law from the nature of mind, for the coordinating of all outer sensa..." (*The Dissertation*). For Kant, our experience of space and time is as basic as is our experience of cause and effect.

Modernist 18th and 19th century space and time bespeak the Kantian duality between things as they appear to the senses (phenomena), and things in themselves (noumena). For

Kant we can have no direct knowledge of the transcendent noumenal world. And our experiences of the phenomenal world are *constructions* of the mind (Kantian Constructivism). Stephen Hawking's new Model Dependent Realism (MDR) is a recent example of constructivism in physics, and philosophy of physics, notwithstanding Hawking's (*The Grand Design* 2010). Here, we cannot know reality in itself, but only a schema as it appears in our various models.

Paul Dirac, who unified the quantum theory with Einstein's Special Relativity (Relativistic Quantum Field Theory or QFT), agreed with Einstein and Leibniz: "At the beginning of time the laws of nature were probably very different from what they are now. Thus we should consider the laws of nature as continually changing with the epoch."

Richard Feynman tells us that the laws of physics are relative, evolutionary and historical. The cosmos is "a vast space of possible laws". This relative view appears to contradict Einstein's first postulate of his Theory of Special Relativity, namely that the laws of physics obtain everywhere, in all reference frames.

On the accord of relativist Lee Smolin, "The laws of nature emerge from inside the universe and evolve in time with the universe they describe" (*Time Reborn*, 2013, p.xxvi). For him, time and space are real, objective, and emergent from a more fundamental strata of nature that is timeless. This is another cosmological example of our wisdom tradition's Two Truths, that is, the ontic duality of relative, conventional spacetime phenomena, and the timeless, ultimate primordial ground in which it all arises and participates.

Smolin's "Loop Quantum Gravity" rehash of Einstein's GR is a reconfiguration of Julian Barbour's "shape dynamics". Smolin rejects mainstream physics' cosmological "block universe" wherein past, present and future are equally real. The reality of past (memories) and future (predictions) lies only in their cognitive artifacts now present to human consciousness. "All that exists is this present moment". Yet, with Dōgen, this moment now must surely be arrayed in a "being-time" context that includes the perennial "three times" of past, present and future.

For Newton the universe of energy and matter is constituted of separate, objectively real point-like particles whose motion and interactions are governed by the timeless, eternal laws of mathematics. Time and space are not relative, but absolute. The bad news for Newton's view? As Lee Smolin pointed out (*Time Reborn*, 2013), in Newtonian mechanics there is no "clock" in the system by which to *measure* relative time changes. Einstein added context and clocks. Now a very brief excursus into Buddhist phenomenology of time.

Dōgen's Being-time. Dōgen, perhaps Japan's greatest zen master, spoke of this arising, emerging dimension of relative time and its contents (relative truth) as "a being-time moment flashing into existence" from the vast spacious expanse of the nondual non-logocentric primordial emptiness (*shunyata*) base or ground that is being itself. This "ultimate truth" or unbounded whole is nothing less than his *Ugi*, or Being-Time. Dōgen's *Ugi* is the here now, always already present unity of the Buddhist *Madhyamaka* "three times"—past, present, future. So there is no beginning, and no end to this vast expanse of reality itself. The dimension of spacetime Relative Truth, including us, instantiates this vast primordial "groundless ground"

of everything that arises and appears to sentient consciousness. Yes, we are luminous primordial awareness instantiations of *That*. Human consciousness intends that.

As we saw above, for Dōgen (and Padmasambhava), the eternal present exists for us only relative to a past and a future. Being-Time (*Ugi*) is a simultaneous array of all three. Thus we live in a single vanishing moment now. Yet, this precious moment derives its meaning from the inter-subjective context of a personal and even collective past, and of a future. This momentous moment now is significant because all of our past and future are interdependently, causally enfolded within it, yet always unfolding in the continuum of now. Yes, we live in the moment, but not only in the moment. To live only in the moment now, with no awareness of past and future (karma) is to "make our life meaningless". Not to live in the moment now, is "to lose all of reality itself". Philosophers of physics and cosmology, if not physicists and cosmologists, are now rediscovering *kosmic* being time in Dōgen Zenji.

Dōgen's great insight is that prior to the superimposition and intervention of conceptual cognition, ordinary direct perception bestows the inherent (*sahaja*), immediate, luminous, "primordially pure" nonlocal, nondual nature of mind, the ultimate ground of all of our relative conventional experience. Here, the epistemic bane of subject/object separation, and conceptual reification have not yet occurred in the causal phenomenal cognitive chain. Immediate perception, a moment prior to conception, is pure perception. And we all do this, all the time, with every perception! Wonder of wonders, we are all "primordially awakened" (*bodhi*, *vidya*) to this always "already accomplished" innate and perfect clearlight mind. That is our actual "supreme identity". The rub? We must recognize, then realize this great truth. As H.H. The Dalai Lama told, "The clearlight mind which lies dormant in human beings is the great hope of humankind".

Hence, there is always, through all of our cognitive states—perceptual, conceptual, emotional, and trans-conceptual contemplative—an ontic prior unity of past, present, future, always now. We can be present to the nondual *presence* of That. And yes it takes a little transpersonal mindfulness (*shamata*) or contemplative practice. As the Buddha told: let physicists, cosmologists and philosophers "come and see".

Time and the Big Bang. The 20th century curved spacetime gravity of Einstein's General Relativity resulted in the view (George Gamow 1946) that time and the cosmos began at the purported Big Bang singularity. All too briefly: Catholic priest Georges Lemaître, first to propose the "primeval atom" (1927) that was to become Gamow's Big Bang, and Alexander Friedman, mentor to Gamow, and author of the three Friedman universes and the marvelous Friedman equation (1922) both proved that Hubble's (1929) expanding universe was consistent with Einstein's original, pre-cosmological constant Λ GR field equations. Einstein rejected this, not on mathematical grounds, but on ideological grounds. He was perhaps ensnared in the 400 year old web of belief ethos, the creation myth of the day, that the universe is a static "firmament", just as the Bible tells. (Such a "confirmation bias" [Peter Wilson] is an aspect of the spooky "*Einstellung* Effect", our counter-productive cognitive predilection to use habit and bias to solve a problem when a more effective strategy can be shown to exist.)

Cosmological models have their antecedents in a culture's creation mythology. We have seen that a cultural "web of belief" (Quine), West or East, requires a cosmogony and a cosmology to explain and understand its world view, and its place in time. The reality that a culture presumes to describe is embedded in and arises from its preconscious primordial cultural system of concepts and beliefs. Thus our cosmologies are ontologically relative. And science is a product of culture. Cosmology may be seen as the cultural "mask of God", or the map of consciousness through which we view and experience both relative and ultimate reality (Kuhn 1961).

Subjective, deep background culture creates objective time. The Stoics, Hindus, Buddhists, Taoists, and many indigenous cultures have created cyclic cosmologies in which time and *kosmos* participate in an infinite cycle, an endless periodicity of creation and destruction with no first cause, and no final end. Our Big Bang/Big Crunch scenario is such a cosmology. Here, if the cosmological constant is zero ($\Lambda=0$), and mass-energy exceeds the critical density value of the universe ($\Omega>1$) gravity will eventually halt cosmic inflation/expansion and contract into a "Big Crunch", in an endless cycle. Multiverse theory is also cyclic. Humanity's views of *kosmos*, it would seem, favor this periodicity—this eternal descending and ascending explanatory archetype.

Entropy and the thermodynamic arrow of time. In 1919 British astronomer/astrophysist Arthur Eddington, in 1919 offered early empirical evidence (whose results are now controversial) that massive bodies bend light, an ostensible proof of Einstein's General Relativity theory of 1915.

In 1927 Eddington introduced us to the notion of time asymmetry, the one-way *arrow of time*. We can remember the past, but not the future. Our epistemic access to the future is logically precluded. A broken egg cannot be unbroken. Causes precede effects, which suggests that the arrow of time is a logically necessary condition of relative-conventional spacetime reality. For Eddington, the arrow of time is a property of, or must be explained only by entropy, the second law of thermodynamics. This is still the view of cosmologists today.

Why does time have this forward direction? Because of entropy. Let's unpack this a bit. Since Newton, the laws of physics at the *microscopic* dimension of elementary particles are reversible. Newton's great revelation was that the laws of nature, the laws of psychics do not have a privileged direction in time; indeed they have no direction; no past or future. The basic laws of physics do not recognize past or future. Yet, at the *macroscopic* level of spacetime reality—molecular to galactic—we have a one-way directional arrow of time. And unlike the microcosmic reality, it is irreversible! This macrocosmic arrow of time, and its entropic cause is *the* fundamental business for physics and cosmology. To wit, why is the entropy of the very early universe so low? Why is the cosmos accelerating? Why is the value of Λ absurdly low? How do we resolve the hierarchy problem? No one knows.

But time itself is not the arrow. The arrow of time is the motion of matter—particles and galaxies—moving in/through time. It is the mechanics (motion) of matter—and our

consciousness of this stuff—that must be understood. This evolution of matter in time is called—entropy.

So, macroscopically, time only moves or "flows" in a forward direction. This is enforced by the relativity laws. Time is the fourth dimension of our physical universe. There are three dimensions of space (north/south, east/west, and up/down), and one dimension of time. These four relative dimensions are a dynamical unity. Looking out in space, we necessarily look back in time (due to c , the velocity of light). Moreover, if Bob and Alice are in motion relative to one another at near the light speed limit, they will not agree on the simultaneity of events, e.g. "What time is it"?

So, why does time have an arrow? It is due to ever increasing entropy as described by Boltzmann's statistical "law" of entropy. Entropy increase is the forward direction of time's arrow. Entropy is the cause of the arrow of time; that we remember the past and not the future. *Entropy is the measure of the disorder or randomness of a closed or isolated system as a function of time.* A "closed system" precludes the flow of matter and energy from the system, e.g. the universe. Thus an unbroken egg has low entropy. It is highly ordered. A broken egg has higher entropy; it is more disordered. A scrambled egg has higher entropy yet. The universe began as an extremely low entropy, highly ordered Big Bang state. Presently it is in a medium entropy state. In 100 billion years, if the dark energy value remains constant, most galaxy clusters will have moved beyond our horizon, space and its contents will continue to expand away from one another, and this universe will abide in a very high entropy state. Hence, time is asymmetrical in an isolated system. For example, as the universe evolves through time it becomes more disordered, moving from a low entropy past to a high entropy future.

Again, this entropy increase in the direction of the future is known to physicists as the *second law of thermodynamics*, first discovered by Carnot, expanded by Clausius, and formalized by Ludwig Boltzmann (1844-1906) in his famous statistical "law" $S=k \cdot \log W$, which appeared upon his tombstone. (The first law of thermodynamics you will no doubt recall from high school physics is the conservation of energy; energy is always conserved, but may change states or forms.) The second law was established in its current form by Max Planck in 1900.

Why does entropy only increase (or stay the same)? Why can entropy not decrease? Simply because there are so many more ways for entropy to increase, to be high entropy states. Why is entropy higher today? Because it was lower yesterday; and the day before, all the way back to the primordial Big Bang state. Or before, on the account of multiverse theorists. A nice unsatisfactory circular definition, to be sure.

This thermodynamic arrow of time (entropic time) seems to be the source of several related time arrows: 1) *The Cosmological Arrow of Time* (cosmological time) wherein the universe is presently expanding toward an ultimate "heat death" or "Big Chill", in short thermodynamic equilibrium or ultimate high entropy as space expands and dissipates its energy. Or conversely, this arrow could reverse ending in a "Big Crunch". By the by, there is no violation of any law of physics should entropy mysteriously decrease; but stochastically it seems quite unlikely.

2) *The Causal Arrow of Time* wherein causes precede their effects. Simple enough. Yet Hume has demonstrated that we cannot objectively apprehend the causal relation as it is merely "an association of ideas", a mental projection. The apparent causal connection between two events is cognition of which we can have no direct impression or idea, but is rather a psychological projection on to events of our "habit of the mind" that assumes that one event follows another. This imagination, and the self-sense from whence it springs are essentially illusory and fictional. Causality cannot be proven. Yet we all take it for granted. Humean ontologically relative radical empiricism indeed. *Madhyamaka* Buddhists should enjoy reading Hume.

Be that as it may, Shakyamuni, the historical Buddha told, "*What you are is what you have been; what you will be is what you do now*". Our actions—positive or negative—cause corresponding effects that we experience in a future now. This very real, non-imaginary law of cause and effect, the inexorable law of karma, is all too real. Perhaps we might here establish a new behavioral causal arrow, the *Karmic Arrow of Time*.

3) *The Psychological Arrow of Time, or memory* (psychological time) wherein our mental perception of time flows from past, which we may remember, to future, which we cannot remember. As yet, this obvious fact of cognitive life has not been epistemically linked to that mother of all time arrows, the thermodynamic arrow of time, or entropy. Philosophers of physics and cosmology are working on it. At this stage it does seem that these two arrows, memory and entropy must always, somehow be aligned.

Stephen Hawking has reduced the arrows of time to three: Psychological time; entropic time; cosmological time. For him they are essentially the same.

Philosophy of Time: Eternalism and Presentism.

The Big Bang Bangs

Now thickening our historical plot, in 1929 former high school basketball star, then coach, and later Oxford lawyer and scholar of Spanish literature Edwin Hubble demonstrated (after a doctorate in astrophysics) that our observable universe is indeed expanding, as if from a great explosion. He was assisted in this by former mule team driver and observatory janitor turned professional astronomer, Milton Humason.

Belgian priest Georg Lemaitre was first to posit the "primeval atom" which was the as yet unnamed Big Bang expansion. He was also first to derive what would become known as Hubble's Constant, and Hubble's Law, published in 1927, two years before Hubble's 1929 discovery. Einstein and Eddington were skeptical.

Lemaitre's thought experiment: a conscious observer might conceptually reverse this primordial cosmic expansion by receding backward upon the entropic thermodynamic arrow of time 13.77 billion years or so to the ostensibly objective, proto-theistic first cause of everything, the as yet utterly unexplained ultra low entropy big bang singularity. Later a hypothesized instantaneous (10^{-35} sec) inflationary epoch (first proposed in 1980 by Alan Guth as the "ultimate free lunch") was added. Such metaphysical conjecture is based upon Hubble's

well confirmed observations of the Doppler redshifts of receding galaxies (Hubble's Constant H). By Hubble's Law this redshift (z) velocity is proportional to the distance to any given galaxy. Hubble's Constant H is the proportionality of that velocity ($H=68$ km/sec per megaparsec, Planck Feb. 2015 release).

So, given the usual cosmological assumptions of cosmic *homogeneity* (uniform density that is the same at any universal reference point) and *isotropy* (the universe appears the same in any direction to any observer), GR predicts that at a time less than H^{-1} the universe of our current conceptions was in a most paradoxical singular physical state: matter density and spacetime curvature (gravity) are infinite—the separation between all matter points in space is zero; the spacetime manifold/metric now contracted to zero! Time is zero ($t=0$). Then, somehow, our knowledge here is empirically and logically precluded as all theory breaks down—**Kaboom!**—genesis, the mathematical singularity in which universal density, temperature, and spacetime curvature are infinite; *stuff* arises from the primordial face of the Deep! (See Timeline below.)

"*Let there be light*". About three minutes after this utterly mystical *ex nihilo* Big Bang singularity arises Big Bang "primordial nucleosynthesis", discovered by George Gamow in 1948. Here, from a quark/gluon plasma of proto-particles emerges the hydrogen and helium that are to become stars; and a mere 340,000 years later, *recombination* or *photon decoupling* from these hydrogen matter particles permits photons/light to travel freely throughout the cosmos. *Vidya, Fiat Lux*: Let there be light! Thus was our much beloved relic cosmic microwave background radiation (CMB)—predicted by Gamow and his grad student Ralph Alpher, and then discovered, quite by accident, in 1965 by Penzias and Wilson of Bell Labs—imprinted upon the heavens for later cosmological consciousness to ponder.

So, from such early quantum density perturbations of this primordial stuff evolved baryonic (protons and neutrons) ordinary matter, stars, their death as supernovae; and from that the star stuff that we are, namely, carbon 12, and the heavier elements.

Then about 9 billion years later, or 4.57 billion years ago, a smallish star in a suburban arm of a smallish spiral galaxy in a nondescript galaxy cluster was born. Its spindrift created a system of planets, one of which was serendipitously located in a "goldilocks zone", evolved life, consciousness, then self-consciousness that asks impudent "why" questions, then, if we're lucky, enlightened consciousness that asks proper "who" questions complete with self-reflexive answers as to just "who is it" that we actually are; and now, what to do with such fabulous fine-tuned good fortune.

Alas, about a billion years hence this little star, our sun, its nuclear fuel nearly spent, begins its evolutionary process toward becoming a red giant. Now the pretty blue planet we have come to know and love as earth no longer supports carbon based physical consciousness systems. (Note that the *physical* non-inhabitability of this planet does not logically or empirically preclude alternative consciousness strategies that may have evolved over that next billion years of earth time.) During the following four billion years this red giant star will

utterly embrace our spaceship mother earth. Very like in the beginning. Perhaps, some sunny day, we beings of the three times shall all together shine with it.

What banged, and what happened before it banged? The first few moments of this fabulous, empirically impossible *ex nihilo* singularity are logically, mathematically beyond the *objective* cognitive reach of Standard Model Concordance Theory mathematics; or any other conceptual process for that matter. Indeed, it is beyond the semiotic structure—logical syntax, semantics and pragmatics—of language. This singularity is, *in principle*, objectively unknowable. But is it subjectively unknowable? We shall see that such conceptually ungraspable phenomena are not altogether unknowable to highly evolved, yet human contemplative mind.

Yes, that first minute is highly conjectural. And the cold Big Bang state at the instant of "chaotic inflation", about 10^{-35} sec before the much beloved hot Bib Bang, is even more speculative. But we must never let that deter us from the inherent objective/subjective knowing unity that abides ever present in the data. As Freud's master Charcot told, "See the data again, and again, until they themselves begin to speak".

We have seen that in the first minute the one billion degree Kelvin temperature precluded the formation of atomic nuclei. A quark/gluon plasma of unconstrained protons and neutrons was all that existed. In the first two minutes things cooled down a bit and nuclei of the light elements—deuterium (heavy hydrogen), helium and lithium—begin to form. Much to the chagrin of Gamow, (he predicted heavy element synthesis here) the heavier elements—carbon, oxygen, nitrogen, iron—the earth elements that form planets and people, came much later, in the nuclear fusion of stars that become supernova that ultimately explode such star stuff into nearly empty interstellar space, that it may perforce, abide in the same empty space that pervades the consciousness of sentient, even self conscious beings, like us.

Anisotropies, minute fluctuations in CMB temperature, discovered by the COBE satellite in 1992 and mapped by WMAP in 2002 through 2010, then the ESA Planck Probe in 2013, 2014, 2015 arise from quantum perturbations in energy density that were to become the seeds of the large scale galactic structure of the universe. In due course, measurement of the CMB led to a prediction of the total energy density of the universe. These predictions seemed to agree with the Λ CDM Concordance Model providing further evidence for mysterious non-baryonic dark matter, as we have seen.

Nucleosynthesis also provides support for General Relativity, and dark matter by revealing an accurate account of baryonic (protons and neutrons) matter in our visible universe. There's not enough to account for all the matter that we know is there, thus supporting the dark matter hypothesis.

Big Bang Cosmology Timeline

The Planck Era: 10^{-43} sec.; size 10^{-30} ; temperature 10^{32} . Quantum gravity era ($t=0$), if there is any (t). Observation and knowledge is here precluded as all physical theory breaks down at this smallest dimensional scale. Spacetime (gravity) assumes its quantum face. Thus arises our

(much later) need for a quantum theory of gravity. Dimensional compactification occurs spawning the laws of physics of this universe for later anthropocentric metaphysical consciousness to ponder. A purely metaphysical dimension.

GUT Transition Era: 10^{-36} sec; the strong force separates from the electroweak force.

The Inflation Era (cold Big Bang): 10^{-35} sec; size 10^{-26} ; temperature 10^{28} Kelvin; Hubble radius about 10^{-28} m. The scalar quantum inflaton field arises. Highly speculative cold Big Bang supra-luminal accelerated expansion of non-zero vacuum energy, or dark super-energy that drives this bizarre exponential accelerating expansion. Should inflation actually exist, and it's now a favorite among cosmologists as we explore the CMB, it explains cold to hot "reheating" (10^{-34} sec), and answers several of the hot Big Bang Problems listed below, to wit, the Flatness Problem, the Horizon Problem, the Monopole Problem, and the Large Scale Structure Problem. Herein quantum fluctuations become the seeds of cosmic clumpyness that were to become the large scale structure of the universe. This apparently theoretically necessary inflaton field and its particle remain a complete mystery.

Moreover, inflation predicts prior and future universes, i.e., the multiverse. At the Planck scale quantum foam, utterly random quantum fluctuations are seeds that produce an infinity of instantly propagating inflationary universes. Wow! What hath God wrought?!

Reheating (hot Big Bang): 10^{-34} sec; As inflation ends, vacuum energy becomes mass energy expanding to eventually fill the universe with structure.

Electroweak Phase Transition: 10^{-12} sec.; size 10^{-15} ; temperature 10^{15} Kelvin. Electroweak symmetry is broken; weak and electromagnetic forces separate. All particles become massive by way of the Higgs mechanism and the Higgs field.

Quark-gluon Phase Transition (quark-gluon plasma): 10^{-34} sec to 10^{-6} sec; size 10^{-12} ; temperature 10^{12} . Quarks and gluons become unified in protons and neutrons. All particles are now present in this "particle desert".

Quark Confinement: 10^{-5} sec: Lowered temperature and density permit quarks to bind together into hadrons, ending quark-gluon plasma, thus beginning the Hadron and Lepton Eras.

Primordial Nucleosynthesis: 2-5 min; size 10^9 ; temperature 10^9 . Temperature has now cooled enough to permit protons and neutrons to form nuclei of the light elements, deuterium (heavy hydrogen), helium, lithium and tritium.

Recombination/photon decoupling, the "time of last scattering"; cosmic microwave background radiation (CMB): 380 Kyr; size 10^{-3} ; temperature 3×10^3 . Free electrons combine with nuclei to create atoms. The cosmos becomes transparent allowing photons to travel freely throughout space. Atomic matter begins clumping into dark matter, seeding future large scale galactic structure. Photon radiation photo-luminously outpictures itself as this 380,000 year old CMB radiation, whose minute anisotropies (temperature fluctuations) have revealed, through 25 years of satellite mapping probes (COBE, WMAP, ESA's Planck), the essential cosmic inventory and age of the universe. ESA Planck Probe (2015 release) has shown, through analysis of the CMB *angular power spectrum*, this cosmic recipe to be: dark energy 68.3 percent;

dark matter 26.8 percent; ordinary baryonic matter 4.9 percent; age of the universe 13.77 billion years.

The Dark Age: 5-200 Myr; size 10^{-1} ; temperature 30 Kelvin. Tiny initial quantum perturbations in matter density finally form atomic gas which becomes dark matter clumps, which then begin gravitational collapse into the first stars, which form galaxies and large scale galactic structure—boom, just like that.

The first stars then, are constituted of primordial atomic gas, hydrogen and helium. They are massive, therefore their lives are hot and brief (1-4 Myr) terminating in massive supernova explosions. Later supernovae free the heavier elements—carbon, oxygen, nitrogen, iron—for future use in planets, and sentient beings who evolve dualistic subject/object consciousness to inquire as to how this all arises. In due course, early star groups emerge to spawn infant galaxies. Increased production of these heavy elements stabilizes later stars by reducing their mass and luminosity, thereby increasing longevity.

Reionization Era: 200-800 Myr; Neutral hydrogen and helium are ionized by radiation from early proto-galactic star groups.

Acceleration Era: 7 Byr; hot Big Bang state cosmic expansion slows, then most mysteriously becomes accelerating expansion, discovered in 1998 through observations of type Ia supernovae; and due perhaps, to dark energy, the cosmological constant Λ , the vacuum energy itself? Or due perhaps to a dynamic Quintessence.

Spiral Galaxies Form: 5-8 Byr; true spiral and disk galaxies augment the stellar inventory of earlier elliptical galaxies. At 8-9 Byr atomic and dark matter density equilibrate with expanding dark energy.

The Solar System: 9 Byr; size 0.5; temperature 6 Kelvin. Our sun is a second generation star. From previously existing heavy elements it formed with its planets about 4.6 billion years ago. The total age of the present universe is about 13.77 billion years.

The Present Universe: 13.77 Byr; size 1; temperature 2.74 Kelvin. Over 100 billion galaxies, each containing at least 100 billion stars now inhabits the known observable, visible universe. The entire universe—that beyond our visible and causal horizon—is very much larger. Astonishingly, this visible universe is but a small part of the total universe, most of which lies beyond our visible, causal horizon; and which is, on the account of multiverse theory, but one in an infinite ensemble of universes. Chaotic and eternal inflation support such a multiverse notion which is fast becoming cosmological orthodoxy. Goodbye creation *ex nihilo* problem.

Mergence of Andromeda (M31) and Milky Way galaxies: +3-4 Byr.

The Sun Dies: +5 Byr; As our sun depletes its finite hydrogen and helium nuclear fuel it becomes a red giant consuming earth's atmosphere and surface. It then explodes its own atmosphere, with its planetary system; ultimately to become a lifeless white dwarf. However, we must not be downcast at the prospect of this sad ending. There are more things in heaven and earth than are dreamt of in our materialist philosophies. Thus does intelligence, in due course, free itself from mere physical embodiment.

Large Scale Structure Development Ends: +20 Byr; Accelerating expansion of dark energy reduces density, precluding further growth of galaxies.

The Last Stars Die: +1000 Byr (1 trillion years). Our timeline fantasy concludes. Fine. Primordial emptiness again. Perhaps form, even life, even self-conscious life—whether physical, mental, or pure intelligence, abides in other universes in this infinite vast expanse, the unbounded whole (*mahabindu*) that is reality being itself. Or perhaps not.

Explore Hindu and Buddhist cosmology to discover a subtler reality dimension that abides beyond the "scientific", merely physical, *objective* cosmos. Let us venture in the brave new world of the *subjective kosmos* reality dimensions of this great unbounded whole (*mahabindu*) that transcends, yet embraces our outer, exoteric understanding.

Following physics' rude metaphysical awakening to the inherently subjective nature of reality—the pure metaphysical speculations of hitherto "scientific" relativistic quantum field theory, pre-Big Bang multiverse theory, post-Big Bang, post-empirical string/M Theory, dark energy, and the rest—we shall not suffer this loss of idyllic pure reason morbidly. Far from it. We have always known, in spite of our rather obsessive pre-conscious deep cultural background modern-enlightenment realist/materialist "web of belief", that our protean human consciousness is constituted by two voices, objective and subjective, at once. Our human condition is to strike a plural, holistic body/mind/spirit cognitive balance. Is it not?

Wow! Our *ex nihilo* Big Bang creation story is here created for all to praise. Glory Be, and long live Fred Hoyle's (he named it) inflated, inflationary Big Bang. But the "how" and "who" questions remain unanswered (but not unanswerable). *Standard Model Λ CDM big bang cosmology cannot explain its creation myth.* Let us then more deeply explore scientific explanation in cosmology.

Here we might consider the often adroitly dodged child's question, e.g. "this is an inappropriate question"; or "this question makes no sense", etc. That simple and obvious question is of course, "What happened before the Big Bang"; precisely what banged, how, when and where? Enter stage left, an occult, trans-empirical all-embracing *multiverse*, and variations on this recent urgent cosmological theme. The Big Bang that we have come to know and love has an inherent series of most vexing theoretical and mathematical challenges that have incited most cosmologists, and philosophers of cosmology and physics to move forward into that next more inclusive theory, namely the spooky, "post-empirical", many-bang multiverse. More on this below.

A New Scientific Revolution Emerges from the Big Bang

We are now entering the next scientific-cultural revolution of our species. The Copernican Revolution gave rise to the Newtonian Revolution, which begat the Quantum/Relativistic Revolution, which is now opening into the post Standard Model, post-quantum Noetic Revolution. Each revolution portends a major cognitive "paradigm shift" in science, culture and religion/spirituality.

The "old paradigm" physics Standard Model of particles and forces, with its cosmological counterpart, Λ CDM (lambda cold dark matter) Standard Model of Cosmology (Big Bang cosmology) has been unable to explain, or explain away 95 percent of the inventory of the present universe! It's a bit anomalous, to say the least, that the 5 percent matter/energy that comprises all of this visible universe, including us, should be made of something entirely different than 95 percent of the rest of the universe! This represents a "naturalness problem" par excellence. That such a belief is now Standard Model orthodoxy bespeaks volumes as to the ignorance of this receding "normal science" knowledge paradigm. Nor has "normal science" explained or resolved the "anomalies" around the accelerating universe, i.e., the cosmological constant Λ /dark energy conundrum; much less the quantum gravity problem. And there are many more.

The current evolution of this Kuhnian (Thomas Kuhn, *The Structure of Scientific Revolutions*, 1961) scientific revolution has however, been hindered by a big money, big science political defense of old paradigm "empirical" Standard Model Λ CDM Big Bang orthodoxy. Funding and academic tenure are quite problematic for non-subscribers to this old paradigm orthodoxy. On Thomas Kuhn's accord, the passage in time of several generations is required for completion of such a knowledge "paradigm shift". The old guard must expire as the new true believers gain academic tenure (Kuhn 1961). Kuhn likens this collective cognitive shift to a religious conversion.

Problems with current Big Bang cosmology: 1) the *Horizon Problem*: widely separated regions of space look much the same, yet are too distant to permit a causal connection, a light signal to pass between them. So how do they "know" to have the same temperature? Opposite sides of the universe have never been close enough together to thermally equilibrate. How could the universe have begun with precisely the same temperature everywhere? Two regions of space separated by billions of years cannot have had causal "thermal contact". So why do they have the same temperature now? Any two "spacelike" separated regions are beyond one another's causal horizon that is the finite light speed limit. In a universe with a finite age, no causal signal can exceed the velocity of light. What to do?

We've seen that in the early 1980's an *ad hoc* Cosmic Inflation Theory (Guth 1981) was proffered to explain the horizon conundrum. Here, femto-seconds after the purported Big Bang, the universe expanded exponentially, at superluminal velocity (faster than light) such that the causal (particle) horizon of hitherto spacelike separated regions of space are now within one another's causal horizon. This solves several of the Big Bang problems, including the Horizon Problem. Inflation is still a hotly debated, highly speculative hypothesis, thirty-five years later.

2) the *Flatness Problem*: the observed spacetime geometry of the universe is nearly flat, an extremely remote and improbable result of Big Bang evolution theory. The initial conditions of the universe would have to have been ridiculously fine-tuned. How did the initial density of the universe become today's flat universe? The universe should not exist. Why is the geometry of the universe so flat, that is to say, why is the observed (actual) energy density nearly, but

not exactly equivalent to the critical density? This is the "fine-tuning problem" that is omnipresent throughout these many Big Bang problems.

We've seen that this present universe has three possible geometries in accordance with its energy density: Its curvature may be positive (spherical), a closed universe; negative (hyperbolic or saddle shaped), or flat (near zero curvature).

The actual geometry of the universe is a function of the cosmological density parameter Ω , the ratio of the observed density ρ to the critical density ρ_c . Remember that the critical density is the density required for a flat universe, which seems to be the case based on CMB interpretations. The relation of the observed density to the this critical density determines the spacetime geometry of the universe, and the ultimate fate of the universe; contraction or expansion. If Ω is less than the critical density, curvature is negative ($\Omega < 1$) ; if Ω is greater than the critical density, curvature is positive ($\Omega > 1$) ; if Ω is zero, the universe is flat ($\Omega = 1$), or near zero spacetime curvature.

The problem: any variation from critical density increases as the universe expands over time. In 13.77 billion years of expansion, or even accelerated expansion, the universe should have by now expired in a Big Chill, or even a Big Rip, precluding the existence of self-conscious observers who ask such impudent questions. Current Big Bang cosmogenesis fails to explain why Ω is so nearly 1, yet not precisely 1. Once again, Inflation Theory comes to the rescue; inflation must have flattened the universe to precisely its current critical density. Inflation has its boosters, and its detractors.

3) the *Smoothness Problem*: The cosmic microwave background radiation (CMB) is ostensibly the cosmic radiation relic of the early universe, during recombination at about 380,000 years old. It is almost perfectly isotropic or uniform, that is, it's very smooth or homogeneous. However, the present universe is not smooth but clumpy. Matter is deposited into stars, galaxies and great walls of globular clusters and super clusters containing billions of galaxies and trillions of stars, all of this distributed throughout vast nearly empty voids of space. Clumpy indeed. But how did this "large structure" arise from such a smooth early universe? Where are the primordial "seeds" of creation? Collisionless non-interacting or weakly interacting cold dark matter would appear to be a good candidate. It could have evolved into clumps attracting ordinary baryonic matter that eventually became stars and galaxies. Moreover, 1998 observations of type Ia supernovae demonstrated that about 7 billion years ago, no one has a clue how, the expanding universe, exceeding the contracting force of gravity, began to accelerate. Dark energy is the hypothesized cause. No one knows what dark energy, or dark matter might be.

In order to explain this inhomogeneous large scale cosmic structure cosmologists have proposed that the distribution of matter in the early universe could not have been smooth or homogeneous. Regions of space that were slightly more dense gravitationally attracted more and more matter resulting ultimately in the clumpy large scale structure of the present universe.

Again, the problem arises through the highly improbable, essentially inexplicable fine tuning between early cosmic homogeneous smoothness and present inhomogeneity. Such inhomogeneities should be evident in the CMB as minute temperature variations. In 1974 NASA's Cosmic Background Explorer (COBE) failed to detect any such statistically significant variations. WMAP's final release in 2013, revealed, after some data and theory tweaking, that very subtle temperature fluctuation imprints in the CMB may have occurred when the universe was about 370,000 years old. Then the recent high resolution Planck probe release in 2013 and again in December 2014 reveals that anisotropic temperature fluctuations in the CMB do not entirely agree with those of Big Bang Standard Model physics.

This latest Planck release, 2014, gives a new value for Hubble's constant, (the Hubble parameter), which quantifies the rate of the universe's expansion. That rate is now measured at 67.3 kilometers per second per megaparsec. The previous rate was 71 (km/s)/Mpc, based on the 1998 observations of type Ia supernovae. Does any of this data save us from the Smoothness Problem? Again, time, if there is any, will tell.

4) the *Monopole Problem*: Elementary particle theory predicts that in the extreme GUT environs of the very early universe, where the electromagnetic, strong and weak interactions or forces were unified in a single "Grand Unified" force, many extremely massive particles called magnetic monopoles should have been created. Yet, there is no evidence whatsoever of such monopole particles, then or now. Where are they? Of course, inflation makes it all OK.

5) the *Antimatter Problem*, or baryon asymmetry: Baryons are composite, quark based protons and neutrons that comprise ordinary visible matter, each with its own antiparticle. At the Big Bang singularity matter and antimatter were, by hypothesis, equally distributed. So where is all the antimatter today? A proposed remedy, baryogenesis, it is now generally agreed, does not provide a tenable explanation for such baryon asymmetry.

6) the *Large Structure (galaxy clusters) Problem (the Age Problem)*: The 1994 and 1998 discoveries that the universe is expanding at an accelerated rate makes some globular galaxy clusters older than the universe. These clusters are observed to be 14 to 15 billion years old. The estimated age of the universe is 13.77 billion years old (ESA Planck data 2014). Since no structure in the universe can be older than its Big Bang creation event, there arises an apparent inconsistency. More Big Bang theory tweaking is needed here.

7) *The Singularity Problem* is the fundamental logical unnaturalness of Concordance Λ CDM Standard Model Cosmology. This Kuhnian (Thomas Kuhn *The Structure of Scientific Revolutions* 1961) "anomaly" is nearly entirely ignored, or denied. Non-orthodox cosmology alternatives are ignored or ridiculed. Funding for study is non-existent. This is the unscientific culture of science at its worst; the result of a theme of "normal science" run its course. This logically impossible singularity is the sub-textual concern, the "exemplar" for the "paradigm shift" that is the "crisis" in the "normal science" of Standard Model Cosmology, as we saw above. This conundrum is the foundation of the "scientific revolution" in physics and cosmology that is now upon us. Old paradigm cosmology is suddenly yielding to Post-

Concordance Model science, namely GR tweaks, e.g. supersymmetry, superstring/M Theory, MOND, etc.

8) *The coincidence problem* (Sean Carroll's "coincidence scandal"): Why is dark energy density about equal to matter density in the current epoch, when 340,000 years after the Big Bang state, in the epoch of the formation of the CMB, dark energy density was a billionth the matter density. Dark energy has a constant density, while matter attenuates in an expanding, accelerating universe. Why should they be approximately the same density now, when there just happen to be conscious observers about to ponder the problem? A coincidence?

The Coincidence Problem is actually part of the essential more general puzzle: *Why is the cosmos accelerating?* It's an utter mystery for cosmologists. Sean Carroll (2004) has identified three challenges. "The simplest explanation (for acceleration), a small vacuum energy (cosmological constant), raises three difficult issues: why the vacuum energy is so small, why it is not quite zero, and why it is comparable to the matter density today." The first of these is the diabolical *Cosmological Constant Problem* (see below). Why is the vacuum energy 120 orders of magnitude smaller than it should be? The second is, The Dark Energy Puzzle: What is the nature of this mystical, evenly distributed, constant energy density that rules the cosmos? The third issue is the Coincidence Problem. Together these present a serious challenge to our prevailing Λ CDM Standard Model of cosmology. As Carroll points out, "there is something fundamental we do not understand". We do not even know whether our ignorance lies in a misunderstanding of the gravity of GR, especially on very large scales; or if it lies in a confusion as to Relativistic Quantum Field Theory; or is it the dark sector; or more probably, as these represent a prior theoretical epistemic unity, all three. Something's gotta give.

At the first instant of the hypothesized hot post-inflationary Big Bang, temperature and density were infinitely high. This is known as a mathematical singularity—an utter breakdown of all physical, causal and mathematical theory. The laws of mathematics and physics cannot apply to such a singular state. This constitutes a most inauspicious, unscientific Kuhnian "puzzle" for the most important event in cosmology! By hypothesis, before this singular event, time and space did not exist. Then, without explanation, *ex nihilo*, from no prior state, cause or condition we get—by magical pixie dust—stuff, to wit, time, space, energy and causality; as blatant a violation of the laws of conservation of mass and energy as ever there was.

Philosophers have known for millennia that stuff cannot arise *ex nihilo*, from absolutely nothing. It seems we need something equally speculative, namely multiverse theory which suggests that this visible universe is a causal result of a prior universe (or many universes) or state that has no ultimate beginning; nor has this primordial process an end.

Maverick cosmologist Eric Lerner (*The Big Bang Never Happened*, 1991), with Hannes Alfven has shown that large scale galaxy clusters could not have been formed since the Big Bang unless their velocities far exceed recent observed recession velocities. In a rapidly inflating Big Bang universe gravity was not sufficiently strong for galaxies to form at all. Just so, how does dark energy cause an inflating universe to accelerate? Will gravity check this

cosmic expansion, or will the outward pressure of cosmic anti-gravitational dark energy cause an eternal, exponential acceleration of the universe ending in a nasty Big Rip? Let's see.

The Big Bang Theory has evolved since 1946 through many *ad hoc* theory tweaks in order to address the above problems. The three primary hypothetical fudges that have become the three primary mysteries of "bangian theory" are: non-baryonic *dark matter*, *dark energy*, and the *cosmic inflation field* (the inflaton field). Standard Model Big Bang theory now purports to explain less than 5 percent of matter/energy in the universe! Recent cosmology requires more bang for its funding bucks. Post-Standard Model physics is now upon us.

We have now an entirely different theory from the Big Bang that Fred Hoyle named, and criticized in the late 1940's. Indeed, the old Big Bang of our grandfathers is beginning to resemble the hundreds of epicycles that were required to keep the Ptolemaic solar system model alive, before it was finally interred. Perhaps our venerable Big Bang cosmogenesis is now yielding to that next more inclusive theory wherein it is but a player in a much grander, yet much subtler (and equally speculative) timeless, infinite, many-bang multiverse.

The "*problem of time*" is the perennially vexed problem of unifying GR with QFT in a quantum theory of gravity. In GR the problem of time reduces to no time ($t=0$). Time is no longer needed to explain motion in spacetime. Fortunately, this GR singularity has become the scourge of cosmology. It represents the failure of objectivist, materialist physical theory. GR's lovely equations cannot account for such infinities. Can quantum theory help?

Time in QFT is, a bit paradoxically, classical and Newtonian with an a priori fixed time and well defined values for measurements of observables existing in an objectively real time. M Theory (superstring theory) favors QFT with its robust, commonsense classical notion of time. However, cosmologists who favor GR appreciate its demoted view of time (Einstein's "spooky action at a distance"). Smolin's Loop Quantum Gravity is such a theory (Craig Callender, *Introducing Time*, 2005; Lee Smolin, *Three Roads to Quantum Gravity*, 2002; and *Time Reborn*, 2013).

LQG is derived from "canonical quantum gravity" theory, based in Paul Dirac's work on quantization, and later by Bryce DeWitt's brilliant 1967 paper. Such early efforts at GR quantization evolved into the Wheeler-DeWitt equation which deleted the time (t) variable altogether! The time variable appears in Einstein's GR field equations, but in a demoted mode. Told Einstein: "The past, present, future are only illusions, if stubborn ones".

So does time exist, or not? If so how? Is it relative or absolute? Or both? Is the flow of time merely an illusion? Perhaps there is a middle way. Wheeler and DeWitt, Barbour, Rovelli and many others have entirely deleted the time variable, as Einstein attempted to do. Craig Callender has pointed out that "although general relativity lacks a global time, it still manages to describe change...it does so by relating physical systems directly to one another rather than to some abstract notion of (absolute) global time" (Scientific American publication, *A Matter of Time*, 2014, pp. 15-21)

Thus, for much recent cosmology, time is no longer necessary to explain the arising of physical form in this universe. We've seen that for most physicists and philosophers

past/present/future are all reduced to a "block time" timescape. The four dimensions of space exist as a "block universe", all equally real. Neither past, present nor future are privileged. Our common experience of the flow of time from past to future is mistaken. Here, Boltzmann was right, time is not dynamic, does not flow, and is reversible. Space, time and causality are simultaneously present with no provision for the passage of time. The illusion of the arrow of time (entropy increases)—that we remember the past and not the future—demonstrates time's asymmetry and subjectivity, not its objective flow. Again, $t=0$.

However, the deletion of the time variable t from physical explanation causes some collateral damage, not only to Relativistic Quantum Field Theory (QFT), but to our common sense notions of the reality of the flow of time upon the seemingly forward-directional arrow of time. Entropy never decreases.

We've seen that ontologically, our perception of time arises from no-time ($t=0$), the nondual, timeless emptiness ground in which everything arises to ordinary direct perception, then to the reifying conceptual designation, then the belief of discursive mind. We create and reify relative time and its contents through our direct perceptual and conceptual experience of it. But in this vast unbounded whole time cannot exist, ultimately, where there are no sentient observers, no consciousness, no mind to experience it. That includes a lot of *kosmic* reality.

Recalling the noetic doublet of the Two Truths of some of our wisdom traditions, namely, *Advaita* Vedanta (Shankara), *Madhyamaka* Buddhism (*Prasangika*, and Dōgen's zen), and Taoism, time exists only in the reality dimension of spacetime relative conventional truth (*samvriti satya*), but not in the nondual dimension of absolute or ultimate truth (*paramartha satya*). Time, and its appearing objective realities necessarily remain observer/theory-dependent. Time cannot exist absolutely, observer-independently, in the absence of a sentient perceiver/observer, in short, a consciousness. Ordinary, non-liberated observer consciousness fabricates and reifies arising experience into a perceiving, knowing subject existing in real time, separate from its intentional objects—the perennial subject/object split.

Without this very pragmatic Two Truths (relative and ultimate) duality, the problem or paradox of time remains an utter mystery. Of course, the resolution of this duality is itself reflexively resolved in the prior epistemic and ontic unity if this diaphanous noetic Two Truths doublet. How shall we understand this?

It is told by our wisdom traditions that the prior unity of this timeless great *kosmic* unbounded whole (*mahabindu*) is knowable (primordial wisdom, *jnana*, *yeshe*, gnosis) through subjective, trans-conceptual, transpersonal noetic contemplative practices under the guidance of a qualified meditation master. Indeed, the entire contemplative wisdom tradition of our species bears witness to such gnosis. How do we know this? As Shakyamuni Buddha told, practice this wisdom path, and "come and see". What has this to do with physical cosmology?

Is there a reasonable physical explanation as to why our discursive knowledge of this vast timeless reality is precluded? Why is our prodigious human reason, our conceptual mind unable to grasp the timeless reality of the primordial ground of a pre-Big Bang universe? Well, in the extreme environs of such a dense white hot singularity, quantum effects will rule and

the classical, non-quantum theorems of an establishmentarian General Relativity break down, as we have seen. "Time-like" events are causally related. Here, a "local" electromagnetic signal can travel from one location to another to cause an effect. However, "space-like" events are causally unrelated. No signal can pass between such locations, and are therefore "nonlocal". In pre-bang prior universe scenarios, and in early post-bang scenarios, a causal electromagnetic signal has had insufficient "time" to reach us. Thus we can know nothing objective about it.

Once again, the classical (non-quantum) gravity of GR must necessarily be quantized by a quantum gravity theory. Clearly the quantum view of the very small, and the GR view of the very large are both incomplete and logically/mathematically inconsistent. Neither of these "perfect" theories, these two fundamental pillars of modern physics and cosmology can penetrate the perfectly subjective "mind of God", or the primordial "womb of nature", for that matter. Gravity is the creator and destroyer of worlds. There is here the usual logical incompleteness inherent in all linguistic semiotic (syntax/logic, semantics/meaning, pragmatics/usage) cognition. What to do?

Scientific Materialism and Its Discontents

So a unification or meta-theoretical synthesis of these two—the quantum wave function with Einstein's field equations—into a consistent *quantum gravity theory* is required in order to grasp the ultimate nature of *physical* reality, if it is graspable at all by any such objectivist, reductionist, materialist cognitive modality.

And therein lies the rub for a relativistic quantum cosmology which refuses to consider the relevance of the inherent subjectivity of the whole multidimensional process of knowing, both objective and subjective. *In other words, this old physically reductionist, monistic materialist physics paradigm—in spite of the inherent subjectivity of the quantum theory—still denies the relevance of the transphysical consciousness of a sentient (usually human) observer.* The strategic subtext here is a destructive clinging to and defense of a thorough-going non-empirical metaphysic that we have come to know and love as hyper-objectivist Scientific Materialism (generally Physicalism). Why is such a view destructive? Because if most of us believe and act on the assumption that "it's all just physical", the subjective nature of us, ethics, aesthetics, spirit/spirituality—the three wisdoms of goodness, beauty and truth—will continue to be marginalized to scientific exploration, or outright taboo. We must have a science of both first person objective data, and third person, introspective subjective experience, that is to say, a *science of consciousness*.

It is this habitual objectivist cognitive lens that colors the cosmological mind materialist, leaving the essential consciousness of a participating observer quite outside in the cosmic cold. Clinically, such schizoid perception would be viewed as pathological.

The extremist, fundamentalist ideological form of this Platonic realist, materialist metaphysic is the common proto-religion known to its critics as "*Scientism*"—*the quite unscientific system of belief that includes and insists upon the following "scientific" metaphysical assumptions: Physicalism, Objectivism, Material Substance Monism, Ontological and Methodological*

Reductionism, Local Causal Determinism, Physicalist Closure, and Universalism ("The Idols of the Tribe: The Metaphysics of Modern Science", www.davidpaulboaz.org).

Such is the fruitful perennial intellectual/metaphysical tension between the objectivist realist materialist view, and the subjectivist idealist ontologically relative view. This dichotomous tension has defined science, philosophy, and religion in the West for five hundred years. Let us now acknowledge it; then consider a middle way between such ideological extremes.

Now these procrustean (all ideology is procrustean) pre-empirical, unproven, unprovable parochial presumptions of fundamentalist Scientism—this pre-conscious inter-subjective deep cultural background "web of belief" (Quine), that the vast whole of reality is only physical, or is ultimately reducible to purely physical brain, or emergent epiphenomena of brain—is perhaps the greatest hindrance to the resolution of these perennially vexed problems of physics and cosmology, not to mention the traditional epistemic and ontic problems of philosophy (causality, other minds, morals, theistic creator God *vis-à-vis* a non-theistic non-creator primordial ground, etc.).

Thankfully, all of this is changing, evolving through the emerging noetic (body/mind/spirit holism) rapprochement between the objective scientific knowledge, and subjective wisdom and spirituality of the 21st century Noetic Revolution that is now upon us ("Being the Whole: Toward the Emerging Noetic Revolution", www.davidpaulboaz.org).

Can this pathological Promethean thirst for the perfect grail gnosis of absolute objective certainty be sated? Can the Descartes' and LaPlace's Demons, our Modernist genetic legacy of dualistic, determinist perfect reason be slain? Can the wild horse of scientific pretention to perfect rationality be tamed by the inherent subjectivity and ontological relativity of the quantum theory? Can the inherently vexed conundrums of an objectivist quantum cosmology (low initial Big Bang entropy; the cosmological constant problem, etc.)—as it labors to unify Relativistic Quantum Field Theory with the gravity of Einstein's General Relativity—ever be resolved without a developed science of consciousness that considers our inherent subjectivity? Stay tuned.

As to cultural subtexts, such idealized Cartesian rationality obtains for most philosophical and scientific texts of the past 400 years of Modernity; and even, paradoxically, for the reactionary subjectivity of the Postmodern mind. This Modernist/Enlightenment cognitive paradigm, our cultural "web of belief" (Quine), "form of life" (Wittgenstein), or "lifeworld" (Habermas) has become the prevailing Cartesian mind-body, matter-spirit dualism, with its pathological pluralism, and its destructive legacy of ontological reductionism and monistic materialism.

The postmodern love-child of this cognitive union of ideological, fundamentalist metaphysical dualism, objectivism and materialism has been the prideful, egoic consumer greed that has colonized both Western and Eastern socio-cultural life. Bertrand Russell lovingly and correctly branded such "common sense" objectivist Scientific Realism and Scientific Materialism as the "metaphysics of the Stone Age".

What then is the epistemic method and ontic status of "real" physical objects given the apparent failure of philosophical and scientific epistemic Realism and ontological monistic materialism/physicalism, which stipulate that such objects have absolute, theory-independent, observer-independent existence; in short, reality exists objectively and independently, not "in here", but in a separate "real world out there" (RWOT) somewhere. Well, is "what there is" (Quine) ontologically "real" or "ontologically relative", or both?

The theory-dependent, observer-dependent view—the Copenhagen quantum view, and Buddhist middle way *Prasangika Madhyamaka* view that appearing reality is dependent on the consciousness of an observer—sees physical existence not as absolute but as relative to and supervening or depending upon our conventional conceptual theories and models of reality. Here physical reality really exists. But *how* does it exist? It exists, not intrinsically, from its own side, but by perceptual imputation, conceptual designation and interdependent participation (*pratitya samutpada*) of a conscious being in this vast causal matrix of causes and conditions arising in and subsumed and embraced by the unconditioned unbounded whole (*mahabindu*) that is singular nondual reality, being itself. To be That, or not to be That; that is the question.

Moreover, as with the multiverse theory, there is no need for a creation singularity hypothesis, a creationist ontology. Again, such a view is then ontologically relative. Let us then further consider this counter-intuitive non-objectivist mode of our being here.

Ontological Relativity in Science and Philosophy

Willard Van Orman Quine (1908-2000), to the philosophy trade the most trenchant American logician and philosopher of science of the 20th century, told that ontology—"what there is"—is relative to language as it arises and is reflexively instantiated through our preconscious subjective deep cultural background assumptions and beliefs. Quine's seminal essay "Ontological Relativity" (1969) demonstrates that such cognition is thickly embedded in our Western collective and thus individual cognitive "web of belief"—Greek Platonic metaphysical realism, Cartesian dualism, and monistic materialism ("Quine's Holistic Revolution in Science and Philosophy", in Boaz, *Being the Whole*, 2013, www.davidpaulboaz.org)

By Quine's lights, the ontological status of this arising phenomenal experience of the wild horse of discursive concept-mind—our arising and appearing realities—is therefore necessarily relative to our conventional cultural and thus scientific conceptual and belief systems, as understood through our reflexive linguistic semiotic cognitive structures. Thus it makes no sense to postulate the absolute existence or reality of an appearing physical or mental object, or to offer the definitive meaning of a proposition about such objects.

Hence, a proposition, or statement cannot be empirically tested and demonstrated to be true or false without reference to prior intersubjective deep background preconscious assumptions and beliefs in our basal "meta-language matrix". Meaning is always deferred to the cognitive whole, the "field of force" that is the whole of language, of science, indeed of the whole of experienced reality itself. So much for old paradigm observer-independent

"scientific" objectivity. Subject and object are reflexively interdependent. And we utilize the logical syntax of language to critique the probative character of logic and language itself. We are both knowing subject and intentional object of our knowledge. The self-reflexive subject reflects upon itself and its objects of knowledge. Indeed, the entire unbounded whole of the multiverse/*kosmos* itself may be seen as a vast reflexive monism wherein the parts of this great whole evolve life, consciousness, self-consciousness, even nondual enlightened consciousness that then cognitively reflects upon itself, and its identity, even its ultimate or supreme identity with itself. Thus is *kosmos*—all that is—ontologically self-reflexive, just as the old Vedas have told for millennia.

In "Two Dogmas of Empiricism" (1951), the most internationally celebrated philosophical essay of the 20th century (required reading for philosophers of physics and cosmology; and, as well, for physicists and cosmologists who presume any ontic context for their equations), Quine first expresses his holism, then his radical nominalism (abstract terms like red do not entail a related real existent like house). Quine's holism precepts: 1) interpretations of empirical observations are "theory laden" or theory-dependent upon prior assumptions, theory and belief; 2) theory is "underdetermined" by its evidential data, that is, empirical evidence in isolation from the entire "field of force", the "whole of science in its globality" is not an adequate criterion of decidability as to the real, or theory verification, falsification or truth.

Now since the primary metaphysical assumptions—the ontology—of modern Science is fundamentalist foundational Scientific Realism and monistic Scientific Materialism, the belief that scientific knowledge consists of an "ontological commitment" to physically real theory-independent, observer-independent phenomena, and that only sensory, empirical evidence is suitable to adjudicate theory validity, Quine's radical, but naturalistic "extreme nominalism" and holism undermines both common sense/naïve realism and Scientific Realism/Materialism. Again, by Quine's lights, monistic ontological materialism (physicalism) is an unverifiable metaphysical presumption.

This urgent notion of ontologically relative cognitive paradigms, first elaborated by Quine and Wittgenstein, then by Kuhn and Habermas, demonstrates that the paradigm or "web of belief" in which we are culturally, intersubjectively, preconsciously cognitively embedded determines the reality, truth, meaning, worldview and ethical conduct for all of us participating in a particular cultural holon that is itself a more inclusive holon that is nothing less than the ontologically self-reflexive vast expanse of the unbounded whole shebang (*mahabindu*), the cognitively primordial set that includes all cognitive experiential sets.

"What there is" then, is ontologically relative to, and supervenes upon the collective linguistic concept/belief systems to which we cling and defend. This must include that set of concepts and beliefs of which we are objectively, and even subjectively certain, e.g. "Scientific" Realism and monistic materialism. In its fundamentalist extreme these two metaphysical assumptions are known to its critics as the proto-religion of "Scientism".

A healthy skepticism then must include our own concept/belief systems, including our deep cultural background ontic assumptions as to "what there is" (materialism), and our epistemic assumptions as to how we know it (metaphysical realism). In the Zen tradition such self-reflexive ontologically relative open cognition is known as *shoshin*, the "beginner's mind" (Suzuki Roshi 1972+). What we believe is what we get. From the epistemology we choose arises the ontic reality we deserve. As Shakyamuni Buddha told, "What you are is what you have been; what you will be is what you do now". Ontological relativity indeed. Now, back to the gravitas that is the "perfect theory" of General Relativity.

Tales from the Dark Side

Now, a little cosmological history. Cosmology really began in 1917 when Einstein began to apply his GR field equation to the whole physical cosmos. We saw that in 1917 Einstein added his cosmological constant Λ to the field equation. Then, astoundingly, Einstein recanted his constant Λ when Edwin Hubble's 1929 red shift calculations showed that the cosmos is not a static biblical "firmament" as was the prevailing proto-religious scientific ideology in 1916, but was rather, dynamic and expanding. Therefore Einstein's Λ was no longer required to contort the original Riemannian tensor calculus of the GR field equation into Fred Hoyle's "Steady State" static, spatially closed universe.

We have seen that in 1922 Alexander Friedman—mentor to George "Big Bang" Gamow—derived the beautiful Friedman Equation indicating that Einstein's original GR field equation, before his insertion of Λ indicated that the universe was expanding, thus the contrived cosmic anti-gravity Λ term that halted this expansion was wrong-headed. Even before Einstein's 1931 formal renunciation of Λ , both relativistic cosmologist Arthur Eddington (The Expanding Universe, 1933), and Georges Lemaitre (Ann. Soc. Sci. Brux. 47:49 1927) retained it. Both agreed with Friedman that Einstein's static universe ($\Lambda > 0$) is radically unstable, and thus untenable. Why? Because, anthropically speaking, we're reflexively here now to ponder it all.

Moreover, Λ is indeed the necessary basis for a propitious expanding cosmology. Finally, in 1932 Einstein, with the brilliant Dutch astronomer and mathematician Willem de Sitter, co-authored a paper that proposed an eternally, exponentially expanding universe with a tiny positive value for Λ , which just happened to predict dark matter at least fifty years before it became mainstream cosmological theory.

Later Einstein referred to his insertion of the Λ term into the field equation as his "greatest blunder". Why? Had he trusted the geometry of his original field equation he would have predicted the expansion of the universe (not to mention dark energy) 13 years before Hubble's great 1929 discovery. As Steven Weinberg might have said, he "did not take his mathematics seriously enough".

The same could be said for the four marvelous equations of Maxwell (1860) that defined light energy, its velocity/momentum in "empty" space, and unified the hitherto separate physical forces of electricity and magnetism into our much beloved electromagnetic

force. Just so, Dirac's mathematical masterpiece unified the quantum theory of Bohr and Heisenberg with Einstein's Special Relativity (discovering antimatter in the process) to give us Relativistic Quantum Field Theory, the very ground of Feynman's QED. It was perhaps Dirac's cognitive reticence to take his equations seriously regarding antimatter—or perhaps he was too humble to acknowledge his discovery—that permitted later genius to steal his theoretical thunder.

Alas, for the great mind that was Einstein, his hastily added (1917), then retracted (1931), then again added (1932) cosmological constant Λ , is now back in the cosmic game as an *ad hoc* ploy to make sense of "dark energy". Indeed dark energy is Λ . Recall that anti-gravitational dark energy is necessary to explain the recent discovery that the space of the universe, with all its matter, is not only expanding, but accelerating exponentially.

So it is, Einstein's "greatest blunder", the cosmological constant Λ has again risen, phoenix-like, into the cosmological chess game. In 1980 Λ was proffered as the cause of the anti-gravitational repulsive force of that great inflationary expansion—a trillionth of a second, give or take a trillionth, after a mystical Big Bang singularity—that we now think we know, thanks to Alan Guth's 1980 fourth post doctoral thesis, as chaotic "cosmic inflation". Again, the 1998 discovery of the repulsive dark energy that is hypothesized as the physical cause of the exponentially accelerating expanding cosmos has, as well, been attributed to a recalcitrant Einstein's Λ . Ironically, Einstein was right after all about Λ ; but he didn't know it until 1930. Platonic irony?

We've seen that Einstein's GR informs us that gravity is the curvature of four dimensional spacetime. This curvature of space is the same everywhere, and the rate at which it expands throughout the expanding universe indicates the energy density of the universe is $\Omega\Lambda$. What is the topology of this curvature? Again, we have three options. It may be negative, like a saddle, positive, like a sphere, or zero, flat.

Current theory based upon interpretations of Penzias' and Wilson's 1964 serendipitous discovery of cosmic microwave background radiation (CMB)—the ostensible primordial energy relics of a purported Big Bang—suggest that the actual curvature is approximately, but not precisely (anisotropy) zero. The energy density of the universe then, the energy present in any volume of space, is on the GR view, a function of this curvature of space and its rate of expansion, probably infinite, ending in a high entropy "heat death" that is the proverbial frosty "Big Chill".

So for Einstein's GR the rate of expansion of the universe is relative to its overall energy density $\Omega\Lambda$. It was the 1998 data (Perlmutter, Riess, Schmidt, Kirschner) from type Ia supernovae explosions that revealed this surprising acceleration of Hubble's already expanding space, along with all of its galactic contents; which by the by, rescues us from the compactified fate of a contracting universal "Big Crunch" following the end of an epoch of cosmic expansion. Current cosmology is now decidedly anti-crunch because the accelerating universe hypothesis precludes an eventual universal gravitational contraction. An accelerating expansion means a cosmological constant Λ with a positive value. Well, how big is it?

"Empty space"—the vacuum of space—contains a small bit of fundamental energy. This tiny energy value is our old friend the cosmological constant Λ , usually identified as the vacuum energy, or dark energy. Again, this is the vacuum energy density ($\Omega\Lambda$) of space. It is not a dynamical field, but a property of curved spacetime itself. Thus it is constant everywhere as the cosmos expands. And yes, $\Omega\Lambda$ is recent cosmology's leading hypothesis for explaining dark energy.

Heisenberg's quantum Uncertainty Principle predicts vacuum energy fluctuations which increase the energy density of space as virtual particles "pop" in and out of spacetime existence. Therefore, even empty space is not empty. It is full of the potential for all of the radiation/light energy/matter in the cosmos. Including us, our self-reflexive consciousness who desires to know its own nature.

This notion of potential energy in the vacuum of space closely parallels the fecundity of the emptiness or boundlessness (*shunyata*) of Buddhist *Madhyamaka* epistemology. It is from this primordial emptiness ground or base (*dharmakaya/trikaya* of the base, *cittadhatu*, *gzhi rigpa*) that energy/mass, and its physical and mental forms arise. As the Buddha told in his *Heart Sutra*, "Form is emptiness, emptiness is form; form is not other than emptiness, emptiness is not other than form". The prior ontic unity of this duality is none other than our perennial wisdom "Two Truths": relative form and absolute/ultimate emptiness. From this great unbounded whole (*mahabindu*) interdependently arises—via the reflexive causality of Buddha's "dependent origination" (*pratitya samutpada*)—all that appears to sentient consciousness.

As energy and matter are related by the special relativity of $E=mc^2$, GR predicts that Λ will have gravitational effects. Λ has a negative pressure that is equivalent to its energy density resulting in this accelerated expansion of the cosmos. Hence, the current Standard Model Big Bang cosmology is known as the Λ CDM or Lambda-CDM Model where CDM is cold dark matter, and lambda or Λ is the basal form of dark energy—Einstein's cosmological constant—a dynamic scalar field which comprises the energy density of a flat universe as the vacuum energy. Until 1994 Λ was assumed to be zero. But an accelerating universe requires a positive non-zero value for the constant $\Omega\Lambda$. Such current theory is supported by temperature anisotropy data from the late releases of WMAP, and SDSS surveys of the redshift of distant galaxies (2007 through 2013). Speculative lambda is radically underdetermined theoretically, and empirically quite problematic. But it fits the density parameters and Hubble's constant, for now.

Alternative explanations of this mysterious, underdetermined dark energy include 1) several theories of "modified gravity" (e.g. MOND) wherein Einstein's GR gravity (the Equivalence Principle—the equality of inertial and gravitational mass) is tweaked; and 2) the Quintessence Field. Quintessence is a hypothetical *dynamical* field—vis-à-vis the *constant* vacuum energy field, of a universal gradually changing energy density evolution. Thus quintessence field differs from Λ in that it is not constant but dynamic in space and time.

Non-baryonic (not constituted by ordinary protons and neutrons) dark matter was predicted in 1931 by Jan Oort, and in 1932 by Einstein and Willem de Sitter, and discovered in 1937 by Fritz Zwicky by applying the virial theorem to the Coma Cluster; then proven in 1974 by Vera Ruben through her work on galactic rotation in distant spiral galaxies.

Dark matter is by hypothesis about 70 percent of the *mass-energy* density (remember $E=mc^2$) of the cosmos. We saw that dark matter—perhaps a neutral, uncharged non-interacting, or weakly interacting massive particle (WIMP), not yet known to humanity—constitutes about 25 percent; and less than 5 percent is baryonic (good old protons and neutrons) ordinary matter. This is the recent Concordance Model of the universe which accounts for only 5 percent of detectable physical reality. Again, one might well refer to such a litany of *ad hoc* explanations of our wondrous physical cosmos as the Substandard Model of particles and forces, but that would be disrespectful. Indeed, it's been a wonderful ride, but the profound "unnaturalness" of the result lights the way for a new physics/cosmology revolution.

The cosmological constant problem. As to unnaturalness, what, in heaven and earth, is the diabolical "*cosmological constant problem*", first described by Steven Weinberg in 1989—later exclaimed by Leonard Susskind to be "the worst prediction ever....the mother of all physics problems"?

As seen above, the cosmological constant Λ , was introduced into the GR field equations by Einstein in 1917 (and later retracted, then added again) in order to "hold back gravity", as a defense of his belief that the universe is static and closed, while we now think we know that it is not only expanding, but accelerating exponentially. As we have seen, Λ is generally viewed as the zero point energy density of the quantum vacuum of space, the energy of "empty" space. Once again, this density was assumed to be zero ($\Lambda=0$). But an accelerating universe requires a positive, non-zero value for Ω_Λ , as we have seen.

We saw as well that the cosmological constant of 1998 is considered by cosmologists to be the current best physical explanation for dark energy, the repulsive force that "holds back gravity" in an expanding and accelerating universe. Again, Λ is the vacuum energy, the energy density of the vacuum of space Ω_Λ . And $\Lambda=0$. Why is it so small?

For years cosmologists had taken Λ seriously, and as Roger Penrose has pointed out (Penrose 2004, 28.10), very few believed it to be nonzero. Then, quantum field theorists calculated that the vacuum energy must be larger than what is observed, a lot larger. It exceeds the observed value by a factor of 10^{120} !

That's the bad news: quantum field theory (quantum fluctuations) predicts that the zero point energy of Λ should be 120 orders of magnitude greater than the observed density of dark energy, the observed (actual) critical density of the universe! Such an absurd value would inflate the universe at a rate that would preclude the formation of galaxies, and thus of conscious carbon based observers to ponder the equation. This is the tautological *Anthropic Principle* of Carter, Barrow and Tipler, namely, that the physical constants of the universe must be compatible with the existence of a sentient conscious observer to ponder such questions. Therefore, this absurd value for the cosmological constant must be incorrect. Hence the "cosmological constant

problem". No one knows how to fix it. This is indeed a recent physics sticky wicket that implies that "improvements" (Penrose) are abroad, not just for GR, but for quantum field theory as well.

What to do? Must we wait years or decades for such a hoped for consistent quantum gravity theory? Again, such a theory requires profound changes to both of the "perfect theories" that are General Relativity (GR) and Relativistic Quantum Field Theory (QFT).

Roger Penrose (Penrose 2004, 29.1) has shown us that "quantum ontologies" are urgent, that is to say, the mere quantum formalism of the prevailing subjectivist Copenhagen Interpretation, which makes no ontological assertion as to the actual nature of quantum reality, is inadequate. The opposing view is that, indeed Schrödinger's wave function ψ represents an objective quantum reality at the instant of the collapse of the wave function during a quantum measurement; that all possible outcomes "coexist" in a physically real vast quantum superposition of parallel quantum universes that is indeed the wave function for the multiverse.

We must understand here that each parallel universe is not independently real. It is rather, the infinite quantum superposition ψ that "exists" (Hugh Everett 1957; Penrose 2004). Penrose would like to see an "improved theory" that objectifies both of these views of what is inherently a subjective quantum ontology. In short, he wants an objective quantum state reduction from a subjective theory. Indeed, all quantum variations are dependent upon the subjective consciousness of an observer. Must a quantum mechanics with "a viable ontology" exclude a subjectivist ontology? Does "viable ontology" mean only an objectivist ontology for Roger?

At the end his remarkable, encyclopedic epic *The Road to Reality* (2004 p. 1045) Penrose laments that, "the most profound mysteries remain...which our present day theories are powerless to describe...Perhaps what we mainly need is some subtle change in perspective..." Indeed. Perhaps what we really need is a cognitive paradigm shift from our habitual preconscious deep cultural background objectivist, realist/materialist ontology—metaphysical realism and monistic physicalism/materialism; in short, the metaphysical dogma that is observer-independent Scientific Realism and Scientific Materialism. Perhaps we need a middle way between Western scientific substantialism, and Eastern subjectivist idealist nihilism. Is there such a middle way (p. 33 below)? But first let us revisit the Higgs sector.

Higgs again: what hath God wrought? There are further concerns with this half century Higgs "God Particle" grail quest: 1) As with the cosmological constant Λ , why is the value of the Higgs so small? Does the epistemic fudge in the incomplete mathematics of the Higgs Field render it pragmatically useful, like the prodigious fudge of QED "renormalization" (with its mixed gift bag that includes the laser, the semiconductor, and the hydrogen bomb)? Or is this bit of untidy theoretical conjuring, under duress of Big Science, but another product of the massive intellectual hubris of human discursive science-mind? Let's remember that the trillion dollar Higgs sector—key to the future of the aged Standard Model of particles/forces and Big Bang cosmology—is under huge funding pressure to produce results.

We have seen that physics' Standard Model odyssey into the brave new world of inherently subjective, unobservable trans-empirical phenomena—the conceptually, even mathematically ineffable quantum world of quarks, leptons, Higgs bosons and multiverses, not to mention (gasp!) "consciousness" of a knowing, observing subject—is, in spite of the intrinsically subjective nature of these parameters, an ambitious objectivist/materialist program to grasp the noetic (objective/subjective, mind/spirit) perfect subjectivity of That (*Tat*)“ nondual primordial ground itself, the very "mind of God", fortunately reflexively instantiated in us.

2) Be that as it may, let us assume the Panglossian view that there was no error in the processing of trillions of points of recorded data in order to "discover" the fabulously fleeting production by an unstable decaying particle of just two high energy photons. (But if there were an error, who could really know? And who would really tell?)

3) The physics by which the non-objective mystical Higgs Field provides the perfectly precise quantity of mass to each massive particle, while leaving the mass-less particles unchanged, is not at all understood, if it can ever be conceptually/mathematically grasped by the conceptually limited two-valued, binary logic that is the outer limit of human conceptual mind. Again, the core theory of the Higgs Mechanism remains—no surprise—mathematically incomplete, to say the least (Zebuhr, Hotson, Phipps, Gulko, *Infinite Energy*, Vol. 18/105, 2012).

We must remember here that Standard Model physics methodology—micro to cosmological (from tiny quantum qubits to the vast array of the gravity of General Relativity)—utilizes precious little causal or cause and effect empirical, observational reasoning, especially since the advent of the acausal quantum theory. Once again, Relativistic Quantum Field Theory remains, after a century of prodigious mathematical effort, utterly incompatible with Einstein's General Relativity field equations, with or without the cosmological constant Λ .

How then shall we unify the quantum world of the very small with the cosmological world of the very large? The theoretical reality of the prior unity of both of these dimensions—that is to say a unified quantum gravity—must have been present at three or four trillionths of a second after the Big Bang, and even before the Big Bang (multiverse theory). So the two separate theories—Relativistic Quantum Field Theory and the gravity of General Relativity are, 14 billion or so years later, conceptually incomplete. We must now mathematically and theoretically re-unite them. That is the rub, and the yoga for quantum cosmology, and the discursive/mathematical theories of our cosmic beginning, present, and end.

Our origin in this vast whole would seem to be utterly beyond the conceptual limit of human discursive mind. Is it also beyond the understanding of the trans-conceptual, contemplative mind of our primordial wisdom traditions? As Shakamuni Buddha told: "come and see". Let theoretical physicists, philosophers of physics, neuroscientists and Buddhist scholar/practitioners dialogue over pizza and ale (or tea and crumpets).

So the fabulous Standard Model of particles and forces—perhaps the greatest intellectual accomplishment of our species—is a necessarily speculative 30 year old *ad hoc*

concatenation of theoretical, mathematical and metaphysical assumptions where, due to the minute, and thus the vast scale of the data—beyond the empirical reach of sense experience, empirical experiment, and even the bivalent reach of human dualistic conceptual mind—hard experimental results are virtually precluded. Indeed a cognitive conundrum.

Welcome to the post-metaphysical reality of nondual (ontologically prior subject/object identity) noetic post-quantum cognition. "Subject and object are only one" (Erwin Schrödinger). Grasping this "one" is quite problematic for one who is conceptually "other" than it. What to do? Practice mindful nondual cognition, along with a bit of dualistic mathematics and philosophy of physics, and see.

Well and good. Such dualistic cognition is the natural result of this intrinsically subjective being whose "supreme identity" is the very ground of nondual primordial reality itself. Let us now acknowledge the inherent, ultimate, even perfect subjectivity of this unbounded whole in which the conceptually ineffable miracle of an objectively "real" reality arises and participates (davidpaulboaz.org, "The Emerging Noetic Revolution: Unifying Our Two Knowledge Paradigms").

Now, from such a balanced cognitive base of understanding—our primordial wisdom's one truth unity—invariant through all cognitive states—of the Two Truths (our objective and subjective *relative* realities [matter/mind], and their perfectly subjective *ultimate* reality ground)—from that inclusive knowledge base let physics proceed with the urgent M Theory calculus that shall enhance a noetic (mind/spirit) understanding of just what the unity of these two relative conventional worlds of the micro and the *kosmic* dimensions, integrally considered, might actually be. We need third person objective, and first person subjective cognition to grasp the profundity of the nondual onbounded whole (*mahabindu*).

All the while we are encouraged by the wisdom traditions to remember the bright nondual, trans-physical presence (*vidya, rigpa, gnosis*) in the human being of this great unbounded whole (*mahabindu*) that is conceptually, but not contemplatively ineffable; that (*Tat*) primordial ground state (*bhavanga, gzhi rigpa*) in which, or in whom the furniture of reality interdependently (*pratitya samutpada*) arises and participates.

Well then, should the physical and mathematical parameters of the putative new Higgs boson "God particle" actually meet the physicalist/materialist expectations of the CERN physicists, and it is, in due course declared by those who know to be *the* Higgs particle, we still do not know if it is creator of all the mass in the timeless physical cosmos, not to mention the all-embracing whole of the Pythagorean *kosmos* with its many universes. This great *kosmic*, panpsychic (everything has some degree of consciousness) whole subsumes, embraces spacetime reality. There is that of heaven and earth undreamt of in our pathologically reductionist monistic materialist philosophies. Can this vast whole really be reduced to a purely physical reality (Materialism)? Or to a merely mental reality (Idealism)? Is there perhaps a synthetic centrist middle way (*Madhyamaka*) view? Again, from the epistemology you choose, arises the metaphysics you deserve.

Cosmology and Buddhism: Brief Meta-Mathematical Excursus

Insofar as the laws of mathematics refer to reality, they are not certain; and insofar as they are certain, they do not refer to reality" (Einstein 1921).

Does theoretical Higgs conjecture admit of mathematical proof? Are mathematical "objects" (e.g. tensors) Platonically "real", existing in an ideal realm of "forms", neither physical, nor mental? Or are mathematical objects mental instantiations or emergent "epiphenomena" arising in purely physical brain matter? Can mind possibly be reduced to mere physical brain? Is there any non-ideological hard evidence? Neuroscientists have become skeptical of this old Modernist paradigm view. (*Mind and Life Institute; Institute of Noetic Sciences, Santa Barbara Institute*)

It is useful here to remember that mathematics is derived from zero, or emptiness. As the late great quantum physicist John Wheeler told, "The basis of all mathematics is $0 = 0$. All mathematical structures can be derived from the empty set", the wondrous empty set containing no members. (Groucho Marx, expressing parallel logical necessity informs us that, "I wouldn't want to join any set that would include me as a member"). So this empty set is the intrinsically empty perfect symmetry of 0. The integer 1 includes this empty set; 2 is the set whose members are 0 and 1, etc. Thus the mathematical ground, and indeed the physical ground of reality is a function of, and arises through this intrinsic emptiness base or ground.

Madhyamaka Prasangika Buddhists would agree. Astonishingly, from the inherent energy potential of this strange perfect symmetry of our nondual boundless emptiness ground—by whatever name—arises symmetry breaking luminous light-energy ($E=mc^2$) that fills and animates the worlds. Once again, Shakyamuni Buddha's wisdom: "form is emptiness, emptiness is form".

So the attempted reduction of this vast multidimensional whole of reality to mathematics may be viewed as an acknowledgement that the primordial base or ground of reality includes the perfect symmetry of zero/nothingness, highest entropy—or in the middle way Buddhist view (*Madhyamaka Prasangika*)—emptiness/boundlessness/*shunyata/dharmakaya*; or perhaps the primordial ground that is Tao; or perhaps we might name (*namarupa*) it *Nirguna Brahman*, that which is empty of all attributes and qualities. Well, does this primordial emptiness ground preclude physical reality altogether? Is this all merely an illusion as the hoary Vedas, and the Buddhist Chittamatra/"mind only" school have told?

Wonder of wonders, Buddhist emptiness does not forestall our real relative spacetime reality. (Recall the Two Truths: *relative* spacetime and the basal *ultimate* unbounded whole in which this all arises). In ultimate emptiness, zero, there is no beginning, no creation, no first cause. Nor is there an end. Yet from this nondual primordial "groundless ground" arises our objective and subjective, often all too real realities.

As we have seen, for Buddhist *Madhyamaka*, relative conventional reality arises and falls away as a function of an endless, timeless causal matrix of prior interdependent causes and conditions (interbeing, dependent arising/*pratitya samutpada*). Indeed, the quasi-theistic, linear

first cause view of early Big Bang orthodoxy is said to arise *ex nihilo*, out of such an emptiness ground, then return unto it in a "Big Crunch". Must there be a beginning or first cause at all? The irascible Fred Hoyle, and now the multiverse theorists say no. An *ultimately* empty cosmos requires no mathematical explanation, nor indeed, any concept of physical matter whatsoever.

Yet there remains this endless relative arising of physical and mental form. The prior ontic unity of this conceptually contrived duality of form and emptiness, becoming and being itself, is unmistakably evident. The unbounded whole necessarily, logically subsumes all its parts. Wholes have parts; parts are included in their wholes. "Form is not other than emptiness; emptiness is not other than form".

Buddhism, with the emerging neuroscience of its contemplative technology (Begley 2007; Boaz 2013; Wallace 2003; Dalai Lama 2005, 2009) demonstrates that we may know (gnosis, *vidya*) this great whole via trans-conceptual direct experience, through mindful attention to the breath (*prana, chi, pneuma*), and other related practices. This has precipitated a "mindfulness revolution". Such mindfulness practice is now utilized to settle, focus and heal the mind in medicine, education, business, corrections, military and law enforcement. Let it be so as well in science. Such practice is a powerful antidote to the obsessive, compulsive dichotomous thinking that the "wild horse of the mind" is heir too. Let this mindfulness revolution facilitate our emerging integral paradigm as the new noetic revolution in matter, mind and spirit arises.

Perhaps then, Buddhist epistemology has something to contribute to the epistemology and ontology of post-quantum physics, philosophy of physics and cosmology, and neuroscience as we enter our 21st century noetic rapprochement of Science and Spirituality (*The Noetic Revolution: Toward an Integral Science of Matter, Mind and Spirit*, Boaz, 2015).

Finally, how it is that this wondrous Higgs particle, "where footless fancies dwell" (William James), bestows mass to that of reality which arises and appears, like you and me, is of course the trillion dollar question of this great epistemic adventure. Higgs miracle, or adventitious Big Science Higgs farce? (Or both, or neither?)

Let us then not rush to the scintillating Higgs desideratum, just yet. Rather, let us patiently follow the continuing drama of this anachronistic, monistic materialist undertaking with a modicum of informed healthy skepticism. (Healthy skepticism must include our own closely held concepts and beliefs; for example, the belief that the ultimate nature of phenomena arising to or in mind is merely objectively real and monistically physical/material. Suzuki Roshi designates such rare fluent freedom of cognition "*shoshin*", zen mind, or "beginner's mind" wherein our current "web of belief" is "bracketed" or placed in brief abeyance). Then let us see, in due course, what our new post-quantum physics paradigm reveals to the prepared mind.

Consciousness? Is consciousness fundamental? Is it universal? Max Planck, founder of quantum theory: "I regard consciousness as fundamental...matter is derivative from consciousness". Philosopher of mind David Chalmers views consciousness as both

fundamental and universal. "Every information system has some degree of consciousness...This view is called panpsychism...every system is conscious...neuroscientist Giulio Tononi has a mathematical measure of information integration he calls ϕ ". A human brain has "high ϕ ". A photon has less, but non-zero ϕ . Are these relative realities not then "derivative from consciousness" ("Big Mind") instantiated in the "Small Mind" of a conscious observer-being?

As we follow this informational "Von Neumann chain" bottom up through a physical quantum measuring apparatus to a human cognitive measuring/interpreting apparatus we begin to appreciate this non-material, non-physical role of the consciousness of a sentient observer in processing physical information integration systems. We here consider the mind—the role of consciousness—in the collapse of the quantum wave function (J. Von Neumann, E. Wigner, M. Planck) from the superposition states of the "probability wave" into a "real" physical particle "popping" into existence (the prodigious "quantum measurement problem").

The current scientific reductionist paradigm—that the whole of human experience is reducible to purely objective physical brain, or emergent epiphenomenal of brain—remains unable to explain, or explain away, our subjective feeling of being, the "what it is like" to be conscious. Why and how is *objective physical* brain processing attended by this bright *subjective* consciousness, this basal awareness of "bare attention"? This is David Chalmers' legendary "hard problem of consciousness". Being "mindful", being present to what's happening right now, in this present moment of our being here (*dasein*) is the practice, the way, as the Buddha told, that we "come and see".

Moreover, why is there this amazing "unity of consciousness"? How is it that our sense experience, as it arises from many different brain structures and functions becomes unified into a single conscious moment in the awareness continuum of our ongoing stream of consciousness? The materialist reductionist program offers no help at all.

As we begin to consider this emerging noetic quantum consciousness paradigm of the relation of a knowing observing subject to its object known—and the recognition of the ontic prior unity of these two—we shall surely, in addition to learning the secrets of human happiness, soon accomplish a resolution to that most vexing problem in all of physics, namely, the mathematical union of the wave function of Relativistic Quantum Field Theory with the gravity of Einstein's General Relativity (the Equivalence Principle), or some amazing new synthesis thereof. Then, it is hoped, will the resolution of the other vexing problems in physics be revealed: the Big Bang ultra low entropy problem, and the dark energy/cosmological constant problem.

Physics and cosmology must at last recognize, research and utilize the inherent, non-physical subjectivity of an observer-dependent consciousness in the collapse of the wave function into our relatively real objective realities. In spite of the "taboo of subjectivity" (Alan Wallace), cognitive science and neurobiology are indeed headed in this direction through the urgent emerging trans-disciplinary *science of consciousness* with its urgent neuroscience of contemplative mindfulness practice.

And all of this without need of a logically impossible Theory of Everything (TOE) ("Gödel and Hawking: Is a Physical Theory of Everything Logically Possible", in *Being the Whole: Toward the Emerging Noetic Revolution* 2013, and *The Problem and Opportunity of Consciousness* 2013, www.davidpaulboaz.org).

Is a Theory of Everything Logically Possible?: Gödel and Hawking

Mathematical realist Kurt Gödel's two 1931 incompleteness theorems, with the greatly enhanced 1936 Gödel-Rosser Theorem point to the mathematical impossibility of a "Theory of Everything".

Astonishingly, a careful reading of Gödel has incited a recalcitrant Steven Hawking's inner realist (*The Grand Design*, 2010) to become disabused of his prior theory independent-observer-independent Scientific Realism (*A Brief History of Time*) in order to embrace a theory-dependent, observer-dependent "Model Dependent Realism" (MDR). Glory Be!

Gödel and Rosser have demonstrated mathematically that not only is a TOE incapable of producing the perfect omelet, they proved that all physical theories are reflexively self-referencing. How shall we understand this?

Gödel's and Rosser's proofs are understood by mathematicians and logicians as proof that no axiomatic system that is arithmetically expressive enough (Peano's postulates) to include the properties of natural numbers can prove all of its internal logical/mathematical truths. Or worse (for Russell, Hilbert and logical formalism): all axiomatic systems that are internally self-consistent, are globally inconsistent!

Gödel's original two theorems state that 1) any such system is either *inconsistent* (a proposition and its denial can both be deduced from the axioms) or 2) it is *incomplete* (there is a true proposition within the system that cannot be deduced from its axioms). Now any putative Theory of Everything (e.g. super-symmetric Superstring M Theory) is necessarily constituted of internally consistent, non-trivial mathematical systems. Therefore they must be mathematically incomplete. So no logical system can capture all of mathematics, the prodigious Russell and Whitehead *Principia Mathematica* is wrong, and the hope of a logically consistent Theory of Everything is *kaput*! This is now the view of many mathematicians and philosophers of physics as to the logical status of any possible TOE.

Let us remember here that a physical TOE begs the question of the dubious metaphysical assumption of Scientific Realism/Materialism (Physicalism): everything is 1) only physical, and 2) somehow exists independently (observer-independent) of our sensory, experimental, conceptual "web of belief" (Quine). On this view ontological relativity is false.

Recent philosophy of physics has shown that the fundamental laws of physics cannot confirm the intrinsic existence of the reality of matter and energy. Rather, what is confirmed is this reality as it arises and appears, not as reality itself, but in a particular *conceptual model* of reality. This is Hawking's correct MDR point in *The Grand Design* (2010). The objectivist realist paradigm model is the theory-independent, observer-independent metaphysic of Scientific

Realism/Materialism, that there is an independently existing, separate "real world out there", as we have seen.

The evolution of science and philosophy have shown that we human beings cannot escape our "ego-centric predicament" to observe an independently existing reality from a "God's eye view" (Putnam) of "the mind of God" (Nagel). This is a healthy skepticism that includes one's own conscious and pre-conscious beliefs, including metaphysical realism, monistic materialism, and physical and neuro-reductionism. As the ontologically relative middle way *Madhyamaka* Buddhists have told, there can be no utterly theory-independent, observer-independent RWOT, separate from the participating reifying consciousness of a sentient observer/participant embedded as we are, in deep cultural background conceptual/linguistic structures. Again, this process is known as ontological relativity. We reify/create our realities by conceptual imputation and designation. Kant would agree. And the intrinsically subjective quantum theory agrees. Bohr's Principle of Complementarity (not either/or, but both) with Buddhist interdependence (*pratitya samutpada*) or "interbeing" are intellectually nearer the truth of the matter.

Who Is It, Really?

Who is it that desires to know, and to be happy? Who is it that is afraid and angry? Who is it that is born, suffers and dies? Who is it that shines through the mind and abides at the heart of all beings, always liberated and fully awake?

So who is it? For the Buddhist *Madhyamaka* and *Vajrayana* view (*darshana*) the very "nature of mind" is the "always already present" luminous "skylike" presence of that trans-conceptual ultimate, that vast matrix ground of appearing reality in which, or in whom this all arises and participates.

In nondual Buddhist *Dzogchen* wisdom it is told that this bright, intrinsic pristine awareness has no cause, no spacetime location, no dimension, yet it pervades everything, subsuming all dimensions of physical/mental/spiritual form. It is utterly conceptually unfabricated and uncontrived, beyond name and form (*namarupa*). It cannot be grasped and objectified through dualistic discursive thinking. It is merely the perfect sphere of *Dzogchen*, the Great Perfection (*Dzog/completion; chen/great*). Again, this unbounded whole subsumes its parts. Just so, the parts perforce participate in the vast whole.

Such primordial wisdom is known to the wisdom traditions of our species as "Ultimate Truth" (*paramartha satya*). Paradoxically, it is through our dualistic conceptual "web of belief" or "Relative Truth" (*samvriti satya*) that we understand the prior epistemic and ontic unity of these two complementary truths of the vast whole itself. Is the interior presence of that all-embracing nondual unbounded whole, by whatever name, not our supreme identity? Who is it? *That* is who it is! *Tat Tvam Asi*. That all, we are. Heady wine, indeed.

Might Science—neuroscience and cosmology—yet contribute to our direct pre-conceptual knowing that perfectly subjective *kosmic* whole—the prior unity of knowing subject and perceived object, of being and becoming, of Science and Spirit? Perhaps objective

Science and subjective Spirit/Spirituality are not at all separate epistemic domains but two noetic voices, two faces of one subsuming whole that is nondual universal primordial reality itself. "Not one, not two, but nondual".

Being: "To Be or Not to Be" Is *Not* the Question

The question is: how is this perennial duality of being and not being to be restored to its prior ontic unity that is primordial nondual being itself, and to our knowing that here in relative-conventional space and time? It may be useful in this regard to remember (Plato's *anamnesis*), that the subtler or more inclusive dimension understands and subsumes the less subtle, less inclusive experiential dimension, but not the other way round. The parent's understanding transcends yet embraces that of the child. The *mahasiddha's* noetic nondual understanding exceeds and subsumes the student's dualistic understanding. The inner or "higher" understanding transcends yet includes the less subtle outer or "lower" understanding, just as a whole is greater than, and includes the sum of its parts.

For example, General Relativity Theory transcends and includes Special Relativity Theory. Just so, SR is more inclusive than Newtonian mechanics, which subsumes the mechanics of Aristotle, Galileo, Copernicus, and Kepler. The greater esoteric understanding transcends yet embraces the lesser understanding. But not vice versa.

This subtler, more inclusive view that embraces the inherent subjectivity of mind nature, of human consciousness—the ontologically relative view of Planck, Bohr, Schrödinger, Wigner, Stapp and many others—is, with Nagarjuna's Middle Way Buddhist epistemology, a middle path between a negativist, subjectivist Eastern nihilistic ontological Idealism, and a pathologically positivist Western objectivist, substantialist realistic monistic Materialism.

For the Two Truths—relative and ultimate—of *Madhyamaka Prasangika*, and of *Advaita* (nondual) *Vedanta*, the dimension of objective relative-conventional physical and mental spacetime reality is really real. It's not just an illusion as Buddhist (*Chittamatra*) and Hindu (*Veda/Vedanta*) philosophical idealists would have it to be. Nor is this reality the philosophical Metaphysical Realism of Buddhist *Theravada/Shravakayana* of the *Pali Canon*), nor of realist, eternalist dualistic Vedanta (Madhva).

We have seen that this objective physical spacetime reality that arises to our ordinary direct perception is not illusory, nor is it inherently or intrinsically real, "from its own side". *The question is not whether reality exists. Of course it exists! The question is, how does it exist?* As with the quantum wave function, for middle way Buddhist epistemology this appearing spacetime reality is reified by perceptual imputation of an observing consciousness, and by conceptual designation of a human consciousness. On this view there is no absolutely existent permanent reality, no separate theory-independent, observer-independent "real world out there" (RWOT) experienced by a separate, independent self or ego-I.

There can be no reality that exists independently of measurement, information to a perceiving, knowing consciousness. Appearing reality is relative to a system of measurement. We cannot know the merely physical. All we can know is the appearances, the information bits

(Wheeler's "its from bits"). Told physics master John Wheeler, "No space, no time, no gravity, no electromagnetism, no particles, nothing. We are back where Plato, Parmenides, Aristotle struggled with the great questions (excerpted from Wheeler's private Journal dated 1.29.02, nytimes.com, 2.3.12). Ultimate reality for Wheeler is "a great smoky dragon". It cannot be objectified, or known with certainty.

Such a view represents the present crisis of Western culture; a revolutionary paradigm shift toward our next collective cultural mindstate. We are now suffering the utter collapse of 400 years of the Modern and Postmodern Greek foundational metaphysic of epistemological realism, and ontological monistic materialism (physicalism). The Western zeitgeist that is our idolatry of reason has ended. A new reflexive, self-reflective ontologically relative noetic (subject/object interdependence) ontology is ascending. What shall we make of this?

We are coming to understand the great truth that appearance is merely luminous, relative-conventional spacetime-conditioned reality as it arises, via the process $E=mc^2$ from its transconceptual nondual primordial ground, ultimate reality itself, the all embracing vast unbounded whole, by whatever name (*mahabindu*, *shunyata*/emptiness, *dharmakaya*, Tao, *Nirguna Brahman*, God the Father, *En Soph*), even Heidegger's being itself. These perennial Two Truths, relative spacetime reality, and its ultimate transconceptual basis, the prior ontic unity of That, is the one truth of the matter. So it is told through the wisdom traditions of our species.

We should note in this connection, that the ontological status of Nagarjuna's Buddhist *Madhyamaka* emptiness is itself emptiness; that is to say, the ultimate emptiness ground or base (*gzhi rigpa*) of the all of the relative conventionally empty furniture of reality (the Two Truths) is itself "empty of any shred of intrinsic existence". Relative existence yes. Ultimate existence no. H.H. the Dalai Lama has termed this ontologically relative perspective "the emptiness of emptiness". Relative conventional spacetime reality is necessarily adjudicated by our mere conceptual and belief cognition. Again, ultimate reality is nondual direct perception, sometimes illuminated by a liberating, trans-conceptual contemplative "bare attention" to this eternal now of our experience (Dōgen, Padmasambhava).

Therefore, as they enjoy their pizza and ale, let our physicists, cosmologists, philosophers, neuroscientists and Buddhist scholar/practitioners plot an ecumenical agenda. Let them consider the reductionist, realist, material monism of microphysics and astrophysics by the lights of Buddhist *anitya* (impermanence/change), *anatman* (no-self/emptiness), *dukkha* (suffering/dissatisfaction), and *pratitya samutpada* (interdependent arising/interbeing, the interconnectedness of everything). This will require much more ale, but shall ultimately bear the meta-cognitive fruit of primordial wisdom.

Quantum physicist Henry Stapp pointed out, in agreement with Max Planck and William James, that it is the consciousness of a "participating observer" that is the non-physical instrument which causes the collapse of the quantum wave function of many potential superposition states into one objectively, relatively "real" reality event. *This non-objectivist quantum view and the parallel Buddhist Middle Way view have profound implications for our cultural*

notions and prodigiously defended beliefs about a permanent, eternal material reality that includes an inherently existing self, or ego-I. Yes, this apparent self exists, but not intrinsically or absolutely. Why is this vitally important? Because as Tibetan Buddhist mahasiddha Shantideva told, "All the suffering of the world is a result of service to the self; all the happiness in the world is the result of selfless service to others".

Scientific Realism and Scientific Materialism can no longer be defended. Most particle physicists and cosmologists, if not most scientists, realize this. And Mahayana Buddhist philosophy, although lacking a tensor calculus and a science of the brain, offers a profound contemplative science of consciousness that is the basis of the present mindfulness revolution, and is now illuminating the vexing epistemological and ontological problems of recent post-Standard Model, post-quantum physics, cosmology and neuroscience ("The Neuroscience of Meditation", *Scientific American*, Nov. 2014; *Mind and Life Institute*, etc.).

Zen Mind, and a Historiographic Note

Let us remember that theory, scientific or otherwise, has a history. Theory interpretation, that ever turning epistemic dharma wheel of hermeneutics—arising from and dependent upon our pre-conscious, deep cultural background metaphysical assumptions and beliefs (e.g. in the West the substantialism of Platonic Realism, Physicalism, Materialism is the prevailing epistemic and ontic ideology; in the East it is the nihilism of epistemological and ontological Idealism)—changes and evolves over perceived historical time. *Scientific theory, as with the entire modal domain of relative conventional truth, is inherently provisional and uncertain.*

Our perennial quest for absolute concept/belief certainty—reason's ideal—is precluded by the truth of ontological relativity (Quine, Einstein), that is, our realities are dependent upon our preconscious, intersubjective deep cultural background "web of belief". Science and philosophy of course participate in this cultural paradigm. It is through understanding this process that we become the auspicious, even liberated discontents of the current popular materialist thinking classes.

Our current scientific "truths" have evolved from earlier theories that are now considered by specialists in the fields to be essentially incorrect, or at least incomplete. None of these theories were extent one hundred years ago. The theories of today have entirely replaced or subsumed yesterday's theories. May we not then assume that our present common sense and scientific cultural "web of belief" will be replaced by radical (real change is always radical) new theories and beliefs one hundred years hence? Most quantum cosmologists, particle physicists, neuroscientists and philosophers of science and of cosmology understand this great truth. Let us do so as well.

Perhaps then, we need no longer limit our knowledge—objective scientific or subjective introspective, psycho-emotional-spiritual—by clinging to and defense of this present popular "web of belief"—our uncomfortable comfort zone of concepts, assumptions, theories, biases and beliefs. Perhaps our binary, dualistic relative conventional understanding—if not its ultimate primordial awareness ground in which we are all instantiated—evolves and changes

almost forever. Our profoundly subtle "beginner's mind", zen mind, knows this truth. And yes, it takes a little perspectival study, as well as trans-conceptual mindfulness practice. This noetic doublet—objective and subjective knowing—is our cognitive key.

Here, arising always in this perfectly subjective unbounded whole, five hundred years of Copernican logocentric incompleteness and uncertainty just goes on, and on. Is there not a sublime aesthetic asymmetry, harmony, beauty in these two—objective/exoteric and subjective/esoteric—at once?

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