

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, where are we going, and why? 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 necessarily non-objective nature of such inquiry. Standard Model Concordance Cosmology (Λ -CDM or Λ CDM) has radically transcended, yet included our venerable Standard Model of particles and forces with its small constraints on non-empirical modes and methods. This Concordance Model "dark sector" assumes highly speculative, almost mystical entities, namely the utterly unknown dark matter and dark energy. What shall we make of these primordial atavistic vestiges that constitute 96 percent of the matter/energy of the observable "known" universe? Such a cosmology relegates the us and the earth, stars and galaxies to a mere 5 percent of the entire universe! Unnatural indeed.

Radical (all real change is radical) post-Standard Model and post-Concordance Model, "post-empirical" cosmology—supersymmetrical/SUSY superstrings, M theory and especially Multiverse Theory—has been enlisted to explain, or explain away this most "unnatural" condition. Such speculative views have 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 an empirically 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 strictly empirically testable. This resolution to the vexing "problem of demarcation"—what is scientific and what is unscientific—seems rather arbitrary, even extreme. Thus Popperian falsifiability has fallen on hard times. For philosophers of science it is no longer generally considered a viable candidate as a demarcation criterion.

Yet the cosmological orthodoxy seems to fear that a more relaxed, post-empirical test criteria is a slippery slope that will lead us astray from our uncomfortable comfort zones of the well established, procrustean presumptions of 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 (see "A New Scientific Revolution Emerges" below).

The physics and cosmology of Western culture seems to recognize only the antiquated physical/material aspect of our being in time. The ideology of *Western ontology* (what there is; being itself) of monistic Scientific Materialism upon which science and cosmology are based reduces mental, emotional and spiritual cognition to mere physical/chemical brain states. Under sway of such ontic and epistemic/methodological reductionism we remain generally closed-minded to any reality beyond the mere physical/material; that is to say, the subjective and intersubjective aspects of mind—intuition, introspection, emotion, religion, spirit—are largely taboo.

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

This culturally constrained realist and materialist/physicalist view is the philosophical foundation for Western cosmology: The Standard Model of Big Bang cosmology, 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 observable, visible universe; dark matter about 25 percent; and slightly less than 5 percent is good old atomic/baryonic ordinary matter that we are made of. Nice to know; unfortunately, 96 percent of the cosmos is missing!

Λ CDM is a cosmic extension—utilizing Einstein's "classical" (non-quantum) General Relativity—of the prodigious quantum physics of the Standard Model of particles and forces, the world of the very small, which utilizes the quantum theory of Bohr and Schrödinger. And yet, our universe of space, time and energy is scarcely understood at all. We can explain less than 5 percent of it! Particle physicists and cosmologists all know that this Standard Concordance Model of cosmology is woefully inadequate. What to do?

We shall herein explore what it is that this amazing conceptual model, this "new physics" post-Standard Model, "post-empirical" 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, an interdependently related unbounded whole.

The current crises in Western science and culture. We are nearing the end of our venerable Standard Model of particles and forces, and as well, its Big Bang Concordance Theory of cosmology— Λ CDM. Thomas Kuhn's unresolved "puzzles" or "anomalies" (*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 struc-

ture, its origin and aim (VII below). The prodigious Big Bang Standard Model is our Western scientific and cultural creation myth, the cognitive lens through which we view and understand our objective and subjective worlds. It continues to evolve.

Clearly, we are now entering a brave new world of post-Standard Model physics, and the socio-cultural consequences that follow therefrom. This is no less than a crisis in Western science and culture. We are on the cusp of that next scientific/cultural revolution. Objectivist Scientific Realism and Scientific Materialism/Physicalism with their dualistic Cartesian, Modernist/Enlightenment idolatry of reason and objectivity is no longer seen, at least by the Post-modern thinking classes, as an adequate worldview.

Obsessive reason and the Postmodern reaction to this Modernist worldview has produced a tyranny of anti-science subjectivity (e.g. the "science wars" of the late 1980s) that only exacerbates the destructive bipolar subject/object, spirit/matter split in human consciousness. Further, such a Postmodern view 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—namely, ethics and the wisdom of kindness; introspection, spirituality and religion. How shall we understand this?

The noble Standard Model of particles and forces, and the latter-day Big Bang Concordance Standard Model Λ CDM cosmology—these greatest human achievements—are incomplete, "unnatural", inelegant and entirely *ad hoc*. These models are vexed with contradictions and paradoxes:

- 1) The Standard Model fails to explain the two primary epistemic pillars of physics and cosmology, namely the objectivity of the gravity of General Relativity, and the inherent subjectivity of Relativistic Quantum Field Theory; and why these two "perfect theories" are utterly mathematically incompatible.
- 2) The Standard Model cannot explain the host of problems arising from the improbable extremely low entropy Big Bang cosmogenesis;
- 3) cosmic inflation's inflaton field with its undiscovered particle;
- 4) the values of the masses of the particles;
- 5) why the 24 or so quasi-universal physical constants have the values they do;
- 6) the Higgs mechanism that recently produced a diaphanous Higgs Boson;
- 7) the Higgs "hierarchy problem";
- 8) the three and curiously, only three generations of matter;
- 9) the failure of these matter particles/fields to account for mysterious dark matter and dark energy;
- 10) the apparent acceleration of the universe, as evidenced by the absurd value of the cosmological constant Λ , our new friend lambda of the Λ CDM cold dark matter Concordance Model of the cosmos.

We've seen that according to the Concordance Model this dark sector comprises over 95 percent of the matter/energy of the visible universe! The remaining 5 percent "ordinary matter" (baryonic protons and neutrons) is the realm of the patriarchal Standard Model of particles and forces that we have come to know and love. Again, about 96 percent of the universe is a complete mystery! (European Space Agency's Planck Probe map of the cosmic microwave background (CMB) 2015 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.)

Once again, this Λ CDM Model explanation is admittedly (by cosmologists) 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 that would be unkind.

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 raiment, 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"). Much 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. In any case physics' current Standard Model inflationary Big Bang creation myth will be gradually subsumed by more inclusive theories, especially non-objectivist non-creationist multiple universe or "multiverse" theories (VII below).

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, ultimate, 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* 2011). 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, should we find them, 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. 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. They are beyond our causal "particle horizon". Thus, the argument goes, we can have no information from such cosmic epochs, and cannot, even *in principle*, ever receive signals and thus conceptually, empirically know of the existence of such "post-empirical" parallel universes. Nor can we prove or falsify hypotheses about any such causally separate, or "non-local" universes (although COBE, WMAP, ESA's Planck Probe and BICEP2 have greatly enhanced our theories). Here our understanding of reality departs, as ultimately it must, the

empirical domain of the purely physical observer-independent, theory-independent reality of material science, that is to say, an observer-independent, theory-independent objectively "real world out there" (RWOT) existing independently of the consciousness of a sentient observer, or the measuring instruments of same.

We've seen that this aspect of the truth of *ontological relativity* (IX 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 of ontic interdependence (pratitya samutpada), 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).

An exemplar of 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 centrist 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 physics and cosmology paradigm prevail? Shall we encourage physics and cosmology to continue this exploration beyond the mere positivist 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 spooky reality subsumes the relative-conventional dimensions of our prosaic, "common sense" observer-independent realities of a RWOT.

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 (IX, *Cosmology and Buddhism*, below).

Now back to the present uncomfortable comfort zone of this seemingly objective, purely physical, observer-independent universe that we have so habitually embraced. Many cosmologists believe, in spite of what appears in the popular science press, that the empirically and logically impossible metaphysical *ex nihilo* Big Bang creation singularity of our 60 year old

Standard Model, and the more recent 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 many, if not most recent cosmologists, as we shall see (VII below).

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 clearly 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, emerging science of consciousness?

Indeed, this is our next scientific revolution that will, in due course, unify Λ (dark energy) and CDM (cold dark matter)—the Concordance Λ CDM Model with its Relativistic Quantum Field Theory (QFT)—with Einstein's General Relativity (GR). (That, or either GR or QFT, or both will be scrapped following a spectacular discovery.) Such a unification is the post-empirical epistemic grail quest of the 21st century. And it shall be greatly facilitated through an ascending noetic (subject/object unity) science of consciousness ("The Problem and the Opportunity of Consciousness", 2013, www.davidpaulboaz.org).

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 GeV at CERN on July 4, 2012, is no doubt a new boson that is consistent with the long sought Higgs boson. Then, wonder of wonders, in March of 2013 both CERN's CMS and ATLAS teams claimed definitively that it is indeed physics' grand desideratum: a Higgs boson. It's a Higgs boson yes, but is it *the* Higgs boson? After all, post-Standard Model supersymmetry theory (SUSY) predicts five Higgs bosons!

Is the recent discovery of this Quixotic "Higgs-like" particle 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 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 Higgs field, its God particle, and everything else 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 the Higgs

parameters as predicted by Steven Weinberg's definitive 1967 paper ("A Model of Leptons" (PhysRevLett, 19:20).

Does this "Higgs-like" particle 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 the new particle reveal the requisite decay parameters? Any statistically significant deviation from these predicted decay rates excludes this new particle from the Standard Model orthodoxy, and augurs well a new post-Standard Model physics and cosmology. This is a big deal for our aging Standard Model of particles and forces. Smart money, and much cosmological hope and fear, is on a new physics.

The requisite predicted decay rates are: two photons (the actual observed decay event announced July 4, 2012); or two W or Z bosons; or a fermion/antifermion pair. In any event, the sum of fermions less antifermions is zero, thus it is *a* boson. And as the total charge of these results totals zero, it's electrically neutral. And it's spin is zero so it's probably an elementary, not composite particle. Well and good.

So by March 2013 new data points eliminated non-zero spin, and odd parity, prompting CERN's CMS team boss Joe Incandela to declare it *a* Higgs boson. But is it *the* Higgs boson? What about those decay rates? What was predicted by Weinberg and others was a decay rate of 57 percent bottom/antibottom quarks, not the .02 percent photon pair that actually appeared. Statistically significant deviation? More data sets are needed.

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? This is the prodigious "hierarchy problem". The two Higgs parameters are its particle rest mass, 125 GeV; and the energy value of the Higgs field in the "empty" vacuum of space, namely, 246 GeV. Why is the Higgs mechanism, at the weak interaction scale, many orders of magnitude smaller than the other force interactions, i.e. GUT unification of the weak and strong forces (Carroll 2010, 2015)?

Does this epistemic fudge in the still 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 Concordance 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, "post-empirical" phenomena—the conceptually, even mathematically ineffable quantum world of quarks, leptons, Higgs bosons and the multiverse, 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 emptiness ground itself, the very "mind of God".

Fortunately, this vast unbounded whole (Buddhist/Bōn *mahabindu*)—Bohm's "holographic holomovement, the implicate order"—is of course, self-reflexively instantiated in the consciousness of us observer-dependent, theory-dependent, ontologically relative sentient beings. Again, ontologically speaking, the relation of this conceptually (but not contemplatively) ineffable whole to its participating parts is one of identity. *Tat Tvam Asi*. That I Am!

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 into just two high energy photons. Let us assume further, that this "Higgs-like boson" is declared to be, not just *a* Higgs boson, as it was in March of 2013 by both CERN's Atlas and CMS teams, but *the* Higgs boson.

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 massless particles unchanged, is still not at all understood. Again, the core theory of the Higgs Mechanism remains—no surprise—mathematically incomplete (Zebuhr, Hotson, Phipps, Gulko, *Infinite Energy*, Vol. 18/105, 2012).

4) The Higgs field is said to pervade all of "empty space". Baryonic particle interactions within this great field infuse them with mass, thereby creating all the mass of the universe. But it cannot be so. Nobel laureates David Gross and David Politzer have shown that "the mass of quarks accounts for only 2 percent of the mass of the proton and the neutron, respectively. The other 98 percent...arises largely from the actions of gluons" (Sci. Am. May 2015). How gluons, the carrier of the strong force, bestow mass on baryonic particles is, however a profound mystery, for gluons are massless. So resolving the mass conundrum depends upon just how it is that gluons bind quarks. No one has any idea.

The strong nuclear force is by far the strongest of the four forces. In order to bind quarks into protons and neutrons, inside baryons, the strong force must counter the huge electromagnetic repulsive force of like-charged protons inside the nucleus.

Moreover, in contradistinction to the other forces, the strong force binds much more strongly as quarks move apart. But the strong force cannot range beyond its nucleus. Gluons then should be massive. Yet they are massless. What then is this strange relation of the Higgs mechanism to the strong nuclear force with its mighty little gluons? Does the Higgs field really bestow mass upon anything? And if so, how?

Hence, just how it is that this wondrous Higgs particle endows 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.

So, let us 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 skepticism. Then shall we see, in due course, what our emerging post-Standard Model noetic paradigm reveals to the prepared mind.

Gravity Behaving Badly: Quantum Gravity and Dark Energy

Gravity is the creator and destroyer of worlds. Gravity is the creative principle of the physical cosmos, the material dimension of the unbounded whole that is body/mind/spirit *kosmos*.

Einstein's General Relativity Theory (1915) 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. However, GR is known by cosmologists of all stripes to be inadequate on cosmological scales.

In 1914 Einstein (with the help of his friend Marcel Grossmann and his mentor Ernst Mach) introduced the tensor calculus of Riemann (the Riemann [**R**]) to the four dimensional spacetime of Einstein's math teacher Hermann Minkowski to produce Einstein's sublime GR gravity field equations of his Theory of General Relativity, published in December of 1915. 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 equations predicted. At this time Einstein believed in a static, non-expanding universe. His GR field equations told him otherwise, leading to Λ , "my greatest mistake". More on this below.

How does it end? Gravity and the density parameter. 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 of the universe is believed to be about 5.8 hydrogen atoms per cubic meter of space.) In a Friedman universe with no cosmological constant Λ the critical density is that cosmological balance precisely between the average density of a contracting, collapsing closed Big Bang universe, and the average density of an ever expanding open universe.

This ratio dictates the geometry of the present universe. Where the observed or actual density and the critical density are equal, the universe—what we can see of it—is Euclidian, or flat, as the CMB indicates that it is. If total 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 critical density ($\Omega < 1$) the universe is open and expands eternally. Dark matter contributes to universal contraction or collapse. But dark energy, the cosmological constant Λ , 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, if dark energy expansion increases, a speedy "Big Rip" wherein the very atoms of matter/energy are torn asunder. Bad for origin and evolution of species.

Spooky dark energy (about 68 percent of the universe, ESA Planck 2015 release) is believed by cosmologists to be Einstein's cosmological constant Λ that exerts an anti-gravitational repulsive force against the natural contracting force of gravity, accelerating the expansion of space and its galactic contents in Hubble's already expanding universe. The ultimate fate of this universe—open and infinitely expanding; Euclidian and flat; or closed and ultimately contracting (Friedman's three universes)—depends upon these two variables, gravity and anti-gravitational cosmic dark energy density Ω_Λ .

As to universal expansion, it is not that galaxies are "moving away", but that space itself is expanding, with all 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 and its contents is expanding. According to Hubble, $\Lambda = Hd$, where Λ is repulsive anti-gravitational galactic recessional velocity, d is galactic distance, and H is Hubble's constant.

Well, what about mysterious invisible dark matter (about 25 percent of the universe)? It is not electromagnetic; it moves slowly, and it does not readily interact so it is not ordinary atomic/baryonic "hot matter". Moreover, it has to be a non-Standard Model entirely new kind of field/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 ordinary baryonic (protons and neutrons) visible matter. Such common ordinary hotly interacting matter is by hypothesis less than 5 percent of the total inventory of the universe!

Jan Oort first hypothesized dark matter in 1933. In 1974 Vera Ruben found it in the rotational action 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 schema for dark matter WIMPS is Supersymmetry (SUSY). The lightest of the SUSY particles is the LSP (lightest symmetric partner), a prime WIMP candidate. Let us hope to find it in late 2015 with CERN's reborn LHC. More on SUSY below.

Adding insight to injury, yes, the cosmos is expanding, and accelerating which may result, if acceleration does not increase, 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 (see Timeline below). In the titanic cosmic struggle between contracting gravity and expanding, accelerating 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, the result is a chilly "heat death. If dark energy speeds up, 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 accelerating, but

non-exponentially accelerating dark energy; that is to say, not a Big Rip, but merely a Big Chill. "Not with a bang, but a whimper".

Or might we even imagine a monstrously reflexive "Big Gulp" wherein a viciously vindictive really big black hole—perhaps Wheeler's "Great Smoky Dragon"—gobbles itself up in a *kosmic karmageddon*, and along with it any extant physically based 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 presumed 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); predicting antimatter in the bargain! This field theory, through the magic pixie dust of a prodigious mathematical fudge called "renormalization", resulted, in 1948, in the quantum electrodynamics (QED) of Feynman, Tomonaga and Schwinger, which bestowed upon us the mixed bag of the laser, the computer, and the hydrogen bomb; and bestowed upon them the Nobel Prize in physics.

However, what was not yet explained in 1948 was the strong and weak nuclear forces, and the gravity "force". (Einstein's gravity is not actually 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 explosions their heavy elements—carbon, oxygen, nitrogen and iron—are spewed into space so that carbon 12 based anthropic star stuff like us may evolve a consciousness to ponder it all. Then, some sunny day, in due course, an enlightened consciousness arises to actually understand that all life is a spacetime instantiation, an instance of the basal primordial ground of this great Promethean unbounded whole (*mahabindu*) that is, in its mere physical raiment, none other than the physical creative principle that is great gravity itself.

Yes, gravity is the creator and destroyer of worlds, and thus the greatest physical mystery for carbon based intelligence to grasp. Gravity displays exoteric outer, esoteric inner, and "innermost" nondual connotations of meaning to grace the prior unity of the objective and subjective understanding of human beings. From such an understanding emerges the great primordial wisdom view that we are not separate from the perfect subjectivity of that vast unbroken whole.

In 1967 the weak nuclear force was finally unified by Weinberg, Glashow and Salam with Maxwell's (1860) electromagnetic force/interaction to create the electroweak force; not to mention another Nobel prize. 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. So this Standard Model does not include the fourth

"force", namely, 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 noetic (subject/object unity), post-Standard Model theoretical whole shebang, but clearly not via a physicalist/materialist Theory of Everything (TOE) (see "Is a TOE Logically Possible", below).

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. Nearly everyone agrees that GR is incomplete in this regard. Why? Physical reality is inherently quantum in nature. Thus GR must be quantized by a quantum gravity theory. Quantum Field Theory (QFT), which according to Penrose (2004 30.1) is also 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.

SUSY and the end of the Standard Model. 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 the holy grail of 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 "s" "sparticles") should be detectable in CERN's LHC, but have not shown up. Perhaps with this year's (2015) higher energies they shall appear. Of course, absence of evidence is not evidence of absence, but the pressure is on for SUSY's suitors.

As to the proverbial Big Bang, we must address certain questions: What banged?; Why did it bang? What happened before it banged? (V below)

M Theory envisions a pre-big bang universe wherein the Big Bang singularity was not a unique "first cause" quasi-theistic creation event, but is actually a "Big Bounce" transition from a prior contracting crunching 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 (VI below). Here, the universe may have begun nearly empty (DeSitter space), then grew into such a "bangian" Big Bounce. For M theory time is relativistic (GR), not absolute (classical/Newtonian). Thus does M Theory require a radically post-empirical, post-cosmocentric, highly speculative infinite Multiverse, as we shall see.

Now in M Theory, nature's 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 contradistinction to the first postulate of Einstein's Special Relativity.

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*. Curiously, the prodigiously difficult mathematics of this string theory dilaton field require not four dimensions—three of space and one of time—but a total of eleven dimensions! These purported Planck 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 an ontologically 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, which suits Bohr's early quantum mechanics nicely. Smolin tells us that LQG is a desirable 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 a unified GUT, is audaciously termed "The Theory of Everything" (TOE); as if human reason could penetrate the very "mind of God" (Nagel). O Hubris!

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). 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 that 25 percent 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 those who know SUSY 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 14 TeV capacity of the upgraded LHC. And they may be correct. But SUSY's mass is predicted to lie well under CERN's LHC new capacity. The pressure is on for SUSY. Time, if there is any, will tell. Now, what about time?

About Time

Time is nature's way of preventing everything from happening at once.

—John Wheeler

Brief metaphysical excursus. Being is time. Dōgen's *Ugi* is "being-time". Human consciousness is being in time, participating in the luminous vast expanse of all-embracing awareness/consciousness/being itself, the unbounded whole (*mahabindu*) in which, or in whom personal human consciousness arises and participates. Sentient consciousness is necessarily a self-reflexive instantiation of this luminous primordial awareness base (*gzhi rigpa*). Such being in time requires *presence*, a present non-logocentric embodied, or even non-embodied consciousness. In the absence of such consciousness there is no time. Being in time is our ontologically relative 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 in the fluent context of our personal past and future. Dōgen tells that 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. Our past and future have meaning to us. These three times are a prior unity, the ultimate nature of mind (Big Mind), displayed and arrayed for our relative conceptual mind (Small Mind) simultaneously. The contents of ordinary mind objectively arise from the vast primordial awareness "groundless ground" of everything. Here knowing subject and perceived object, these two dimensions of our unbounded whole, are a prior ontic unity. For Dōgen then, time is not a logocentric entity, vessel or "thing" that contains the world. So being is time. Time is the actual epistemic nature or presence of being in the world. What then is time's ontic status?

Being does not arise in time. Time, or spacetime arises because being itself happens. This vast expanse that is the interconnected continuum of being descends and ascends endlessly. Primordial being in time is inherently trans-rational and nondual, yet arises descends and manifests as relative, temporal and spacial. Being in time is the continuity of

interdependent, impermanent change arising through/in its perfectly subjective primordial matrix ground, a vast participatory causal matrix, this unbroken whole that is trans-conceptual, nondual being itself.

Viewed historically this change rides the breath of instantiated spacetime embodied consciousness. Ordinary direct pre-conceptual, "primordially pure", naked perception, the pre-reified, pre-empirical, luminous nondual primordial awareness of this great process, moment to moment, is profoundly good. The less direct, *objective*, conceptual/discursive understanding of this great process is good. The *subjective* feeling awareness, at the Heart, of this great process is good. These three awareness modalities—these modes of being here, sensing, reason, and feeling awareness—are always, already an ontic prior unity, prior to discursive thinking about them.

A very brief history of time: East meets West. The nature of time, the problem and opportunity of time, undergirds all philosophical, quantum and cosmological questions. Time is key to resolving the perennial conundrums of ontology—being in the world—and epistemology, knowing *about*, and knowing *that* being itself.

Relativity is about time. The gravity of Einstein's General Relativity (GR) slows the seeming flow of time (time dilation). Time is key to Special Relativity (SR), its generalization as GR, and the quantization of the gravity of GR, 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 relative-conventional physical spacetime (particles and forces) is quantum in nature, a unified quantum understanding of gravity, "Einstein's Dream", is most essential; yet still escapes us.

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

Physicists have not been kind to time. 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. The time (t) term of Einstein's GR field equations is suppressed. Here, in opposition to Newton's classical, absolute objective scientific realist view of time and of space, our experience of time is subjective, almost illusory.

The apparent flow of time, entropy, the thermodynamic arrow of time—past, present, future—are equally real, or equally unreal. Here, our sense of the now, the present, is an illusion arising from our ontologically relative, linguistic, inter-subjective culture based reification/objectification of a separate self over against an objective, observer-independent "real world out there" (RWOT). In short, the perennial, proverbial dualistic 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 or reason, and trans-conceptual or trans-rational noetic-contemplative cognition. These three arise in the phenomenological chain of our experience of being in time.

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 (*vikshepa*) 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 nondual 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 nondual "ultimate truth" for a relative-conventional conceptual abstraction of it. That is to say, we grasp at, conceptually reify/objectify and concretize the appearing objects of spacetime "relative truth"—scientific objectivity (form)—while ignoring (*avidya*) that all-embracing perfectly subjective "ultimate truth" (emptiness, the unbounded whole)—the very ground of *That (tat)*—in which this all arises and participates.

Can "Science" abandon its objectivist/physicalist bias and actually consider the meta-cognitive 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—all knowing subjects with their intentional objects?

As we penetrate this veil of ignorance (*avidya*, *ajanaana*, *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 our 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. As Whitehead told, "Western philosophy is a footnote to Plato." For better or worse.

These universal 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, primordial, nondual "groundless" ground. The merely conceptual Two Truths—relative and ultimate—are instantiations of 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", as an entified thing. This is the prevailing Western metaphysic of Platonist/Augustinian foundational Realism. 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. Here, appearing reality is but an unreal merely mental illusion (Hindu Veda/Vedanta and Buddhist *Yogachara/Chittamatra*.) Is there a centrist view (XI)?

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 holographic unbounded whole itself (*mahabindu*). This one all-embracing truth is invariant, and present throughout all cognitive changes, all reference frames—outer, conceptual, objective, exoteric; and inner, trans-rational, subjective, esoteric, even nondual. On this view, spacetime is *relative* foreground, arising within its *ultimate* timeless deep background, the unbroken whole itself, Bohm's Implicate Order—which is the nondual, trans-conceptual

primordial ground of everything, by whatever name. Is it humanly possible to know (gnosis) such a timeless luminous non-conceptual ground? Let's see.

Space and time for Newton, Leibnitz, Kant and Einstein. For Einstein, the *ultimate* universe is a timeless unity. *Relative* time—past, present, future—(the "three times" of Buddhist Mahayana) is but a dimension of space. Following Leibnitz, 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 local realist and determinist, time is not, for Einstein, as it was for Newton, an absolute observer-independent reality, existing as a "real world out there" (RWOT), from its own side. It seems that the great mind that was Einstein was unable to reconcile his objective inner realist with the inherent ontological relativity (time is a linguistic construction) of his view of time.

For Leibnitz (1646-1716), arguably the most subtle Western mind ever, ultimate reality resides not merely objectively in an observer-independent spacetime, but as well in an inter-subjective, interpretive and perspectival 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, independent of an observer. *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).

The philosophical foundations of recent Big Bang quantum cosmology, and Einstein's General Relativity are embedded in the 18th century spacetime notions of Newton, Leibnitz and Kant. Let us then explore a bit of this Modern Science.

At the beginning of the 18th century, the two greatest intellectual giants "ever to adorn the species" (Hume)—Leibnitz and Newton—with their followers, vigorously debated the nature of space and time (the prodigious Leibnitz-Clarke correspondence). Newton defended the "absolutist" or "mathematical" view; Leibnitz argued the paradigmatically opposite "relationalist" or, as Leibnitz preferred, the "relativist" position.

The absolutist view of Newton is a classically "external" local 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, and independently existing observers. This view is then objectivist, substantialist or substantial, physicalist/materialist, epistemologically and ontologically reductionist, and causally determinist.

The relativist view of Leibnitz is relational, and observer-dependent, that is, appearing reality is dependent upon and relative to the consciousness—perception and conception—of an observer. Here, space and time do not exist absolutely, as independent substances, but merely through spatiotemporal relationships among material bodies. The relativist view of

Leibnitz then, is relational, subjectivist, ontologically relative, panpsychic and proto-idealist. Enter Immanuel 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*): 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* (prior to experience) 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 sense..." (*The Dissertation*). For Kant, our experience of space and time is as basic as is our experience of cause and effect.

Modernist Enlightenment 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 this transcendent noumenal world. And our experiences of the phenomenal world of physical and mental forms are *constructions* of the mind (Kantian Constructivism). Middle way Buddhist epistemology agrees.

Stephen Hawking's surprising new anti-realist Model Dependent Realism (MDR) is a recent example of constructivism in physics, and philosophy of physics. Notwithstanding Hawking's (*The Grand Design* 2010) witless statement that "philosophy is dead", we have here an incipient new ontology for physics. Here, in observer-dependent, theory-dependent, model dependent thinking, we cannot know reality in itself—existing independently from an observing consciousness—but only as a Kantian "schema" arising and appearing in our various conceptual scientific and philosophical models of reality. Centrist Middle Way *Madhyamaka* Buddhists would agree.

Paul Dirac, who unified the Copenhagen Interpretation of the quantum theory of Bohr and Heisenberg with Einstein's Special Relativity (i.e. Relativistic Quantum Field Theory, or

QFT), agreed with Einstein when he wrote, "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 and always, in all physical reference frames throughout the universe.

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 formation (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 this all arises and participates.

Smolin's creative "Loop Quantum Gravity" rehash of Einstein's GR could be seen as a reconfiguration of Julian Barbour's "shape dynamics". Smolin rejects mainstream physics' cosmological "block universe" wherein past, present and future are equally real, or unreal. The reality of past (memories) and future (predictions) lies only in their cognitive artifacts now present to human consciousness. For Smolin, "All that exists is this present moment". Yet, I think that we must assume Smolin's moment now must surely be arrayed in a Dōgen-like "being-time" (*Ugi*) context that includes the perennial "three times" of past, present and future. As Dōgen pointed out, this "eternal moment now" makes no sense without consideration of a personal past and future to which it is relative (see Dōgen below). If Smolin is not familiar with Dōgen, so much the worse for Smolin. Let cosmologists, and philosophers of cosmology read Dōgen!

For Newton, the universe of energy and matter is constituted of separate, objectively real point-like particles ("corpuscles") 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/boundlessness (*shunyata*) base or ground that is ultimate nondual 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 now 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, while 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 reality itself". Philosophers of physics and cosmology, if not always physicists and cosmologists, are now rediscovering *kosmic* being time in Dōgen Zenji's syncretic view of the prior epistemic unity of our two faces—objective and subjective—of an inherently reflexive unbounded whole (*mahabindu*) that is reality being itself, the very nature of mind, our actual identity.

Dōgen's great insight is that prior to the superimposition (*vikshepa*) 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, in basal naked awareness, the epistemic bane of subject/object separation and conceptual reification have not yet occurred in the causal phenomenal cognitive chain. Immediate perception, an instant 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 "perfectly subjective" truth. How do we do this? We consult the experts, of course. 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 being here now. We can learn to be present to the trans-rational, trans-conceptual, even nondual *presence* of *That*. And yes it takes a little transpersonal mindfulness (*shamatha*) contemplative practice. As the Buddha told, "come and see". So, by all means, check it out!

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 George 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, that became the creation myth of 19th and 20th century physics, that the universe is a proto-theistic 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 given problem when a more effective strategy can be demonstrated to exist.)

Cosmological models—even scientific ones—have their antecedents in a culture's cosmogony, its 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 and space. The reality that a culture presumes to describe is embedded in and arises from its preconscious primordial cultural system of concepts and beliefs, its semiotic "web of belief". The elephant in the room: our conceptually constructed cosmologies are ontologically relative. Physical science is a product of culture. Cosmology may be seen as a cultural "mask of God", or the map of consciousness through which we view and experience both relative and ultimate reality. Scientific empirical "facts" are generally "theory-laden" and woefully underdetermined. Theory arises from, and is founded in preconscious deep cultural background "web of belief".

Hence, subjective, deep background culture creates/constructs its 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 of creation and destruction. Multiverse theory is equally cyclic. Humanity's views of *kosmos*, it would seem, favor this periodicity—this descending and ascending explanatory archetype of the "eternal return".

Entropy and the thermodynamic arrow of time. In 1919 great British astronomer/astrophysist and conscientious objector Arthur Eddington, in league with Einstein, offered early empirical evidence (whose methodology is 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 empirically and logically precluded. A broken egg cannot be unbroken. Causes precede effects, which suggests that the arrow of time is a logically necessary condition of our understanding 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, and may indeed prove to be the very definition of great gravity itself, that spooky creator and destroyer of worlds. More on this below.

Why does time have this forward direction? It is 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 physics 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 at this microscopic strata of formation. 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 (the cosmological constant problem)? Why is the cosmos accelerating? Why is the value of the cosmological constant Λ absurdly low? How do we resolve the Higgs "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 evolutionary process of the motion 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. Einstein demonstrated that 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"? Simultaneity is relative. This is spooky "time dilation".

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 merely 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. The whole universe is such a closed system. Both the universe and an unbroken egg have low entropy. They are highly ordered. A broken egg has higher entropy; it is more disordered. A scrambled egg has yet higher entropy.

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 Λ 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 sparse high entropy state of near equilibrium, a "heat death". 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 recall is the conservation of energy. Energy can neither be created, nor destroyed. Energy is always conserved, but may change states or forms.) Boltzmann's second law was established in its 20th century 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) is 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. The second law is statistical, not absolute, or logically necessary.

2) *The Causal Arrow of Time* wherein causes *ipso facto* 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 due to our "habit of the mind" that presumes that one event follows another. For Hume this causal imagination, with the self-sense from whence it springs are essentially illusory and fictional. "The self is a fiction". A permanent abiding self is an illusion, is delusory, just as Shakyamuni Buddha told. And its projection of causality cannot be proven. There is here no logical necessity at all.

Yet we *must* take causality for granted. Inductive logic is stochastic; it provides no deductive logical proofs, no deductive certainty; only probabilities. Yet we are all relatively certain that the sun also rises tomorrow. Humean skeptical, ontologically relative radical empiricism indeed. Religious studies folks of all stripes should all at once rush out and purchase Hume's *A Treatise of Human Nature* (1739), his greatest work, written when he was 28 years old. They shall all love its robustly skeptical, radically empiricist ontological relativity.

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 non-imaginary law of cause and effect, the inexorable law of karma, is all too real. Perhaps then we might here establish a new behavior/conduct causal arrow; to wit, 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 itself. Philosophers of physics and cosmology are working on it. At this stage it does seem that these two arrows, memory and entropy must necessarily, 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

And darkness was upon the face of the deep.
—Book of Genesis

Now to thicken our historical creation 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 volatile research 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. But Einstein and Eddington were skeptical as to an expanding universe.

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 velocity (z) is proportional to the distance to any given galaxy. Hubble's Constant H is the proportionality of that velocity (now 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 ($t=0$). Zero is emptiness/boundlessness. 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 consider.

So, from such early quantum density perturbations of this primordial stuff evolved our 5 percent allotment of baryonic (protons and neutrons) ordinary matter as stars, then their inevitable death as supernovae; and from these explosions, the seeding of the star stuff that we actually are, namely carbon 12, and the other heavier elements, iron, oxygen and nitrogen.

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. As a second generation star its spindrift created a system of planets, one of which was serendipitously located in a cosmic "goldilocks zone" where conditions for life were "just right"; then 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 fabulously fine-tuned anthropic 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, or any other planet does not logically or empirically preclude alternative consciousness strategies that may have evolved over that next billion years or so of time. During the following four billion years this red giant star of ours will utterly embrace our lifeless spaceship mother earth, and all the planets of its solar system. Very like in the beginning. Perhaps, some sunny day, we beings of the three times—past, present, future— 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 transcends the semiotic structure—logical syntax, semantics and pragmatics—of language. At such a singularity all theory—whether relativistic quantum field theory, or General Relativity—breaks down. 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 still human contemplative mind.

So once again, let quantum cosmologists dialogue with Buddhist scholar practitioners, particularly those who know a bit of physics. Let us not continue to presume that mere objective knowing of mere physical/material reality exhausts our cognitive repertoire. Even common sense (Russell's metaphysics of the Stone Age) mandates such a healthy skepticism of our unconscious, habitual, mass-mind "web of belief; does it not?

Yes, that first minute is highly conjectural. And this cold Big Bang state at the instant of "cosmic inflation", about 10^{-35} sec before the much beloved hot Big 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".

In this purported 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 stars, 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. A heavenly miracle if ever there was one. Again, fabulously finely tuned "good karma".

Then what? 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. From these predictions evolved our amazing Λ CDM Concordance Model providing further evidence for mysterious non-baryonic dark matter.

Nucleosynthesis also provides support for General Relativity, and for exceedingly arcane dark matter by revealing an accurate account of ordinary 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/mathematical theory breaks down at this smallest dimensional scale. Spacetime (gravity) assumes its quantum face. Thus arises (much later) our 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. Can such physical laws abide with no observing consciousness to do the math?

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

The Inflation Epoch (cold Big Bang): 10^{-35} sec; size 10^{-26} ; temperature 10^{28} Kelvin; Hubble radius about 10^{-28} m. Now, emerging from the GUT Era arises the empty, scalar quantum "inflaton field" with its yet to be discovered inflaton particle. This highly speculative "inflation scenario" inflaton quantum field is said to be a cold Big Bang accelerated expansion of a non-zero vacuum energy density—a dark super-energy term that acts as a time-variable cosmological constant Λ driving this utterly *fantasque* instantaneous, exponentially accelerating, supra-luminal expansion of spacetime. (Here, space can travel faster than light; but matter cannot travel through space faster than light.)

Something like this may have occurred just after the GUT phase transition. Cosmic inflation is, for now, the only extent scenario that comes close to resolving the Kuhnian "puzzle" or "anomaly" of the large scale homogeneity of our observable universe, namely, the Horizon Problem of explaining why large scale structure today is so smooth when galaxies and clusters have not been in causal contact with one another since the purported Big Bang singularity at (t)=0. (Homogeneity: the cosmos appears smooth in every direction, i.e. it has a nearly uniform density and structure on the largest scales and does not change with distance or direction. This is known as the Cosmological Principle.)

However, the mathematics of inflationary phase transitions are incomplete and highly conjectural, and there is still no observational evidence, if such is logically possible, that the various and sundry models of the inflaton field actually produced the CMB, or any other long term effect.

Should cosmic inflation (Guth 1981, Albrecht and Steinhardt 1982, Linde 1990) actually provide some believable supernatural first cause—and it's now a favorite "post empirical" theory among cosmologists as we further explore the luminous result of this primordial genesis through our exploration of the primeval CMB echo—it explains a lot: 1) cold to hot "reheating" (10^{-34} sec), which 2) launches our old friend, the hot Big Bang, and 3) it neatly provides *ad hoc* solutions to several of the hot Big Bang Problems listed below, to wit, the Flatness Problem, the Horizon Problem, the gauge Monopole Problem, and the Large Scale Structure Problem (see "Big Bang Problems" below).

As to the structure problem, "quantum jitters" or quantum fluctuations become the germ of cosmic "roughness" or clumpiness that begat the gas that collapses under gravity to

form later stars, galaxies, and large scale structure of the universe. Moreover, inflation predicts prior and future universes; among them candidates of Brian Green's nine-fold Multiverse (Green 2013).

So it was, that at the Planck Scale, and during GUT Transition, utterly random quantum fluctuations, as it were, quantum foam, came to be cosmic seeds that shall then spawn an infinity of instantly propagating inflationary universes, one of which, ours, was photoluminously captured 380,000 years later during Recombination/Photon Decoupling and photoimprinted upon the heavens for much later sentient consciousness to exult. Wow! What hath God wrought?!

Reheating Era (hot Big Bang): 10^{-34} sec; As cold Big Bang inflation ends, the non-zero vacuum energy becomes mass energy expanding to eventually fill the small visible part of the our universe with large scale structure sprinkled among vast empty voids of space.

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" without form, just as the hoary old Vedas, Buddhist *Abidharma*, and the Old Testament Genesis have told.

The Breaking of Supersymmetry (if there is any supersymmetry): 10^{-16} sec; creation of supersymmetric post-Standard Model partner particles to matter fermions (composite quarks and elementary leptons). The lightest supersymmetric particle (LSP) is the top candidate for the WIMP that may be the undiscovered particle that comprises dark matter.

Electroweak Phase Transition: 10^{-10} ; size 10^{-15} ; temperature 10^{15} Kelvin. Electroweak symmetry is broken; weak and electromagnetic forces separate; all particles are bestowed with mass by way of the as yet mathematically incomplete mystical Higgs mechanism, its all-space pervading Higgs field, instantiated in physics' holy grail, the diaphanous, Higgs boson. It is useful to recall that the nature of physical reality is the wave function, the quantum field. Particles are "useful fictions"; excitations in the fields. Is reality a point-like particle, as Newton believed? Or is it Schrödinger's wave? Or is it both, as in Bohr's complementarity? Quantum field theory now tells us definitively that it is the wave.

Quark Confinement Era: 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 Era: 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. Heavy earth elements—carbon, oxygen, nitrogen, iron—are formed in much later supernovae explosions (1-2 Byr).

Matter/Radiation Density Equality: 57kyr; photons and both atomic and dark matter density are here about equal.

Recombination/Photon Decoupling Era: the "time of last scattering"; creation of the cosmic microwave background radiation (CMB); 380 Kyr; size 10^{-3} ; temperature 3×10^3 . Free electrons now combine with nuclei to create the first 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 the present 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 roughness or *angular power spectrum*, this luminous cosmic recipe to be: dark energy 68.3 percent; dark matter 26.8 percent; ordinary baryonic matter, the visible stuff of the universe, including us, 4.9 percent; age of the universe 13.77 billion years.

The Dark Age: 5-200 Myr; size 10^{-1} ; temperature 30 Kelvin. The tiny initial quantum perturbations in matter density have now formed hydrogen and helium atomic gas, along with dark matter clumps, which then begat gravitational collapse forming the first stars, which form galaxies and large scale galactic structure.

The first stars then, were constituted of primordial atomic gas, 75 percent hydrogen and 25 percent helium. They are massive, therefore their lives are hot and brief (1-4 Myr) terminating in great supernova explosions. Much later supernovae explode away their heavier elements—carbon, oxygen, nitrogen, iron—for future use in planets, and in 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* (1-2 Byr), and many supernovae. Increased production of these heavy elements stabilizes later stars by reducing their mass and luminosity, thereby increasing their longevity.

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

Acceleration Epoch: 7 Byr; hot Big Bang state cosmic expansion begins to peter out, then most mysteriously becomes an *accelerating* expansion, discovered in 1998 through observations of type Ia supernovae. This strange inexplicable expansion is due perhaps, to dark energy, the cosmological constant Λ , the static vacuum energy itself? Or due perhaps to a dynamic Quintessence field.

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. Dark and ordinary matter now equal 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 believed to be 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, and is presumed to continue the present visible structure. Astonishingly, this visible universe is but a small part of the total universe, 95 percent of which lies beyond our visible, causal "particle horizon"; and which is, on the account of Multiverse theory, but one in an

infinite ensemble of universes, some with entirely separate spacetime continua. Cosmic and eternal inflation support such a Multiverse notion which is fast becoming cosmological orthodoxy. Goodbye creationist *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 gradually becomes a red giant. At about +1-2 Byr earth's atmosphere and surface are consumed. At +5 Byr the sun explodes off its own atmosphere, obliterating its planetary system; ultimately to become a lifeless white dwarf. However, we must not be downcast at the prospect of this sad consummation. There are more things in heaven and earth than are dreamt of in our materialist philosophies. Thus does intelligence, once created, in due course, free itself from mere physical-chemical embodiment.

Large Scale Structure Development Ends: +20 Byr; accelerating expansion by dark energy reduces density, precluding further growth of galaxies. Existent galaxies hold together by way of their own local gravity. The universe continues its high entropy decline. Dark energy continues exponential accelerating cosmic expansion. The Virgo super cluster passes through and beyond our event horizon in +100 Byr.

The Last Stars Die: +1000 Byr (1 trillion years). Our timeline fantasy concludes. If accelerating dark energy Λ remains stable in its acceleration, high entropy heat death/Big Chill is the ultimate fate of this universe. If Λ acceleration slows, we end ultimately in the proverbial cyclic Big Crunch, the possible seed of an all new Big Bang. If Λ increases, look out for a super accelerated Big Rip in which the very atomic structure of physical reality is torn asunder. In any case, *Fin.* Primordial emptiness again; but even here, not without very rare quantum fluctuations, the "quantum foam" that, in the fullness of time, seeds a new universe.

Perhaps form, even life, even self-conscious life—whether physical, disembodied mental, or pure intelligence, abides in other, parallel universes in this infinite vast expanse, the unbounded whole (*mahabindu*) that is reality being itself. Perhaps this process is never ending. Or perhaps not. ("Timeline" thanks to Mark Whittle, Sean Carroll, Joseph Silk.)

Seek Hindu and Buddhist cosmology to explore subtler reality dimensions abiding beyond the "scientific", merely physical, *objective* cosmos. Let us venture in the brave new world of the *subjective kosmos* reality dimensions of this vast whole that transcends, yet embraces our outer, exoteric understanding of mere physical cosmos.

Following physics' recent metaphysical rude awakening to the inherently subjective nature of reality itself—the 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 faces, 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 this 20th century 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.* What to do?

Here we might consider the often adroitly dodged child's question: "What happened before the Big Bang? What banged, how; when; where? The ready response is usually something like, "this is an inappropriate question"; or "this question makes no sense", etc. This question makes no sense only if time begins at the Big Bang; which is, of course, the very question begged. Well, *did* time and space begin with such a Bang? With the advent of Multiverse theory, this is a fair and urgent question. Nowadays the smart money is on a post- Λ CDM Standard Cosmology Model multi-bang view.

Enter stage left, an occult, trans-empirical all-embracing *Multiverse*, and variations on this recent urgent cosmological theme. The singular Big Bang state that we have come to know and love has, as we have seen, a series of inherently vexed theoretical and mathematical challenges that have incited most cosmologists, and philosophers of cosmology and physics to move toward that next more inclusive theory, namely the spooky, "post-empirical", many-bang Multiverse.

A New Scientific Revolution Emerges from Big Bang Cosmology

We are now entering the next scientific-cultural revolution of our species. The Copernican Revolution begat 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 is 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 the notorious "naturalness problem" in cosmology, par excellence.

Most of the players agree that both of these venerable Standard Models are woefully incomplete. That such a "web of belief" (Quine) is still Standard Model orthodoxy bespeaks volumes as to 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, as it always is, 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" wherein the two ideological camps are cognitively "incommensurable". The good news? This is changing, as it must.

Problems with recent Big Bang cosmology: Let us briefly survey some of the conundrums presented by Standard Model Concordance Big Bang cosmology (Λ CDM model).

1) The *Horizon Problem*: How could two "spacelike" separated points in today's universe that were never in thermal/causal contact have the same temperature now? Widely separated regions of space have the same matter density—they look the same—yet are too distant to permit a causal connection, a light signal or a thermal 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 evolved with precisely the same temperature everywhere? Again, 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 c . In a universe with a finite age, no causal signal can exceed the velocity of light. What to do?

We've seen that in 1981 Alan Guth proffered "cosmic inflation" to explain the Monopole Problem. It was later noticed that inflation also explained away the Horizon Problem, and some of the other Big Bang anomalies as well. Here, at about 10^{-35} sec into the purported Big Bang, just after the Planck Era (10^{-43} sec), and the GUT Transition (10^{-36} sec), the universe quietly expanded exponentially, at superluminal velocity (faster than light) such that the causal (particle) horizon of later spacelike separated regions of space are here within one another's causal/thermal horizon. This has become known as the Cold Big Bang, femto-seconds before the Hot Big Bang began. Inflation is still a hotly debated, highly speculative hypothesis, thirty-five years later, but seems to be quickly progressing toward cosmological orthodoxy.

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? Our 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 actual energy density: Its curvature may be positive (spherical), for a closed universe; negative (hyperbolic or saddle shaped); or flat/Euclidian (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 matter density required for a flat universe, which seems to be the case based on CMB interpretations. Critical density is precisely the density between a gravitational contraction and a gravitational expansion. Therefore the relation of the observed density to the the 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 ($\Omega = 1$), 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. Indeed. a ludicrous, empirically impossible fine-tuning problem. Again, inflation has its boosters, and its detractors.

3) The *Smoothness Problem*: The cosmic microwave background radiation (CMB) is ostensibly the cosmic radiation relic or echo of the early universe during recombination (photon decoupling), at an age of about 380,000 years. It is almost perfectly isotropic or uniform, that is, it's very smooth or homogeneous. However, the present observable 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 clumpy "large scale 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. Cosmos could have evolved into clumps gravitationally attracting ordinary baryonic matter that were eventually compressed by gravity into stars and galaxies.

Moreover, 1998 observations of type Ia supernovae have demonstrated that about 7 billion years ago, no one has a clue how, the expanding universe, contra the contracting force of the gravity of matter and dark matter, began to accelerate. Dark energy Λ is the hypothesized cause. Alas, 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 very, very slightly more dense gravitationally attracted more and more matter resulting ultimately in the clumpy large scale structure of the present observable 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 ESA Planck probe release in 2013, again in December 2014, and again in February 2015 all reveal that anisotropic (temperature) fluctuations in the CMB do not entirely agree with those of Big Bang Standard Model physics.

This latest Planck release, 2015, gives a new value for Hubble's constant, (actually 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 by the Perlmutter and Schmidt search teams. 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 gauge magnetic monopoles should have been created. Yet, there is no evidence whatsoever of such gauge monopole particles, then or now. Where are they? Of course, inflation makes it all OK. Indeed, this monopole problem was Guth's original motivation for his cosmic inflation theory.

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 not only expanding, but 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 2015). 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. The accelerating universe convincingly provides such a cosmic tweak.

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, non-Standard Model cosmology alternatives are often 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 Kuhnian "normal science" run its course.

This logically impossible Big Bang 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, Multiverse Theory, etc. Roger Penrose (2004), and others have pointed out that QFT is, as well, in dire need of "improvement".

8) *The Coincidence Problem* (Sean Carroll's "coincidence scandal"): Why are dark energy density and matter/dark matter density approximately equal today, in the current epoch, when 380,000 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 (Λ) has a constant density; it does not dissipate, while matter gradually attenuates in an expanding, accelerating universe. Why should they be approximately the same density now, when there just happen to be conscious observers abroad to ponder the problem? Another fine-tuning coincidence?

The Coincidence Problem is actually part of the essential more general puzzle: *Why is the cosmos accelerating?* Is it the constant vacuum energy Λ ? The dynamic Quintessence Field? It's an utter mystery for cosmologists. Nobody has even a clue.

Sean Carroll (2004) has identified three major challenges. "The simplest explanation (for acceleration), a small vacuum energy (cosmological constant Λ), 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 QFT says 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 "naturalness" 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 cosmic scales; or if it lies in a confusion as to Relativistic Quantum Field Theory (QFT); 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 post-inflationary hot 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 and most "unnatural" Kuhnian "puzzle" or "anomaly" 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, light, causality, and the 20+ physical constants; as blatant a violation of the laws of conservation of mass and energy as ever there was. What is going on?

Time and the Multiverse. 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 observable 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.

Past and future, the entropic arrow of time, result from the fact that entropy increases; or alternatively, entropy cannot decrease. Entropy was/is always lower in the past. Why? Because entropy was extremely low at the Big Bang. Now this purported event may be viewed 1) as an *ex nihilo* proto-theistic first cause singularity creation; 2) as a Big Bounce from a prior universal Big Crunch; or 3) as one of infinitely many creation events in a vast ensemble of multiple parallel universes.

When we look back in time to the causal, observable horizon of the relatively small finite part of this universe that we can see, we cannot know whether that of this universe continues to infinity, or ends, or is entirely different elsewhere. Why? Because light from such events has not yet reached us. So, is this necessarily unknown universe more of the same, or not? We can never conceptually, objectively. Our causal horizon is local, precluding any nonlocal, faster than light knowledge. Indeed, an epistemic sticky wicket.

Maverick cosmologist Eric Lerner in *The Big Bang Never Happened*, 1991 (with Hannes Alfvén), believes that he has shown that large scale galaxy clusters could not have been formed since the Big Bang unless their velocities far exceed recent observed recessional velocities. In a rapidly inflating hot 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 contracting gravity check this cosmic expansion, or will the outward pressure of cosmic anti-gravitational vacuum energy/dark energy Λ cause an eternal, acceleration of the universe ending in a chilly high entropy "heat death"; or in the event of an exponentially increasing expansion, a nasty Big Rip? Let's see.

Our much beloved Big Bang Theory has evolved since 1946 through many *ad hoc* theory tweaks in order to address the above problems. The three primary, highly speculative hypothetical fudges that have become the three primary mysteries of a singular "bangian theory" are: 1) non-baryonic *dark matter*; 2) *dark energy*; and 3) the *cosmic inflation field* (the inflaton field with its new inflaton particle). Once again, Standard Model Concordance Λ CDM Big Bang theory now purports to explain less than 5 percent of matter/energy in the universe! As to explanatory "naturalness" this is beginning to look more like a Substandard Big Bang Model. Meanwhile, recent cosmology now requires more bang for its funding bucks. Post-Standard Model physics, with its many-bang Multiverse is now upon us. Indeed it is fast becoming the new orthodoxy.

We have now an entirely different Big Bang state from the Big Bang that Fred Hoyle derisively named, and criticized in the late 1940's, in defense of his static, non-expanding "Steady State" universe. Indeed, the old Big Bang of our grandfathers now resembles the hundreds of epicycles that were required to keep the geocentric Ptolemaic solar system model

alive, before it was finally superseded in the 17th century by the heliocentric model of Copernicus, Galileo and Kepler. Perhaps our venerable singular *ex nihilo* 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 state Multiverse in one of its many theoretical guises.

We have now considered three possible Big Bang scenarios: 1) a proto-theistic singular first cause; 2) a cyclic Big Bounce segue into a reflexive new bang state; and 3) a universal creation event among many other such events, ad infinitum, throughout an endlessly vast infinite multiverse. In any event, we cannot see far enough into the past, before the cosmic microwave background (CMB) horizon, to know which, if any of these three is correct. Non-falsifiable, post-empirical cosmology indeed.

The "problem of time": quantum gravity and common sense. The perennially vexed problem of unifying GR with QFT in a quantum theory of gravity may be seen as the *problem of time*. 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 Big Bang singularity has now become the scourge of cosmology. It represents the utter failure of objectivist, materialist physical theory. Objectivist GR's lovely equations cannot account for such singular infinities. Might a subjectivist 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 this QFT with its robust, commonsense classical notion of time. However, cosmologists who favor GR appreciate its demoted ontologically relative view of time (Einstein's "spooky action at a distance"). Smolin's Loop Quantum Gravity (LQG) is such a theory (Craig Callender, *Introducing Time*, 2005; Lee Smolin, *Three Roads to Quantum Gravity*, 2002; and his *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? Or neither? 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. Philosopher of cosmology 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, or unreal. Neither past, present nor future are privileged. On this view 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, at least at the microscopic level, reversible. Space, time and causality are simultaneously present here now with no provision for the "passage" or directional flow of time. The illusion of the arrow of time (entropy only 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 cognitive collateral damage, not only to Relativistic Quantum Field Theory (QFT), but to our common sense notions of our experienced reality of the "flow of time" upon the seemingly forward directed arrow of time. After all, entropy never decreases.

We've seen that ontologically, our perception of time arises from no-time ($t=0$), the nondual, timeless boundless emptiness ground in which everything arises to a perceiving consciousness, i.e. to ordinary direct perception, then to self-reifying conceptual designation, then the supporting belief of discursive mind. We create and reify relative time and its phenomenal contents, not through our direct perception, but through our imputed conceptual experience of it.

Hence, in this vast unbounded whole time cannot exist, ultimately or absolutely in the absence of a sentient observing, perceiving consciousness or mind to experience it. That includes a lot of *kosmic* reality. This is our perennial view of ontological relativity. "What there is", ontology, is relative to a perceiving subject, and that subject's semiotic "web of belief" (Quine).

Recalling the noetic doublet of the Two Truths of some of our wisdom traditions—*Advaita* Vedanta (Shankara), *Madhyamaka* Buddhism (*Prasangika*, and Dōgen's zen), and the nondual Taoist schools—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, with its appearing objective spacetime realities necessarily remains observer/theory-dependent. Contrary to Newton, time cannot exist absolutely, observer-independently, in the absence of a sentient perceiver/observer, in short, a consciousness. Ordinary, non-liberated discursive observer consciousness fabricates and reifies arising experience into a perceiving, knowing subject/self existing in a real time, separate from its intentional objects—the perennial subject/object split. This is our Western cultural "web of belief".

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 primary nondual or highest wisdom traditions (e.g. *Advaita Vedanta*, *Dzogchen*) 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 with its liberated masters, bears witness to such gnosis. How do *we* do this? As Shakyamuni Buddha told, practice the injunctions of the wisdom paths, and "come and see". Once more, let philosophers of physics and cosmology read *Madhyamaka Prasangika*, *Dzogchen*, and the subtle zen mind of master Dōgen (1200-1253). Well, what has this to do with physical cosmology?

Is there a reasonable physical explanation as to why our discursive conceptual knowledge of this vast timeless nondual reality is precluded? Why is our prodigious Greek ideal of objective human reason, our concept-belief mind, unable to grasp the timeless reality of the subjective primordial ground of a material/physical pre-Big Bang universe? Or of a many bang multiverse? Are our objective physical and subjective emotional and spiritual knowing dimensions utterly incommensurable? Not at all. Once again, being human necessarily involves both faces of our nature—objective/rational and subjective trans-rational.

Thus, in the extreme physical environs of a dense white hot Big Bang singularity, subjective quantum effects will rule and the classical, objectivist, Newtonian 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. QFT has shown that no electromagnetic 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 our knowledge of it is rebarbatively "post empirical" and highly speculative.

Once again, the classical (non-quantum) gravity of GR must be quantized by a quantum theory of gravity. Clearly the quantum view of the very small, and the GR view of the very large are both incomplete and logically/mathematically inconsistent. All the players agree on this. For now, neither of these "perfect" theories, these two fundamental pillars of modern physics and cosmology can penetrate the perfectly subjective "mind of God" (Nagel); nor 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? Can these seemingly incommensurable modalities—objective and subjective—of our human knowledge be pragmatically hitched?

Scientific Materialism and Its Discontents

The idols of the tribe. A unification or meta-theoretical synthesis of the two pillars of cosmology—the subjective quantum wave function, with Einstein's objective GR field

equations—into a consistent *quantum gravity theory* is required in order to grasp the ultimate nature of spacetime reality in both its objective relative and subjective ultimate voices.

And herein lies the rub for a relativistic quantum cosmology which, by the lights of most theorists refuses to consider the relevance of the inherent subjectivity of *the whole* multidimensional process of knowing, both objective and subjective modalities. Fortunately, this pattern is shifting to accommodate the "post-empirical", indeed essentially trans-rational world of quantum cosmology—namely, the radical subjectivity, or at least ontological relativity, required to approach such post-Standard Model theoretical demons as Supersymmetry, M Theory, dark energy, and of course, the latest candidate, multiverse theory.

In other words, this old physically reductionist, monistic materialist physics paradigm—in spite of the inherent subjectivity of such objective mathematical theoretical entities as M Theory, and the Multiverse—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). In its fundamentalist incarnation, this metaphysical dogma is known as *Scientism*, the proto-religious opiate of the masses. What follows is a rather censorious look at such destructive metaphysics.

Why is such a view destructive? Because if most of us believe and act on the objectivist assumption that "it's all just physical", the subjective nature of us, ethics, aesthetics, spirit/spirituality/love—the three wisdoms of goodness, beauty and truth—will continue to be marginalized and sacrificed to the objective idol of "science", or worse, such subjective knowing shall become outright taboo.

Human beings, and our scientific knowledge have both objective and subjective voices, as we have seen. Therefore we must have a science of both first person empirical objective data, and third person empirical introspective subjective experiential data, that is to say, we need a long neglected *science of consciousness*. This noetic doublet—objective and subjective—is key to understanding the incipient Noetic Revolution that is now upon us.

It is this habitual, obsessive objectivist cognitive lens that colors the recent 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.

We have just seen that the extremist, fundamentalist ideological form of this Platonic, local, 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: Monistic 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", blog, www.davidpaulboaz.org).

Such is the fruitful, perennial intellectual and metaphysical tension between 1) the objectivist realist materialist, reductionist view of a permanently observer-independent "real

world out there" (RWOT); and 2) the subjectivist idealist, sometimes nihilist, often panpsychic view that reality is ultimately observer-dependent, mental, or of consciousness. This dichotomous tension has defined philosophy, religion and science in the West for 400 years. Let us now acknowledge it; then consider a centrist ontologically relative middle way between such ideological extremes. Middle Way *Madhyamaka* Buddhist epistemology is such a view, as we shall see.

Now these procrustean (isn't all ideology procrustean?) pre-empirical, unproven, unprovable parochial presumptions of fundamentalist Scientism—this habitual, 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. Moreover, 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, ontological monism vs. dualism, etc.) are equally obscured by such dichotomous thinking. Once again, we limit our understanding most by clinging and defense of our most cherished concept/belief systems; do we not?

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 ("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 satiated? Can the Cartesian and Laplacean demons, our Modernist genetic legacy of dualistic, determinist perfect reason be slain? Can the wild elephant of scientific pretention to perfect rationality be tamed by the inherent subjectivity and ontological relativity of the quantum theory, and of post-empirical, post-Standard Model ventures into the intrinsic nondual primordial nature of reality itself; e.g. the dark energy Λ /quantum vacuum emptiness (*shunyata*) ground of spacetime being in form, M Theory, Supersymmetry and the rest? Can these many inherently vexed conundrums of an objectivist epistolary legacy of what is at root a subjective quantum cosmology—as it labors to unify the subjectivism of Relativistic Quantum Field Theory with the gravity of Einstein's objectivist General Relativity—ever be resolved without a developed science of consciousness? Can such impudent questions be never-ending?

Such a science of consciousness begins to balance our two human atavistic cognitive gifts, the bright music of our inherent trans-rational, even contemplative subjectivity, with contrapuntal objectively pure reason, our prodigious, unreasonably effective geometry of physical reality. 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, a bit ironically, for the reactionary subjectivity of the Postmodern mind. This Modernist/Enlightenment cognitive paradigm, our Western 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 individualism and their destructive legacy of ontological and methodological reductionism and monistic Scientific 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 epistemological Realism and ontological monistic materialism/physicalism? These ideologies stipulate that arising physical 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)—reality itself—ontologically "real", ontologically "ideal"/illusory, or perhaps something in between, to wit, "ontologically relative"? Let us then consider again this latter view of ontological interdependence, the view of the Pragmatists, Neopragmatists, and Buddhist Middle Way *Madhyamaka*.

This theory-dependent, observer-dependent ontologically relative view is approximately the "Standard" *Copenhagen Interpretation* quantum view of Bohr and Heisenberg. And it is the Buddhist Middle Way *Prasangika Madhyamaka* view. Here, appearing reality is dependent upon the consciousness of an observer, and the observer's instruments of measurement, mechanical or biological. This ontologically relative view sees physical existence not as absolutely real, but as relative to and supervening or depending upon our conventional perceptual and conceptual theories and models of reality. Here physical and mental reality really exists! Reality is not just an illusion or mental superimposition (*vikshepa*), as in the old Vedas and Vedanta (with the exception of *Advaita Vedanta*) have told.

We have seen that the urgent question here is, *how* does this arising, appearing reality exist? The centrist view of ontological interdependence suggests that it exists, not intrinsically, absolutely or ultimately, from its own side. It exists rather, by perceptual imputation, conceptual designation and reification, and interdependent participation (*pratitya samutpada*) of conscious and reflexively self-conscious beings. Such a one arises through this vast causal matrix of causes and conditions, subsumed and embraced by the unconditioned unbounded whole itself (*mahabindu*); this reflexive singular nondual reality that is trans-conceptual being itself. And That is the actual identity of all of us participants. So it is told in the primordial nondual wisdom traditions of our species.

Our realities then, are constructed or fabricated by way of our deep cultural background "web of belief". That cultural background is, in the West, our 400 year old Enlightenment-Modernist assumption that it is by human reason alone that we shall know the

truth of the ultimate objective, physical/material nature of reality itself. And thus has the liberation of the plurality of the truth of the whole been ruined.

As to this material reality; to be that whole, or not to be That; that is the question. Or perhaps the proper question is, what is the nature of mind that knows (gnosis, *jnana*) the *ultimate* reality (*paramartha*) that transcends, yet embraces the conceptual, merely relative spacetime reality (*samvriti satya*) that requires this lopsided dichotomy of being and non-being? This pragmatically useful if dualistic view is known to our primordial wisdom traditions as "The Two Truths" that are finally, the logically ineffable prior unity that is one truth, invariant through all awareness state changes—body, mind spirit; relative/ultimate; objective/subjective; exoteric/esoteric; being/non-being, and the rest. So, just *who is it* that participates in this nondual, bright, vast unbounded whole? Perhaps *that* is the question.

Be that as it may, as with Multiverse theory, there is no need here for a creation singularity hypothesis, a creationist ontology, whether cosmological or theistic. Such a centrist view of ontological interdependence is ontologically relative. Let us then further consider this counter-intuitive, holistic and centrist view of our being here in relative spacetime.

Who am I? Ontological Relativity in Science, Philosophy, Life

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 our thinking is thickly embedded in our Western collective and thus individual cognitive "web of belief"—namely, 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. Enter Quine's radical holism.

Knowing subject and its intentional object are necessarily reflexively interdependent (*pratitya samutpada*). Thus do we utilize the logical syntax of language to critique the probative

character of the semiotics, that is, the logical syntax, semantics and pragmatics of language itself. Human consciousness consists of *both* knowing subject and intentional object of our knowledge. Here, the self-reflexive subject reflects upon itself and its interdependent objects of knowledge. *Indeed, the entire unbounded whole of the multiverse/kosmos itself may be seen as a monistic vast reflexive "implicate order" wherein the parts of this primordial unbounded whole (mahabindu) 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, or as that very luminous whole itself.*

Thus is *kosmos*—all that is, including mere physical cosmos—ontologically self-reflexive, just as the hoary old Vedas, and Mahayana Buddhism have told for millennia. *Tat Tvam Asi*. All that, I Am; this unbounded whole, the unity of being/nonbeing itself. It's so logical, so law-like.

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 real ontic contextual ground for their equations—Quine first expresses his holism, then his radical nominalism (abstract terms like red, do not entail a related real existent entity, like house).

Quine's holism precepts: 1) conceptual interpretations of empirical observations are "theory laden" or theory-dependent upon prior theory and belief assumptions; 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 to theory verification, falsification or truth.

The primary metaphysical assumptions—the ontology—of modern Science is the ideology of foundational Scientific Realism, and monistic Scientific Materialism, whose extreme, fundamentalist version is the "scientific" proto-religion that we have come to know and love as "Scientism".

This procrustean, subjective ideological "web of belief" consists of an "ontological commitment" to objective, physically real, theory-independent, observer-independent phenomena existing absolutely in a separate "real world out there" (RWOT). Moreover, only objective, sensory empirical evidence is suitable to adjudicate theory validity and truth (Boaz, "The Idols of the Tribe", blog, davidpaulboaz.org). Quine's holism, and radical, but still naturalistic "extreme nominalism", undermines this ontic ideology of monistic Scientific Realism/Materialism, and its epistemic sidekick, common sense/naive realism. Bertrand Russell lovingly glossed such a primitive metaphysical duo, "the metaphysics of the Stone Age". 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 Bohr and Schrödinger, then by Kuhn and Habermas; and long before, luminously expressed by Buddhist Middle Way *Prasangika Madhyamaka*, demonstrates that our present 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 a more inclusive holon, that is itself nothing less than the ontologically self-reflexive vast expanse of the unbounded whole shebang (*mahabindu*) itself, the primordial set that includes all cognitive experiential sets. That is to say, That is our "supreme identity". *That* is who we actually are. How shall we understand this?

"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, monistic materialism, and perhaps even a separate, objectively "real" creator God.

A healthy skepticism then must include our own concept/belief systems, including our deep cultural background ontic assumptions as to "what there is" (monistic 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). Such a rare skepticism is truly radical, for it questions its own closely held conceptual and belief assumptions! That is to say, a truly healthy skepticism brackets its owner's deep cultural background "web of belief". Rare and refreshing indeed.

Must one become a Zen master to accomplish such a degree of cognitive/emotional freedom? The good news: our wisdom traditions teach that this seed of liberation, that very presence of it, by whatever name, is "always already present", abiding within the bodymind, "at the Heart" of every human form. The bad news: it takes a bit of practice to awaken to it.

Well then, what you believe is what you get. *From the epistemology you choose arises the ontology you deserve.* As Shakyamuni Buddha told, "What you are is what you have been; what you will be is what you do now". As good a definition of cause and effect, karma, as ever there was. Ontological relativity indeed.

Tales from the Dark Side

Einstein and the history of time. Western cosmology really began in 1917 when Einstein began to apply his General Relativity field equation to the whole physical cosmos. We have seen that in 1917 Einstein added his cosmological constant Λ to the field equations. Einstein later recanted his constant Λ (lambda) when Edwin Hubble's 1929 red shift calculations showed that the cosmos is not a static, closed biblical "firmament" as was the prevailing proto-theistic scientific ideology in 1916, but was rather, dynamic and expanding. Therefore Einstein's Λ , to his great chagrin, was no longer required to contort the lovely original Riemannian tensor calculus of the GR field equations to comply with the ideology of the day, namely, a 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 retraction of Λ , both relativistic cosmologist Arthur Eddington (The Expanding Universe, 1933), and original Big Bang theorist 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, even accelerating universal cosmology. Then, astonishingly, 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 energy 66 years before it was discovered in 1998 through observations of Type Ia supernovae.

Later Einstein referred to his insertion of the Λ term into the field equations as his "greatest blunder". Why? Had he trusted the geometry of his original field equations, before insertion of the Λ term, he would have predicted the expansion of the universe 14 years before Hubble's great 1929 red shift discovery, and 83 years before the Perlmutter and Schmidt search team's 1998 discovery of dark energy/ Λ and the acceleration of the expanding universe. 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 c 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 bargain) 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 learning game as an *ad hoc* ploy to make sense of "dark energy". Indeed dark energy is probably the cosmological constant Λ . Recall that anti-gravitational dark energy is necessary to explain the recent 1998 discovery that the very space of the universe, with all its matter on board, 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 astounding 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", or even "eternal" 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's inner realist was right after all about Λ ; but he didn't know it until 1930. Platonic irony?

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

We have seen that current theory, based upon anisotropic (temperature fluctuations) interpretations of Penzias' and Wilson's serendipitous 1964 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. Thus the universe is Euclidian, or flat. 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"; 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 sets (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 that 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 very slight positive value. Well, how big is it?

Emptiness, the primordial vacuum ground state, and Bohm's holomovement. Paradoxically (to limited conceptual mind) "empty space"—the quantum vacuum of space—contains a bit of fundamental energy. This tiny energy value is our old friend the cosmological constant Λ , usually identified as the basal vacuum energy, or dark energy; the very trans-physical ground state of the primordial whole of reality itself. Once 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 the utterly *fantasque* mystical dark energy Λ .

Heisenberg's quantum Uncertainty Principle predicts such vacuum energy fluctuations, "quantum foam", which increase the energy density of space as "virtual particles" "pop" in and out of spacetime existence. So even empty space is not empty. It is full of the emptiness potential of all the radiation/light energy/matter ($E=MC^2$) in the cosmos, David Bohm's "holomovement", the "implicate order" that includes us, our self-reflexive reflective primordial consciousness who desires to know it's own true nature.

This notion of the basal potential energy in the vacuum of space closely parallels the fecundity of the emptiness or boundlessness (*shunyata*) of Buddhist Mahayana *Madhyamaka* epistemology. It is from this primordial emptiness ground or source (*dharmakaya/trikaya* of the base, *cittadhatu, gzhi rigpa*) that the Relative Truth (*samvriti satya*) that is energy/mass, with its physical and mental forms arises. As Shakyamuni 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 primordial wisdom "Two Truths": relative form, and absolute/ultimate emptiness/boundlessness. 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.

So quantum physicist and colleague of Einstein David Bohm's "holomovement" closely parallels this Mahayana Buddhist primordial ground—emptiness/boundlessness, *cittadhatu, gzhi rigpa*—this trans-physical "implicate order" that is the utterly interdependent, "interconnected unbroken whole", self-reflexive consciousness-being-reality itself. Again, such an implicate order is closely analogous to our wisdom tradition's Ultimate Truth (*paramartha satya*). From this primordial base arises and appears its relative-conventional spacetime instantiations, Bohm's "explicate order", and our great tradition's dimension of Relative Truth (*samvriti satya*). These the physical/mental forms arising from Ultimate Truth, some participating as sentient, even self-aware consciousness.

For Bohm such consciousness is a subtle aspect of all forms of matter, the very ground or basis of spacetime relationship abiding deep within the holographic implicate order, the very holomovement itself. Thus, it makes no sense to speak of consciousness and matter separately, as interacting, one with the other. Rather, we conscious observing subjects are not other than our objects observed. We *are* this reality that arises. The relationship is one of identity. Praise be.

Moreover, we are also the measuring instrument. So this perennial apparent subject-object duality is false. We perceiving, knowing subjects and the objects of our perceptions are not intrinsically separate. To "ordinary direct perception" which arises in the phenomenological chain prior to conceptual imputation, designation and reification, "That I Am". In this phenomenal chain of consciousness reality is not always as it seems to our deep cultural background concept and belief systems. This is also the Mahayana Buddhist view of both realist/centrist Middle Way *Prasangika Madhyamaka*, and as well, the idealist *Yogachara/Chittamatra* School.

In the brand of panpsychism (all material and mental forms possess some degree of mind or consciousness) of Bohm, Leibnitz, James and Chalmers, consciousness is always present in degrees of enfolded, always unfolding spacetime instantiations of Bohm's primordial holographic holomovement itself. An electron has a lesser degree of consciousness than a human being, or a Buddha. Again, "Form is emptiness; emptiness is form". On Bohm's view,

The ability of form to be active is the most characteristic feature of mind, and we have something that is mindlike already with the electron...life too is enfolded throughout the totality of the universe. Life and intelligence are present in all matter, energy, space and time, the fabric of the entire universe (Talbot 1991).

This "fabric", the holomovement, we mistakenly view as a bunch of inherently separate parts, but it is all interdependently, interconnected, as in a hologram wherein every bit of information in the hologram embraces, participates in and duplicates the "unbroken whole" itself. Just so, every part of the universe participates in, indeed enfolds this continuum of always "unfolding" cosmic "activity" of the whole shebang. What would Bohm's scientific realist pal Einstein think of such a realistic holism?

As energy and matter are related by Einstein's Special Relativity, $E=mc^2$, its natural extension to the gravity of General Relativity (GR) predicts that Λ will have gravitational effects. Λ has a negative pressure that is equivalent to its energy density Ω , 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—our old friend Einstein's cosmological constant Λ —a dynamic scalar field which constitutes the energy density of a flat Euclidian universe as the vacuum energy itself.

Until 1994 Λ was assumed to be zero. But the 1998 accelerating universe requires a positive non-zero value for the constant Ω_Λ . We saw that 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 Λ 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 Principal—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 Λ 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 Λ CDM Concordance Model of the universe which accounts for a bit less than 5 percent of the detectable physical reality that we presume to be us, and the entire universe of our imagination. Scientifically "Unnatural" indeed. Again, one might well refer to such a litany of *ad hoc* explanations of our wondrous physical cosmos as the Substandard Model of creation, but that would be disrespectful.

Yes, it's been a wonderful ride, and the profound "unnaturalness" of the present state of theory lights the way for a new post-Standard Model physics/cosmology revolution, that is no less than the fourth consciousness revolution of our species, namely, the emerging Noetic Revolution in science, religion/spirituality, and culture.

The cosmological constant problem. As to the purported "unnaturalness" of our current Standard Models of physics and cosmology, 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 Einstein's GR field equations in 1917 (retracted in 1931, then added again in 1932) in order to "hold back gravity", in defense of his belief that the universe is a static and closed "firmament", 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 quantum 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 $\Omega\Lambda$.

We saw as well that the cosmological constant Λ 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 $\Omega\Lambda$. 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: QFT, relativistic 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 12 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 especially for quantum field theory.

What to do? Must we wait years or decades for a much 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 new "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 nothing less than the wave function for the entire many-bang multiverse.

We must understand here that each parallel universe is not *independently* real. It is rather, the infinite interdependent 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. A tall order, to be sure. 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 that only an objectivist ontology will suffice for Professor Penrose?

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, theory-independent Scientific Realism and Scientific Materialism. Perhaps we need a centrist middle way between Western objectivist scientific substantialism, and Eastern subjectivist idealist nihilism. And there *is* such a middle way ("Buddhist Emptiness, Consciousness, and a Theory of Everything", below)?

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 . Therefore, both of these wondrous theories are now recognized to be incomplete. What's going on here?

Toward Unification. 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, or even before the Big Bang (multiverse theory). So these two separate theories—Relativistic Quantum Field Theory and the gravity of General Relativity are, 13.77 billion or so years later, conceptually incomplete, therefore both must be incorrect. We must now mathematically and theoretically re-unite them. That is the rub, and the yoga for quantum cosmology, and these mathematical theories of our cosmic beginning, present, and end.

Our origin in this vast whole would seem to be utterly beyond even the outermost conceptual limit of human discursive mind. Is it also beyond the "innermost secret" understanding of the highly trained trans-conceptual, contemplative mind of the great mahasiddhas of our wisdom traditions? As Shakamuni Buddha told: "come and see".

Therefore, let theoretical physicists and cosmologists, philosophers of physics and cosmology, neuroscientists and Buddhist scholar/practitioners dialogue over pizza and ale about the emerging integral Noetic Revolution.

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 Kant's "pure reason", that is, of human dualistic concept/belief mind—hard experimental results are virtually precluded. Indeed a cognitive conundrum for a scientific realist/materialist metaphysic.

Welcome to the brave new world of the "post-empirical" reality of nondual (ontologically prior subject/object unity) self-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? "Come and see". Practice subjective mindful contemplative, nondual cognition, along with a bit of dualistic objective mathematics, philosophy of physics, and philosophy of cosmology.

Well and good. We've seen that such dualistic cognition is the natural result of this intrinsically subjective being in time whose "supreme identity" is necessarily the very emptiness ground of nondual primordial reality itself. Let us now acknowledge the inherent, ultimate, even perfect subjectivity of Bohm's trans-rational "implicate order", the "unbroken" unbounded whole (*mahabindu*) 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 state changes 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 the noetic doublet of a third person objective, and first

person subjective cognitive methodology to grasp the profundity of the nondual unbounded whole itself. In short, we need a science of consciousness.

All the while we are encouraged by our wisdom traditions to remember this bright trans-rational presence (*vidya, rigpa*, gnosis) in the human being of the great unbounded whole that is conceptually, but not contemplatively ineffable; that (*Tat*) primordial ground state (*bhavanga, dharmadhatu, gzhi rigpa*) in which, or in whom the furniture of reality interdependently (*pratitya samutpada*) arises and participates. The primordial awareness wisdom of *that* has many names, e.g. gnosis, *jnana, yeshe*.

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 boson, 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 *cosmic*, panpsychic (everything has some degree of consciousness) whole subsumes and embraces spacetime reality, even beyond the merely material/physical multiverse. 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.

Buddhist Emptiness, Consciousness, and a Theory of Everything

"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).

May an open, healthily skeptical mind (skepticism of one's own closely held concepts and beliefs) ascertain *objective* certainty about/of anything? Is subjective certainty possible? May objective and subjective knowing modalities—these two voices of our knowing—be meaningfully separated?

Are mathematical "objects" (e.g. tensors) "real", existing in an ideal realm of Platonic "forms", neither physical, nor mental? Or might mathematical objects be mental instantiations or emergent "epiphenomena" arising in purely physical brain matter? Can mind possibly be reduced to mere physical/chemical brain matter? If so is there any non-ideological hard objective evidence? Philosophers of physics and cosmology, and neuroscientists have become increasingly skeptical of this paradigmatic, reductionist Modernist/Enlightenment view. (*Mind and Life Institute; Institute of Noetic Sciences; Santa Barbara Institute*)

Brief meta-mathematical excursus. It is useful here to remember that mathematics is derived from zero, or emptiness. As the late great gravitational 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 mystical, foundational empty set is the intrinsically empty perfect symmetry of 0. The symmetry-breaking integer 1 includes this empty set; 2 is the set whose members are 0 and 1, etc. Thus the mathematical ground, and perhaps the spacetime ground of physical cosmos, as well as the all-subsuming physical/mental/spiritual *kosmos* ground of reality arises through this empty set, analogous to middle way Buddhist intrinsic emptiness base or ground.

Buddhist Emptiness. Astonishingly, from the inherent energy potential of this strange perfect symmetry of our trans-conceptual nondual boundless emptiness ground—by whatever name—arises symmetry breaking luminous light-energy ($E=mc^2$) that fills and animates the worlds with stuff. Once again, Shakyamuni Buddha's wisdom: "form is emptiness, emptiness is form". Our primordial wisdom's Two Truths—Relative form and Ultimate emptiness—are always already a prior perfectly subjective unity.

So an 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 *Prasangika Madhyamaka*, emptiness/boundlessness/*shunyata/dharmakaya*; or perhaps the primordial ground that is Tao; or perhaps we might name (*namarupa*) it *Nirguna Brahman*, or *Parabrahman*, that (*tat*) which is empty of all attributes and qualities. Well, does this primordial emptiness ground preclude physical reality altogether? Is this all merely a mental illusion as the hoary Vedas, *Upanashads*, and Buddhist *Yogachara/Chittamatra* "mind only" school have told?

Wonder of wonders, Buddhist emptiness does not forestall our physically 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, basic space (*dharmadhatu*) there is no beginning, no creation, no theistic or cosmological first cause. Nor is there an end. Yet from this nondual primordial "groundless ground" arises our objective and subjective, often all too real spacetime 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 cyclic 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 bright 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 profound 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 (*shamatha*) attention to the breath (*prana, chi, pneuma*), and other related practices. This knowledge has precipitated the present "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 neuroscience and neurobiology, physics and cosmology. 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 emerges.

Perhaps then, Buddhist epistemology has something to contribute to the epistemology and ontology of post-quantum, post-Standard Model 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).

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 phi". A human brain has "high phi". A photon has less, but non-zero phi. Are these relative realities not then "derivative from consciousness" (Suzuki Roshi's "Big Mind") instantiated in the "Small Mind" of a self-conscious observer-being?

As we follow this informational, phenomenological "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 epiphenomena of brain—remains unable to explain, or explain away, our subjective feeling of being, the "what it is like" to be

conscious of the arising qualia of our phenomena experience. Why and how is *objective physical* brain processing attended by this bright *subjective* consciousness, this basal awareness of naked "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 of the Path, 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 ongoing awareness continuum of our "stream of consciousness" (James)? The materialist, neuro-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 objects 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 quantum 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 and cosmology be revealed: the several Big Bang problems, and the dark energy/cosmological constant problem: that boundless enigma of the accelerating universe.

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 emerging trans-disciplinary *science of consciousness* with its urgent neuroscience of contemplative, be here now 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).

The Structures of Consciousness: *Exoteric/Outer, Waking State, Gross Body:* Dualistic, indirect, relative-conventional truth, concept-belief; empirical subject-object knowledge (doxa, namtok, opinion, information, third person objective scientific data). Manovijnana, the gross waking state (physical, emotional, mental). Empirical spacetime Gross Body energy dimension; exoteric/outer conceptual and experiential belief in a separate material reality and a separate "other" God. *Nirmanakaya* dimension.

Esoteric/Inner, Dream State, Subtle Body: Dualistic, lesser esoteric form; contemplative and devotional first person subjective recognition of the trans-conceptual, nondual "state of presence" of the primordial ground state; discriminating, quasi-conceptual knowledge-wisdom (*dianoia, sophia, prajna*). Deity realms. Subtle Body energy dimension, *Klishta manovijnana, Vijnanamaya kosha, Saguna Brahman, Ishvara*, esoteric/inner yet separate reality. Path stage. *Avidya maya*.

"Innermost" Esoteric Causal Body: Deep Dreamless Sleep State, Causal Body energy dimension, *Alayavijnana*, *Anandamaya kosha*. *Satchitananda*: Buddhist *Sambhogakaya* dimension. *Saguna Brahman as Sutratan*. Path of the late *bhumi* Bodhisattvas, Arhats, rishis, and saints. *Vidya Maya*.

Non-Dual State/Turiya"The Fourth", *Essence Body*: Realization of nondual pristine presence of the basal primordial ground, reality itself, Buddhist *Dharmakaya*, beyond dualistic, subject/object, concept, belief and even of the subjective bliss of deep contemplative experience. Final fruition stage. Realization of the prior unity of the Two Truths (relative and ultimate), the three *kayas* and three *vijnanas*. The primordial Tao/emptiness/boundlessness of Absolute or Ultimate Spirit lived with its cognitive, meditative and compassionate ethical conduct finally stabilized and actualized in the lifeworld (transcendent primordial awareness wisdom mind, *prajnaparamita*, *noesis*, *gnosis*, *christos*, *logos*, *vidya/riqpa*, *yeshe*); Plato's noetic-logic final development stage); mahasiddha Christ-Buddhahood. Buddhist *Svabhavikakaya*, prior unity of the three bodies—*Trikaya* of the ground/base (*gzhi*), body of pure *alaya* (*amalavijnana*), *turiya* "the fourth," ultimately realized as *Turiyatita*, the final nondual fifth state.

"Ground Luminosity." *Atman* as nondual "empty of attributes" *Nirguna* Brahman, beyond all theistic concept and belief. Fruition of the unity of *Madhyamaka*, *Mahamudra* and *Dzogchen*. These five views or dimensions arise and display as a prior unity in the unbounded whole (*mahabindu*) itself. This perfectly subjective whole transcends yet subsumes and embraces all arising objective phenomena; it may be seen as the trans-rational one truth, invariant through all cognitive state changes.

These five innate states of consciousness, supported by their five corresponding energy bodies or dimensions are potentially, momentarily available directly to each self-conscious being. However, the ascending levels of meditative stability and realization (*samadhi*), are nonordinary aspects of these five states that result, ultimately from the contemplative discipline of the Path (*marga/lam*).

The various levels of understanding of the interdependent relation of these five views and five states of the "two minds" or Two Truths of this one great source/ground—the vast reality expanse that is nondual spirit reality itself—constitute both the exoteric-conventional and the more subtle, esoteric-contemplative View of this supreme source of all appearing reality for these religious and philosophical wisdom traditions of our primordial Great Wisdom Tradition. Just so, from this relative-conventional View arises the Path to the realization of that unbounded whole, and its ultimate Fruition or result—full Bodhi—in the everyday lifeworld and conduct of the individual, and thereby the spiritual and scientific worldview and its potential realization for our sociocultural whole. As H. H. the Dalai Lama has told, "just open the door."

Is a Theory of Everything logically possible? If it is not, the mathematics of post-Standard Model String Theory/M Theory/Supersymmetry are in big trouble.

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's incompleteness has incited a recalcitrant Stephen 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 an ontologically relative, theory-dependent, observer-dependent "Model Dependent Realism" (MDR). Glory Be!

Gödel and Rosser have discovered a mathematical proof that demonstrates that not only is a physicalist 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 (e.g. 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. supersymmetric Superstring M Theory) is necessarily constituted of internally consistent, non-trivial mathematical systems. Therefore they must be mathematically incomplete. It follows that 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 and cosmology 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 1969). On this view, ontological relativity—that "what there is" is real only via our semiotic deep cultural background concepts and beliefs—is false.

Recent philosophy of physics has shown that the fundamental laws of physics cannot at all confirm the intrinsic, absolute physical existence of the reality of matter and energy. Rather, what is confirmed is this reality as it arises and appears, not as absolutely real objective reality itself, but in a particular *conceptual model* of reality. This is Hawking's correct model-dependent realism (MDR) point in *The Grand Design* (2010). The old paradigm objectivist realist model is the theory-independent, observer-independent metaphysic of Scientific Realism/Materialism, namely, that there is an independently existing, separate "real world out there" (RWOT).

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 an absolutely objective "mind of God" (Nagel). This is a healthy skepticism that must include one's own closely held conscious and pre-conscious concept-belief systems, including Metaphysical Realism, Monistic Materialism, and physical and neuro-reductionism.

As the ontologically relative middle way *Prasangika Madhyamaka* Buddhists have shown, there can be no theory-independent, observer-independent RWOT, separate from the participating reifying consciousness of a sentient observer/participant embedded as we are, in deep cultural background semiotic conceptual/linguistic structures. Once again, this process is known as *ontological relativity*. We reify/create/construct the *process* (not an entity) of the self/ego-I, and its putative "other" realities, via conceptual imputation and designation. Kant, the inveterate epistemological constructivist, would agree. And the inherently subjective Copenhagen Interpretation of the quantum theory agrees. Bohr's Principle of Complementarity (not either/or, but both), with Buddhist "dependent arising" (*pratitya samutpada*) or "interbeing" are intellectually/conceptually nearer the truth of the matter.

Who Is It, Really?

Philosopher, know thyself.

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?

Well then, 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 (*tat*) trans-conceptual ultimate unbounded whole, vast matrix ground of appearing reality in which, or in whom this all arises and participates. *This whole mereologically subsumes and embraces its parts. And all of the parts perforce participate in the great whole.*

In the 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. Nondual *Dzogchen* "corrects" and transcends the Two Truths duality of the Mahayana Causal Vehicle (Klein 2006). It is thus 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 great 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 ostensibly incommensurable 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 (nothingness) 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?

This fundamental *philosophical/ontological/metaphysical* question of being is, as German polymath Leibnitz told 300 years ago: "Why is there something, rather than nothing?"

This impossible question cannot be resolved conceptually because any answer is necessarily contained in that "something" to be explained. Robert Nozick has suggested that there is no objective answer that can explain why there is anything at all. Conceptual explanation proceeds via the explaining of things in terms of other things. However, this question precludes the introduction of explanatory propositions (Nozick 1998).

These questions point to the inherent limit of human reason in deciding ultimate matters of ontology, of "what there is" (Quine 1969), the ontological problem, the very nature of being itself. Therefore, are we necessarily referred beyond such habitual cognition to transrational, contemplative technologies; for example, dualistic Buddhist *Madhyamaka* and nondual *Dzogchen Ati* yoga.

It may be useful in this regard to remember (Plato's *anamnesis*/remembrance), 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, subtler 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 transcends yet includes Special Relativity. Just so, SR is more subtle and inclusive than Newtonian mechanics, which subsumes the mechanics of Aristotle, Galileo, Copernicus, and Kepler. The greater esoteric understanding transcends yet embraces the lesser exoteric understanding. But not vice versa.

This subtler, more inclusive view that subsumes 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 and Shantideva's Middle Way Buddhist epistemology, a middle path between a negativist, subjectivist Eastern nihilistic ontological

Idealism, and a pathologically positivist Western objectivist, substantialist monistic Materialism, and observer-independent, Metaphysical Realism (Scientific Realism).

For the Two Truths—relative and ultimate—of *Prasangika Madhyamaka*, 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 *Yogachara* (*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 the realist, eternalist dualistic Vedanta of Madhva.

In the Mahayana Buddhist view this objective physical spacetime reality that arises to our ordinary direct perception is not illusory; neither is it inherently, absolutely 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.

By these lights there can be no reality that exists entirely *independently* of measurement, that is, information to a perceiving, knowing consciousness. Appearing reality is relative to a system of measurement. We cannot know physical reality at all. All we can know is the appearances, the information bits (Wheeler's "its from bits"). Told gravitational 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" whose existence cannot be known with objective certainty.

The universe does not exist "out there", independent of us.
We are inescapably involved in bringing about that which
appears to be happening (Wheeler quoted in Searle 1995).

Such a view represents the present epistemic crisis of Western culture; a Kuhnian evolutionary paradigm shift toward our next collective cultural mindstate, a new "web of belief". We are now suffering the utter collapse of 400 years of the rationalist Modern and even cynical Postmodern foundational metaphysic of Platonic epistemological "external realism" (a RWOT), and ontological monistic Materialism (physicalism).

This Western zeitgeist that is our idolatry of "pure reason" has finally ended. A new reflexive, self-reflective ontologically relative noetic (subject/object interdependence) ontology is ascending. What shall we make of this?

Twenty-first century science, religion and culture are now coming to understand the great truth that appearance is merely luminous, observer-dependent, relative-conventional spacetime-conditioned reality as it arises, via the process $E=mc^2$ from its trans-conceptual nondual primordial "groundless" ground. This 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" is "what there is". These perennial Two Truths, relative spacetime reality, and its ultimate trans-rational basis or ground—the prior ontic unity of That, invariant through all cognitive state changes, outer, inner, "innermost secret"—is the one truth of the matter. So it is told through the "highest", subtlest nondual teaching of the great 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". Thus the nondual primordial emptiness base of this relative-conventional appearing reality is a "groundless ground".

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 the "primordial purity", the "pure presence" of nondual "ordinary direct perception", illuminated by the prepared mind as liberating, trans-conceptual contemplative naked awareness of "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 Prasangika 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".

Metaphysical Scientific Realism and its ontic cohort Scientific Materialism can no longer be defended. Philosophers of physics and cosmology, if not most physicists and cosmologists, realize the truth of this ontologically relative view. And Mahayana Buddhist philosophy, while lacking a tensor calculus and a science of the brain, offers a profound pre-modern 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*, *Santa Barbara Institute*, etc.).

Zen Mind, and a Historiographic Note

Let us remember that theory, scientific or otherwise, has a cultural history. Theory interpretation, that ever turning epistemic 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 our prevailing epistemic and ontic ideology. In the East the prevailing ontology is the nihilism of epistemological and ontological Idealism. These views change and evolve 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 objective concept/belief certainty—reason's ideal—is precluded by the truth of ontological relativity (Quine 1969), that is, our realities are dependent upon our preconscious, semiotic 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, quasi-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 extant 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 urgent truth. Let us do so as well.

Perhaps then, we need no longer limit our knowledge—objective scientific and 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—the two voices of our being here, is the cognitive key.

Here, arising always in this perfectly subjective unbounded whole, 400 years of continuous Copernican correction, logocentric incompleteness and objective 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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