the general science journal

The Current Universe As A Phase Transition, Part 2

By David Cornberg, PHD
dcornbrg@seed.net.tw

Tung-kuo Tzu asked Chuang-tzu, "Where is that which you call *Tao*?" Chuang-tzu said, "Everywhere." Tung-kuo said, "You must be more specific." Chuang-tzu said, "It is in this ant." "In what lower?" "In this grass." "In anything still lower?" "It is in tiles." "Is it in anything lower still?" Chuang-tzu said, "It is in ordure and urine." Tung-kuo Tzu had nothing more to say. (Creel, H.G., "The Great Clod: A Taoist Conception of the Universe," in Chow Tse-tsung (ed.), Wen-lin. Studies in the Chinese Humanities, Madison, University of Wisconsin Press (1968) 262-3)

But in all these theories the question naturally occurs:--If something is transmitted from one particle to another at a distance, what is its condition after it has left the one particle and before it has reached the other? (James Clerk Maxwell, A Treatise on Electricity & Magnetism, Volume II, Merchant Books (2007) 437-8)

An aerobically dependent, aquatic animal that lives its entire life underwater extracts oxygen from the fluid that surrounds it. A human body, whose mass is mostly water, extracts oxygen from the atmosphere that surrounds it. In both cases, all the substances are composed of atoms whose structure is mostly space. According to the model put forth here, and introduced in my previous article, "The Current Universe As A Phase Transition," wherever there is space, there is a quantum vacuum (qv), and the qv is a transition zone or region between all energy configurations of the current universe (cu) and a more fundamental substance (mfs). Everything that exists, does so in and through space, the qv and the mfs. Everything that exists, does so with and in space, the qv and mfs, in the sense that everything is in space and space is in everything. All energy configurations move at some rate relative to each other. Each one can therefore be understood as tunneling through space, the qv and the mfs.

A tunnel through a mountain conveys no force to a vehicle traveling through it, but does change the geometrical structure of the medium, the surface of the earth, which the vehicle needs in the first place to move at all. Applied to energy configurations of any kind in the cu, this analogy implies that gravity functions independently of mass/energy, so the mass/energy terms in any gravitational interaction can range from 0 to ∞. This implication simply restates both Newton's and Einstein's views of the universality of gravitation, viewed either classically or relativistically. In the infinite case, gravity would be equivalent to mass/energy and would thus have to work on itself entirely, in every region and on all scales. This consequence is consistent with the original field equations of general relativity. Although my personal lack of mathematical acumen limits my ability to demonstrate the following symbolically, I would suggest that thus understanding the infinite case may point in a direction more useful and more fruitful than renormalization.

The tunnel analogy also connects to this model of the cu. For example,

repeated observations have confirmed spacetime bending of photon paths in vicinities of large masses. However, no experiments have shown that the structure or features of the photon are altered before, during or after the bending. Apparently there is no interaction between the photon and any other energy configuration. From this standpoint, the photon tunnels through its spacetime environment. The spacetime environment must not only allow the photon to pass through untransfigured but must also allow it to maintain velocity. This phenomenon alone, therefore, implies that there is a constant relationship between the energies of every configuration and their multilayered environment. These relationships constitute the cu as a phase transition.

Three images can help conceptualization of this model of the cu. First, the current universe is an interconnected system of mirrors: from the largest scale of galactic superclusters to the smallest scale of quark clusters and pions, every energy configuration that has surface or surfacelike features can be visualized as a mirror. These mirrors can be flat, concave, convex or topologically non-uniform in one or more dimensions. Every mirror can emit, absorb, reflect and refract energy. And, every mirror can also transform its configuration in response to suitable combinations of emitted, absorbed, reflected and/or refracted energy. In a mechanical image, the cu is an enormous, self-circulating pump: pipes, valves, junctions and compression/decompression units are everywhere as well as a leakage region that we study as dissipative dynamics.. This second metaphor, though suggestive in capturing dynamic features of the cu, is structurally too rigid and materially too simple to warrant further elaboration. A final analogy, with greater simulative power, could be constructed by combining the human respiratory and circulatory systems: everywhere there are veins, forkings, layerings, interchanges, valves, and pressure regulators and gradients. Imagery must give way, though, to more abstract expression.

The cu is a phase transition with layers, one of which is the mfs. The mfs is a reciprocating accelerator with a ratchet clutch: whatever a thing puts into it comes back to the thing in some way, and, once a thing acts, only a subsequent action by the thing, or a subsequent action by another thing, can alter the course of the first action. From these two conditions of the mfs flow all the conservation laws of physics. Also flowing from these two conditions are the equivalence of mass and energy in special relativity, because this equivalence depends on irreversible, unlimited acceleration, and the self-reflexivity of gravity in general relativity, because this self-reflexivity depends on the reciprocative power of the mfs. Whether these two conditions can receive mathematical expression remains an open question.

There is, moreover, a relation among a thing's saturation index, its contraction/expansion and compression/decompression (cc/ed), and its motion. The saturation index expresses the embeddedness of a thing, in the cu, including surface and surfacelike features, where surface is understood minimally with measures of continuity and permeability. Cc/ed refers to the simultaneous contraction/expansion and compression/decompression of a thing through the entire span of its existence. Motion includes, again minimally, measures of the shape, direction and speed of path. There are different types of energy at different values of the relationships among these three features. The qv and electromagnetism form boundaries of this range of types. The mathematical expression of this relation has yet to be formulated for two reasons. First, the idea itself is new and generally unrecognized and unaccepted. Second, the second term of the relation, cc/ed, is complex. In the case of a star, for example,

gravitative and radiative processes take place simultaneously. The mathematical expression must capture the simultaneity in order to express the actual, physical situation. Why is this so? This question leads to the question of the nature and workings of the mfs. We can approach these questions from the small scale.

The numbers, sizes and features of elementary particles are in principle limited only by the energy of collision and the sensitivity of detection. Experimental findings on particles to date support this hypothesis. In the PETRA Tasso project, the non-appearance of the top quark and the appearance of a three-jet event suggest two possible assumptions. First, the vacuum potential is composed of particles that pre-exist collision experiments and are then drawn into detection by those collisions. Second, the vacuum potential exists in an undifferentiated state, relative to detectable energies, and responds directly and sometimes unpredictably to human manipulation through experiment.

The first assumption implies knowledge of the degrees of freedom of the vacuum potential. Since there is no such knowledge, the second, not the first, assumption, seems more reasonable and tenable. The three-jet event also raises the question of whether existing detection apparatus is sensing everything that is happening. If we hold to the second assumption, then we can proceed to consider detection technology that would sense the vacuum potential without inducing or requiring that the potential be materialized or particularized. More refined scintillation detection seems an inappropriate path as do more refined cloud or bubble chambers. Equally inappropriate is a screen component of the device. Any screen assumes that the detectable energy has surfacelike features capable of surface-to-surface interactions. Unmaterialized, unparticularized vacuum potential would have no surfacelike features. It would have no wavefront, packet or particle structure. Its mode of appearance would more likely resemble a portion of cloudless sky or of matterless outer space.

The possible structure of the vacuum draws further exploration. At some point in the 20thc, particle physics made problematic a distinction between detecting particles and producing them. On a macroscopic scale, colliding the face of a hand-held sledgehammer into the surface of a granite boulder produces a configuration of fragments. Colliding the face of a machine-driven rock crusher into the face of the same size and weight granite boulder produces a different configuration. Particle physics has clearly demonstrated that the vacuum potential responds directly to the level of energy applied in a collision. The mathematical structures of QM, QED and QCD can thus be understood as the laws of high-energy particle productions. Whether or not these laws accurately reproduce the structure of unforced nature is another question. The wide range of highly successful engineering applications that has flowed from particle physics since the late 19thc does not necessarily answer this question affirmatively. In all such applications, naturally available energy is shaped, manipulated and forced to behave in ways that are both predicted by and useful to human beings. However, if the only samples of horse behavior available were from Lipanzer stallion and Kentucky Derby performances, inaccurate inferences about the natural behavior of horses would be likely.

Focusing on a distinction between detection and production returns us to the two assumptions stated above regarding preexistence or undifferentiated potential.

The current state of particle physics presents us with a definite situation: known energy sources and known detectors not only confirm the predictions of QED and QCD but also increase the number of elementary particles in a more or less direct relation to the amount of energy applied in the experiments. This latter point leads to the question of the structure of the vacuum potential, from which the particles come.

If we reject the hypothesis that the vacuum potential is already composed of preexisting particles that are those and only those detected in experiments, then we are, conceptually, at an intriguing boundary. Since particles with many different features come from the vacuum, we must view it as undifferentiated with respect to our ability to detect charge, momentum, mass, color, flavor, strangeness, etc. below a certain scale of measurement, which may or may not correspond to the Planck constant. The qv potential as an undifferentiated energy source must, then, lie beyond this boundary of detectable features. But how, in this case, are we to understand the transition from non-differentiation to particulate materialization?

We may reapproach this question by positioning this boundary in a larger picture. In the first installment of this paper, the quantum vacuum is a transition zone between a more fundamental substance (mfs) and the current universe (cu). This picture can be expanded in terms familiar from contemporary physics. In any portion of spacetime, there are five layers: an mfs, or unlimited potential (O); the vacuum potential, or, evanescence (V); the particle region (P=probability); the macroscopic region (D=determinism); and, the thermodynamic region, including life, (I=dissipative). From here, we proceed substractively. First, all living, macroscopic and atmospheric matter is removed. We have a vacuum. Next, all electromagnetism is removed. This step takes the imagination off the earth, out of the galaxy and into extragalactic space. Here, moreover, we must further imagine that we can remove all gravitational and electromagnetic fields. Nothing is visible or detectable in any way by known detection techniques. We are, in a sense, in the inverse of a singularity. The absence of any kind of signal, in this thought experiment, is not a feature of extreme compression bounded by an event horizon. It is a feature of scale. The portion of spacetime has been refined to such an extent that there are no surface or surfacelike features. On this scale, neither gravity nor electromagnetism can exist or be produced.

A clue to structure on this scale comes from three directions. If general relativity is an accurate account of gravity, then any energy moving in spacetime describes a more or less complex helix, because its geodesic is formed by displacements/deflections coming from all directions around its path. Second, the only physical structure that satisfies simultaneously both the divergence and curl conditions of Maxwell's equations is a helix, structurally defined and complexified by its alternating, reciprocating electric and magnetic components traveling around an axis. Finally, in P, any energy that has any kind of spin and moves must show helicity. A moving, charged, spinless energy would show helicity also because its path would form around displacements/deflections from other charged energies around its path. A spinless, chargeless energy with mass, if observed for a long enough period of time, would show helicity due to relativistic effects. A spinless, chargeless, massless energy would seem to be undetectable because it would have no surfacelike features.

The ubiquity of helicity in nature is the clue. Everything is in the quantum vacuum and the quantum vacuum is in everything. This statement follows from the condition that everything is in space and space is in everything. It seems to follow naturally and logically that V is structurally helical or spiral. Maxwell's imagery, namely the vortex that preceded the cell, and the elastic spring that predicted the displacement current, was more representational than fanciful. Of course, following Maxwell by reducing the structure of V to the dynamics of either P or D is not possible. P and D, in the phase transition model of the cu, are layers or regions of energy and not the first or final forms of energy. D and P depend on V for their existence and V cannot be reduced to either or both. This impossibility of reduction seems to be not only a feature of this model but also an undeniable conclusion of particle research.

For heuristic purposes, V's structure can be built imaginatively. We have a closed, flat, vortical spiral whose number of coils, diameter across largest coil, coil thickness and between coil intervals are all arbitrarily large or small. From each coil, at regular and irregular intervals, other spirals come out in every orientation relative to and different from the plane of the first spiral. From the coils of each of these spirals, more spirals come out. When the imaginative space fills with branching spirals, the identity and location of the first spiral is lost unless previously marked in some way. The simultaneous feature and featurelessness of this image mimics the surface of water at its transition to turbulence, when boiled or otherwise repeatedly disturbed, with its blur or smear of information (critical opalescence) about the location and disposition of individual water molecules. From inside and outside this image, supposing that we model it in three dimensions and on a scale larger than the average human body, V looks, at one and the same time, that is, simultaneously, both the same and different than itself.

Additionally, the entire structure vibrates. Its vibrations, however, are not sequential; they are simultaneous. This is possible because, since no mass and thus no interfering or restraining surfaces or surfacelike features are present, the entire structure is completely transparent to itself. If it were not then, clearly, it would not be V; it would be some form of P, D or I. The vibrations consist of simultaneous contractions and expansions of all dimensions of the structure.

Another clue that might aid conceptualization is the large variety of types of energy in the cu that are already detected and more or less well known. For the cu to exhibit a range from quasars to quarks, the potential energy of V must exceed what has already been detected by magnitudes that are well beyond what can presently be observed, produced or even imagined. Whatever that potential is, however, it must, in this model, fall short of the potential of O. V is a transition zone from O to P and the rest of the cu. Therefore, to be consistent with the known features of phase transitions, O must be an original and enduring energy far in excess of what comes into V and the cu.

From the standpoint of dynamics, once having imaginatively constructed V as vibrating, interlocking, interleaving and intertwining spirals, we may radically simplify the image. V may be understood as simultaneous, instantaneous contraction and expansion and compression and decompression, wholly transparent to itself, relative to human visual detective capacity, that conducts and insulates an enormous

potential from O (the mfs, or, unlimited potential). V is formally undifferentiated with respect to both micro- and macroscopic features of the cu, and responsive both directly and productively to manipulation from the cu. This simplification, while obviating the spiral imagery, does not remedy the logical and empirical defect of this model that it is an ex post facto construction arguing from known effects to a possible cause without giving direct evidence that the constructed cause uniquely exists. We are thus urged again to the question of detection.

Before directly addressing that issue, however, an aspect of the simplification just given points to an additional feature of the phase transition model in general: long-range correlations. Because they involve cc/ed, long-range correlations in the cu are not only dynamical, deterministic, probabilistic and statistical in their mathematical appearances, they are also structural. The single most important long-range correlation manifests as soon as we redefine the field of the entire cu as composed, not of harmonic oscillators in idealized point-force formations, but of simultaneous cc/ed. This redefinition, which maintains that simultaneous cc/ed takes place in the quantum vacuum—V—in all and every portion of spacetime, allows us to understand an astrophysical phenomenon in a new way. The Hubble Deep Space Image results from repeated resolutions of apparently empty areas of space. As more sensitive photodetectors are applied, more and more regularly dispersed galaxies appear. A standard interpretation of this image is that we are seeing the edge of the universe. However, the visible evidence of the image does not support this interpretation. At the edge of any physical form or structure detectable by human vision or its extensions, the form or structure diminishes to nothing. For example, a slow approach to the edge of a spherical collection of floating balloons filled with helium and weighted to hang at different distances from the ground, would present a thinning of the number of balloons in direct proportion to the distance of the observer from its edge—its outer spherical surface. There is no visible evidence of thinning in the successive resolutions of the Hubble Deep Space Image. There is no visible edge. Rather, the sizes, orientations and intervals of the visible galaxies remain constant in the successive resolutions. First, self-similarity across different scales, as a feature of phase transitions, shows itself in this astrophysical image. Second, the long-range correlations involve the existence of similar galactic structures, or similar ensembles —clusters, superclusters—isometrically and isomorphically throughout the cu. With this correlation also occurs another long-range correlation, occurring on all scales of size and distance in the detectable cu, which is the simultaneous cc/ed of gravitation and radiation.

The absence of an edge, moreover, also suggests that the cu has no beginning and no end, or, that its beginning and end are currently beyond our powers of detection and conception. Again, we are uncommitted to a singularity at a beginning or end of a spacetime arrow, because time is a feature of the phase transition, a phenomenon of layering, with life as an emergent characteristic, rather than an absolute, permanent, structural reality.

How, then, might the structure of V, as presented above, be detected? Means of detection must directly reflect the qualities of the thing to be detected. The possibility of detecting V can be more clearly understood through distinctions among randomness, chaos and order. Randomness refers to a system in which no independent variable involved in the system's initial state can be used to predict any

additional state of the system. The biasing effects of all independent variables are equalized, or neutralized, relative to each other. In the coin toss, for example, no characteristic of the state before the first coin toss can be used to predict the outcome of either the first or the four millionth toss to any degree of precision greater or less than1/2. In deterministic chaos, however, the usefulness of initial state variables for prediction decays, degenerates or decreases in relation to the temporal distance of the detection event from the initial state, as expressed quantitatively, for example, by the Lyapunov exponent. Confusion between randomness and chaos in the physical sciences seems endemic. (Cf. eg., Joseplh Ford, "What is chaos that we should be mindful of it?" in Paul Davies, **The New Physics**, Cambridge UP (1989) 148-72, Peter Knight, "Quantum Optics," ibid., 289-315, and Ilya Prigogine, **The End of Certainty**, The Free Press (1997) 41). Absolute unpredictability and decaying unpredictability are clearly not the same. There is a difference between the inability in principle to predict tomorrow's weather from any known conditions of today's weather and the decreasing inability in principle to predict subsequent days' weather from any known condition of today's weather. Order, then, refers to a system in which one or more independent variable can be used to predict other states of the system, within a given range of precision, at any time distance from the initial state. These distinctions lead directly to the well-known fact that the cu exhibits all three regimes as well as various combinations of chaos and order. V must therefore be a type of energy, assuming for now that "energy" is still an appropriate term, that is not predifferentiated into one of the three regimes and that can be differentiated into any of them and perhaps into others yet to be discovered. By what means could such an energy be detected?

We can approach this question by exploring the conditions of energy prior to the primary bifurcations of charge and electromagnetism. The obvious focus for this exploration seems to be the massless, chargeless photon with spin 1. This form of energy has motion and structure but lacks charge. Is it possible to imagine a photon prior to its electromagnetic bifurcation? If so, we would seem to be at the very boundary of the cu and to possess some guidelines for detecting V. Absorption and emission of a photon by an electron may show some sign of the predifferentiated state. To understand how photon absorption and emission can cause a change in electron energy levels, we must be able to grasp the following process. A massless, chargeless energy with spin 1 contacts an energy with mass 0.51100, positive/negative charge and spin ½. The photon energy does not change the electron to another type of energy, but changes its energy level. How is this possible? A potentially transforming feature of the photon is spin. How does spin become a change in energy level? As a structureless energy, with no known stable surface or surfacelike features, the electron acceptance of the photon cannot be attributed to fitting of preexisting structural components, such as in chemical bonding. Two observations are relevant. First, bonding can be considered a contraction or compression of the orbital of one atom to fit the orbital of another atom. When a bond is broken, the contracted/compressed orbital expands/decompresses to its unbonded configuration. Hence appears another example of the ubiquity of cc/ed. Second, the fact that both the photon and the electron are fundamental energies, in the sense of fundamental as irreducible, and the fact that the only characteristic they share is spin, suggests that spin is at the boundary of V and P. It is possible that a photon, phase-locked in its alternating, right-angled configuration, entrains the spin of the electron by collapsing the potential of ½ into spin 1 or 2 exclusively. This change in

spin is a definite increase that intensifies or amplifies the electron's electromagnetic feature and appears, in detection, as an excitation, or, change in energy level. The experimental evidence on excited electron spin does not contradict this description.

Consideration of electron-photon interaction in this manner leads to the nature of quarks. The most relevant feature of quarks in this context is their intrinsic spin. If spin is at the V/P boundary, and if cc/ed occur in both V and P, can spin be understood in terms of cc/ed? Photons, electrons and quarks, are, as far as we know, irreducible. This places them as close to the V/P boundary as energy can be and still be detectable by existing instrumentation. Spin therefore looks like the signature of vacuum cc/ed that, at one and the same time, expands and decompresses V into materialization while contracting and compressing it into distinguishable energies. The pathway to detecting V thus leads us through the process of the production of these energies. We may conclude this part of the exploration with the generalization, of at least heuristic value, that bifurcation always accompanies materialization.

The notion of bifurcation deserves some elaboration. A bifurcation is a resonant reflection, the first expression of the capacity of energy to work on itself and to self-replicate. A bifurcation is a dynamic self-dividing unity, a unity of opposites. It makes self-similarity across different scales possible and thus structures all the fractal patterns of the cu. Bifurcation leads, through the wave/quantum nature of electromagnetism, from the classical to the new physics. A bifurcation, moreover, is a simultaneous cc/ed. It is an expansion/decompression into two realizations and a contraction/compression into two potentials. Birth and death, creation and destruction are mirror, resonant reflections of the capacity of energy to be other than itself. Resonance, in turn, couples motions, oscillations, frequencies, and vibrations. Resonances arise in extended, persistent interactions that join creation and destruction events as reciprocating reflections of each other (Cf. Prigogine, op.cit., 39-44, 119, 124, 129, etc.).

We can re-engage our attempt to understand the mfs by detecting V with an examination of spontaneous photon emission. We may assume that spontaneous decay transitions are caused by perturbations of "the residual vacuum fluctuations of the quantized ground state vacuum of the electromagnetic field" (Knight, op.cit. 290). This assumption can be refined, first by noting that "the zero point energy of (1/2h-barω) associated with the random fluctuations of electric and magnetic fields even in the lowest vacuum state" does not allow us to determine whether the dynamics of residual fluctuations are chaotic or random. Additionally, since the zero point energy also "prevents precise localization of position and momentum," (Ibid.), no a priori description of structure can be advanced with certainty. We detect spontaneous emission by detecting a photon coming from a source shielded from external stimulation. The cause of the emission, which is a change in the overall energy configuration of the source, must therefore be, in some sense, in the source. Since the cause so far eludes direct detection, it must exist on a scale and in a manner different from either the source (atom), an electron, or the photon that triggers the observed signal. The cause must, however, be able to interact with an atom and more specifically with an electron in an atom. Could the cause be a photon produced spontaneously elsewhere in the source? This possibility seems to lead to an infinite regress, unless the detected photon is the result of a so far undetected photon cascade that occurs in the source and causes the emission of the detected photon. If there is no

prior photon activity in the source, then the nature of the fluctuation is unknown.

We may therefore open the hypothetical scope of this exploration by suggesting convertibility among the terms oscillation, fluctuation, vibration, perturbation and cc/ed on this scale of energy. Since we do not have a precise description of the cause of vacuum fluctuation, we can allow for alternate possible structures, at least verbally. We can refine further by making explicit again an aspect of the cu as phase transition model: bifurcation always accompanies materialization. Is the cause materialized? Does it exist before or after bifurcation? Since we cannot definitely answer these questions, we also cannot assume that the cause is quantized. An unquantized energy in a quantum vacuum seems to be a contradiction, or at least a paradox, but entertaining it may further the exploration of the question of detection.

Apart from the verbal paradox, the physical pathway would strip away charge, spin and resonance. Moreover, any structure—surface or interior—that involves mass/energy transformations, would also be left behind. We would, as it were, have to go through a photon, an electron or a quark as though it were a gate, fence or wall. We would then find ourselves also without velocity. Collapsing bifurcation of space/matter into itself, we would find nothing to move and no place for it to move in. No two, three or four-dimensional calculations can help us here. Rather, the path seems to require dimensionless thinking. Or, the quote from Maxwell at the head of this paper can be reworded. The term "dimension" can be substituted for both instances of the term "particle." Then, the type of thinking needed is neither dimensional nor non-dimensional, but interdimensional. Interdimensional thinking takes dimensionality as a given of P, D and I and seeks what is between any one dimension and another. The answer is not another dimension. Thus, taking V as an infinite-dimensional function space does not work. First, multiplying possible dimensions to infinity does not show us anything about what is between dimensions. Second, an infinite-dimensional function space seems to lead to the standard paradox of linear systems, whether it is framed as Russell's paradox of classes or as Goedel's proof of incompleteness: some dimension is going to be either non-dimensional or a dimension that includes all other dimensions, and thus the mathematical structure either self-destructs or, in effect, swallows itself, which renders it useless as an heuristic for investigating physical reality. Indeed, the notion of a singularity at the beginning and end of the evolution of the cu can be understood as a materialization in astrophysical/cosmological terms of this paradox, which results from coupling exclusive non-contradiction and atomistic elements with linear implication in certain systems of logic and mathematics. Instead, interdimensional thinking requires the postulation and conceptualization of a non-quantitative frame of reference. Such a frame of reference lacks numerically describable coordinates, axes or dimensions, such as space and time coordinates, but, in some sense, conditions and produces the P, D and I regions of the cu.

What then could be detected and what could detect it? It might help the thought process here to see the cu, as a phase transition, as a large one-way mirror. From one angle, we see electromagnetic radiations of all kinds. From another angle, we see through electromagnetic radiation. The cu has both transparency and reflectivity. Both conditions involve either classical or quantized energy. In either case, the input and output of detection reflect the capacity of detection apparatus. As Knight puts it, "Quantum fluctuations of the electromagnetic field reflect our inability

to measure precisely the electromagnetic field of light" (Ibid. 313). However, from the telescope of Galileo to CERN, apparatus has progressively rendered reflective surfaces transparent. From a reflective surface that repelled alpha particles, presenting itself physically as a continuous, electromagnetically impervious surface, the atomic nucleus has become a porous cloud or swarm of larger and smaller energies. The detectable energic structure of the cu is thus already simultaneously reflective and transparent, the difference depending on the energies of resolution. Another way to frame the question of detecting V, as a step toward understanding the mfs, is to ask, How far does this dynamic structure, like a mutable, partially silvered mirror, go? Will higher and higher energy collisions continue to transparentize elementary particles to show even smaller, more fleeting, reflective constituents? Or will there be, as is known to happen in "a laser ring cavity made up of highly reflecting mirrors and containing a thin cell of excited atoms" (Ibid. 309), a phase transition of anther kind? This transition would not move the system dynamics from linear to non-linear. The energy level necessary to transparentize quarks or the quantum vacuum, for example, would produce subquantum effects in which both classical and quantum determinations of order regimes such as linear and non-linear would be impossible. These effects would not "obey Heisenberg's uncertainty relation" or self-limit at "just the minimum zero-point energy fluctuations permitted by the uncertainty principle" (Ibid. 314).

An approach to subquantum or interdimensional effects could be through observing spontaneous quantum fluctuation, not its effect as photon emission, energy level transition or virtual particles. If a fluctuation could be observed, then the surface of the foam of V would be observed. From this kind of observation, it might then be possible to devise a way to tunnel through the foam to some kind of direct detection of V. Observing a spontaneous quantum fluctuation would seem to require a passive experiment, or an active one in which the spontaneous fluctuation of an energy change can be disentangled from the rest of the event. The frame for devising such experiments may be a broader understanding of the mfs. We can view the cu as a projection the mfs makes through V. If the mfs is O, and V is simultaneous cc/ed, then the vacuum is the first step into materialization as we know it in the observable cu. If this is the structure, then there should be a driving energy of some kind in and of the vacuum that cannot be described without infinities. Its detection and measurement would require a device that allows for infinite bifurcations, or, fluctuations, since, from this point of view, every spontaneous quantum vacuum fluctuation would be evidence of a bifurcation of some kind. The detectable energy spectrum would to be able to display varying couplings of finite and infinite quantities and magnitudes. The detectable unit could be designated ce (contraction/expansion), cd (compression/decompression), or cc/ed (contraction compression/expansion decompression). The same fluctuation would also be an expansion, decompression relative to V as unmaterialized potentiality, once removed stepwise from the unlimited potentiality of O, the mfs.

Another way to conceptualize the detection pathway is to view the primary bifurcations of charge, electromagnetism and space/matter as reflections. In each pair, each one is the mirror reflection of the other. Bifurcation here is a projection of a non-dimensional, or, alternately put, simultaneous, infinite dimensional, condition, through a materializing and dematerializing transition zone into a four-dimensional condition in which cc/ed materializes as detectable and often opposite energic

features, such as spin and charge. The detection pathway consists in collapsing the reflections to return the projections that are their source to the condition prior to bifurcation, a condition assumed by the process to correspond to detection of the vacuum itself which is, in turn, a step toward V. Reaching V experimentally would then require collapsing the vacuum foam or ferment into its prior condition in which there are no surface or surfacelike features. This would be equivalent to, paradoxically put, seeing the face of V.

More concretely, a possible experimental setup could be as follows. A radiative decay source is put in a slightly larger chamber that is both shielded and ultrahigh vacuum. To as large an extent as possible, incident electromagnetic fields are prevented from interacting with the source material. The detecting device would be an audiovisual system using the highest energy gamma rays as the resolving energy, perhaps in a refined Mossbauer spectroscopy. A gamma ray video device would continuously record all activity on the surface of the material, the entirety of which could be brought to the device aperture by appropriately placed reflectors inside the shielded cavity. The gamma ray video recorder would pick up all surface activity accessible at its wavelength. It would clearly see spontaneous photon emission. However, that would not be the primary target. Once photon emission is detected, that portion of the recording could be isolated. In isolation, the portion can be replayed using appropriate filters to screen out the photon radiation. In this manner, the actual vacuum fluctuation that caused the spontaneous emission might be visible. The gamma ray imager should be connected to a computer readout system that can display the fluctuation holographically, that is, in four, animated dimensions. Coupled with the gamma ray detector would be an audio detector that could be modeled on the audio sensitivity structures of animals, such as whales, which exceed human auditory capacity by many magnitudes. Since this attempt to detect V through a quantum fluctuation takes place at the edge of the cu, unusual effects may occur. Conditions could be infinite dimensional, zero dimensional or non-dimensional. Non-dimensional would refer to a condition for which no known quantitative measures are available. To allow for the detection of these effects, part of the experimental setup could include compounds, solutions or living organisms, such as E. Coli, that are known to show unusual types of sensitivity. No doubt such a setup awaits future technological developments.

Before leaving the field, this project can be reframed in a more comprehensive reflection on the issue of observation. Human perception and its extensions anchor the physical science picture in the organism's need for stability to decrease insecurity and increase predictability relative to survival and dominance. The spacetime, causal picture suits this agenda but results in serious anomalies. It works well if and only if the objects of experimentation are isolated both theoretically and physically from the environment. The logical alternative to isolation is wholism.

Human perception and its spacetime, causal interpretation of nature are embedded in a manifold of energic conditions: O (mfs/unlimited potentiality), V (evanescence/quantum vacuum/potentiality), P (probability/quantum mechanics/qed/qcd), D (determinism/classical physics/special and general relativity) and I (dissipation/life). Human embedding is similar to a deep-sea creature that lives in water devoid of visible radiation but creates its own light through biological processes of energy transformation. It is no accident that this analogy resonates with

Plato's "human beings living in an underground den" (Jowett, trans. The Republic, Book III, Sec. 514) and with his simile that "a creature who was at the bottom of the sea were to fancy that he was on the surface of the water" (Jowett, trans. The Phaedo, Sec. 109). Nor is it an accident that Plato's idea of the good in The Republic as "seen only with an effort; and when seen, is also inferred to be the universal author of all things beautiful and right, parent of light and of the lord of light in this visible world, and the immediate source of reason and truth in the intellectual" (Jowett, trans. op. cit., Sec. 517) implies an entirely correlated universe, interconnected by a power that acts simultaneously throughout with no mediation of space, time or causality. There is no suggestion in this passage that the power is inside, or outside, of anything, or that it possesses any surfacelike features, or has any temporal dimensions whatsoever. Plato clearly understood embedding and, in synch with ancient yogic and shamanic practices from all parts of the world, also understood that the education of mental attention can lead any human being to such an understanding and realization as he describes above.

The question of the nature of the current universe is thus inextricably intertwined with the issue of human education. This intertwinement has, in a sense, been masked by the dominance of mathematics and highly complex detecting technology in 20thc physics, but the fact that most people cannot do physics at the quantum or astrophysical level clearly extends this intertwinement from the ancient to the contemporary world. The spontaneous interconnection of the cu also echoes the Hindu image of Indra's net, already explored in detail in this relevance by Fritjof Capra in his The Tao of Physics (4^{th} ed,, Updated, Shambala (2000)). The image of Indra's net visualizes how non-locality phenomena in quantum mechanics as well as non-local correlations in astrophysics happen by means of V. How could this assertion be tested? The first step would seem to be to detect vacuum fluctuations. More clearly and fully understanding these ultra-finegrained events would allow us to use concrete physical data to further investigate V and initiate approach to O.