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STEM – a better metaphor and a new concept!

The content of this paper is primarily the product of an attempt to understand consciousness by working through the *Gestell* - conventionalised epistemology, at least some of several foundational concepts. This paper indirectly addresses the ancient question: “How is objective reference – or intentionality, possible? How is it possible for one thing to direct its thoughts upon another thing?” (Chisholm, 1981:1) As such, I have adopted a holistic methodology; one in which I develop a framework based on a form of process philosophy and descriptive emergentism ¹. Many of the problems associated within the philosophy of mind arise because of a failure to understand the interrelations among the concepts we employ when we talk about consciousness and perception. These concepts are generally associated with certain structural features of reality. Hence, the paper advances through a series of attempts at defining the concept of time, moving through to some of the central figures, their thoughts and arguments and problems associated within the philosophy of time. Given the intertwined nature of the associated concepts (i.e. space, time, event and motion), I have expanded on these to a level of conceptual integration.

Some thinkers (e.g. Augustine, J.M.E. McTaggart) within the field of philosophy of time have argued that nothing that exists could be temporal and consequently time must be unreal. Yet, the corporeal nature of the Universe is consistently expressed – exists, seemingly through temporal features of change formed into heterogeneous morphological patterns, such as organisms, planets, stars, etc. However, temporal features are fundamental aspects of a universal ‘energy’ (*quantum foam; law of conservation of energy momentum*) in resonant phase transition, of which change occurs consonant to Expressive motion, and not of time *per se*. That is, unless, of course, time is construed as an aspect or property of universal energy. (The term Expression and its adjective Expressive are technical terms, partly to denote ‘motion’ of the manifested material universe akin to that of David Bohm’s terminology and sense given to the *Explicate Order*.) Simply put, the World, we now know, is fundamentally a dynamic, if not, a self-

organising system. The World is responsive-participatory. Ecologically, the World is as alive as its inhabitants are. That is to say, if life emerges from the World we must concede it is part of the living process! The interactive play of life between environment and its dwellers is scientifically corroborated and the very structure and content of the World as Expressive (i.e. in and of the manifested life) as it is responsive-participatory.

Accordingly, the content of this paper is an attempt to produce a supply of richer metaphors to tackle the various interconnected levels of physical activity at all levels of operation and coherency in the production of consciousness. I introduce the metaphor Signature-Energy-Frequency (SEF) corresponding to Planck's Constant (see below) to describe the coherent level of cerebral activity hypothesised to be responsible for cognitive functions, although not of consciousness in its fullest sense. SEF is a connective concept bridging relations between subsystems and systems. I adopt an enactive viewpoint, that is mental acts are "characterized by the concurrent participation of several functionally distinct and topographically distributed regions of the brain and their sensori-motor embodiment" (Varella, 2002:6).

It is my contention that consciousness underlies the activity of the material universe, in some kind of raw amorphous state, in line with Chalmers (1996) and is the basis for its actualisation. In accord with Peter Marcer's (1997) proposal that in order for objects to be perceived in three-dimensional reality as they really are, necessarily requires the condition phase-conjugate-adaptive-resonance (PCAR) being met. That is, "resonance requires a virtual path mathematically equal but opposite to the incoming sensory information about the object" (Mitchell, 1999:3). Accordingly, memory is treated as a feature of patterned or more specifically SEF's that contribute to the production of thoughts and mental experience. Along with the advent of quantum physics Space and Time have conceptually become dimensionally connected, in the same way, I believe, the concept of Motion (change) and the Events of the Expressive Universe have become relative concepts.

Time, what is it? The concept of time is one that most people are familiar with, but would no doubt struggle to define or fully explain. A simple test is to ask oneself - at what speed does time expire? To say that it expires at the rate of constructed temporal measurements (i.e. seconds, minutes, hours, etc.) says nothing – it is a tautology. Time, undoubtedly, is the most pervasive component of human experience just as it is conceptually fundamental to our physical theories. The concept of time has led many to wonder about questions such as... If time did not exist would the universe stand still? Would the Universe expand? Would the Universe have even begun? Is motion, a necessary or sufficient condition for time to occur? “What, then, is time?” This last question features prominently throughout the collection of essays on the subject of time assembled in the book *The Philosophy of Time* (1968) edited by Richard M Gale. I would not presume to answer this question although what I have to offer epistemologically expands upon our western inherited notions of time seen as an arrow of infinitesimal moments, which flow in a constant stream.

It is not uncommon to select some cyclical physical process to serve as a clock whereby *temporal congruence* (equal intervals) is defined by the corresponding cyclical ‘events’ comprising the clock. The notion of temporal congruence ushered in the introduction of optimum simplicity in order to maximize our own ability to function in a communicative and coordinated manner; to manipulate physical phenomena to suit our needs, and; to help us understand the physical properties of the Universe. Ideal clocks are defined specifically within the confines of physical theories, consider *inertia* (i.e. the resistance of a body to acceleration) in Newton’s theory and the atomic clocks of relativity theory based on the regular vibrations associated with atoms e.g. *caesium atoms*. As Gale reminds us, an operational or scientific definition of time is based on the method by which we measure time. All such definitions suffer the fate of circularity. Defining the concept of a clock will naturally involve temporal notions. A clock is defined as a closed physical system that operationally returns to exactly the same state it found itself at some *earlier instant in time*. Time, is a self-referential system! The *conditio sine qua non* of measuring time is that two different observations – “non-simultaneous” observations –

(occurring at different times) be made of the measuring scale (Gale, 1968:3). Our definition is therefore circular.

The most famous serious attempt to define time is found in Augustine's *Confessions*. Augustine's famous lament: *What, then is time? If no one asks me, I know: if I wish to explain it to one that asketh, I know not.* This encapsulates the mystery that time holds for him. The predicament is that he has an immediate experiential awareness of time and the means to express the temporal stages grammatically through the use of tenses – *past*, *present* and *future*, *earlier than* and *later than*. Yet as soon as Augustine attempts to provide a definition every proposal turns out to be circular, for reasons given above. There are myriad words such as 'red' that stand for indefinable properties. Yet ostensibly we can define 'red' by pointing to a red object. But time eludes such straightforward demonstrative definitions. We cannot point to anything and say, "This is the past (or future)". A photograph or memory of a past event it depicts should not be confused with actual events. The present poses the same problem, since as Aristotle had claimed it serves merely to connect the past with the future. Whenever someone points to anything it will always be the present (Gale 1968).

Augustine wondered that if the present connects the past with the future, could it have duration? 'Must the present be zero duration?' In an instant the present shifts to the past and strictly speaking *nothing* is present now². Augustine decided that the present must be an *indivisible instant*. Moreover, if we cannot even ostensibly define time how is it possible to measure time? How *long* is a length of time? How long is the past or future when neither exists now? Essentially, Augustine was convinced that the present could not have a finite duration. Augustine thought that the only way around this anomaly was to suggest that time is a *protraction* of the mind; reflecting the subjective sense of time in such a manner that when we measure time we are measuring an expanse of our conscious memory. Time, according to Augustine, is purely subjective and mind-dependent and it is only the "present of things past, memory; present of things present, sight; present of things future, expectation" (Gale, 1968:5). Unfortunately, if this is meant to be a

definition of time it is nonetheless circular as Gale claims, for any reference to *memory* or *expectation* presumably involves temporality (1968:5).

What, then, is time? Most attempts to define time since Augustine, irrespective of their varying degrees of difference, presuppose the meaningfulness of the question. Ludwig Wittgenstein's *Philosophical Investigations* represents a radical departure and perhaps for the first time the legitimacy of the question is brought into doubt. Augustine's mystification with time concerns the restrictive 'name-substance theory of meaning', in use while he was alive. That is to say that words themselves mean the very things they name. Time was employed semantically as a noun and the mystery for Augustine emerges from the fact that there is no object it names. There was no way to measure something that seemingly did not exist. J.N. Findlay (1941) points out that Augustine's confusion about measuring time was based on the misapprehension that temporal-wholes be treated in the same way as object-wholes.

Augustine's paradox concerning the indivisible nature of the present is also dispelled as a consequence of the way we use temporal language in different contexts. Findlay points out that Augustine's question "What is now present?" is not restricted to only one right answer. The parameters of the *present* will ultimately depend upon the context in which the question is asked. Context is a determining factor. Indeed, motion in space involves a rate of change of spatial position with respect to temporal position. What, then, could be meant by the rate at which the present shifts along the temporal series? (Michelle Beer, 1994:87)

Obviously, our notions of space and time figure prominently on our map of reality; they serve to enable us to order things and events in our environments. Classical physics was based on the notion of an absolute, three-dimensional space, independent of the material objects it contains, obeying the laws of Euclidean geometry. Time was a separate dimension, which again was thought to be absolute, flowing at an even rate, independent of the material world. Both Aristotle and Newton believed that one could "unambiguously measure the interval of time between two events, and that this time

would be the same whoever measured it, provided they used a good clock” (Hawking, 1988:18). In the context of relativity theory, ‘empty space’, however, has to be thought of as having a well-defined structure and properties. Space and time are intimately connected to form a four-dimensional continuum - space-time, we can never talk about space without talking about time and vice versa. Different observers will order events differently in time if they move with different velocities relative to the observed events. In such a case, two events, which are seen as occurring simultaneously by one observer, may occur in different temporal sequences for other observers. All measurements involving space and time thus lose their absolute significance. Perception cannot therefore be uniform among perceivers. Yet as individuals we perceive a spatiotemporal world we also inhabit.

The modification of the concepts of space and time, which are so fundamental for the description of natural phenomena, entails a modification of the epistemological framework we use to describe nature. Perhaps the most significant consequence of this modification is the realisation that *mass* is just a *form of energy*. That is to say, even an object at rest is said to have energy stored in its mass, and the relation between the two is given by Albert Einstein’s mass-energy equation $E = mc^2$. Where E is the energy in joules, m is the mass in kilograms, and c is the speed of light, in a vacuum, in meters per second (Capra, 1975:65). There is no such thing as absolute stillness; motion is the one constant. All measurements involving space and time are relative and the very structure of space-time depends on the distribution of matter in the universe.

According to quantum physics, on the very smallest scales over distances commensurable to the Planck length³ space and time lose their identity in what is referred to as the ‘quantum foam’. American physicist, John Wheeler, has suggested that the presence of what is conventionally regarded as a ‘real particle’ in space is “no more significant in the context of the ‘quantum foam’ than the presence of a cloud is to the dynamics of the atmosphere” (Gribbin, 1998:367). What we see as a cloud or a particle is only a minor disturbance in the “sea of activity in the quantum foam” (1998:367). At the subatomic level, the solid material objects of classical physics dissolve into wave-like patterns of

probabilities, and these patterns, ultimately, “do not represent things, but rather probabilities of interconnections” (Capra, 1975:71). The Universe according to quantum theory is completely interconnected revealing itself as a whole; nature does not show us any isolated ‘building blocks’. Instead nature appears as a complicated web of relations between the various parts of the whole (1975:71).

Time, according to quantum physics has directionality only in the conventional sense determined by the discourse of tensed language, in reality its existence is context-dependent. Recall that in the context of relativity theory, ‘empty space’, has a well-defined structure and properties. Accordingly, space and time are by their very nature physical. For this reason, understanding the concept of ‘space’ necessitates understanding the concept of ‘time’ beyond the contemporary relativized notion, in line with other associated features of nature. Two particularly important relational features both perceptively and objectively are the concept ‘event’ and the intrinsically conjoined concept of ‘motion’. The intrinsic nature of these concepts [Space, Time, Event, and Motion (STEM)] can only make sense when each of the adjoining concepts are themselves integrated within the defining terms for comprehension. Separately each concept cannot stand in absolute terms. There is no doubt in my mind that these concepts are interrelated, indeed, interdependent both definably and effectively. Problems arise when any attempt is made to define these concepts in abstraction. The meaning of each concept is given in conjunction by employing a unified sense of these other associated STEM concepts.

I will now commence establishing a redefined ontology of ‘STEM’. The first two STEM ontological concepts, space and time have been outlined above by their intrinsic unifying relation i.e. spacetime. Because of the philosophical tradition inherent in the association of the concepts, space, time, and motion, I shall directly attend to the concept of motion. The concept of motion as I am employing it derives in its approximation to countless interpretations of the ancient notion ‘All is in Flux’ attributed to Heraclitus – ‘everything is a process’. That is to say, there is no absolute stillness or in contemporary terms no zero-point energy. Motion, according, to Sir Isaac Newton is explained in terms of three

universal laws (Newton's laws of motion) which govern the workings of the everyday world (together with gravity and electromagnetism). The first law is that every body continues in its state of rest or moves in a straight line at a constant speed unless it is compelled to change that state by forces impressed upon it. This is counter-intuitive, because although we see that objects around us are stationary, and ordinarily we do need to provide the force to move them, without the continued force the object will soon come to a halt. For example by pushing or peddling a bicycle. However, in the everyday environment of the Earth's surface motion is always opposed by friction. A slowing moving object (e.g. bike) is in fact obeying Newton's first law of motion. Newton's second law says that when a force is applied to an object, this changes its momentum (velocity) of the object in a precise way. The change of motion is proportional to the motive force impressed and the direction in which the change of momentum occurs is in the direction of force impressed. In other words, twice as much force will produce twice as much rate of change in velocity. The impressed force equals mass times the rate of change of velocity, i.e. acceleration ($F = ma$). This distinguishes the mass of an object (inertial mass) from its weight; the mass is measured by the amount of acceleration of any given force produces. Newton's third law says that whenever a force is applied to an object, the object pushes back with an equal and opposite force. To illustrate this, consider a billiard table. Striking one ball directly towards another ball will cause this second ball to be deflected at an angle to which the first ball is itself deflected in the opposite direction (Gribbin, 1998:253-56).

Now, then, the concept of 'event' according to the Oxford English Dictionary (1989) has its origins in the Latin word *e'vene*, [ad. L. *even-ire* to come out, happen) (OED, 1989:456). An earlier rendition of the word *'evene* [ME. *efne*, *evene*, ad. ON. *efni* material, *pl.* ability, Osw. *æfni* (Sw. *æmna* stuff, Da. *evne* ability).] 1. "material; subject-matter" 2. **a.** "Nature; form or shape". **b.** "Natural powers" (OED, 1989:456). The word 'event' came to mean, "issue, f. *evenire*, to come out, happen, result" (OED, 1989:459). A.N. Whitehead said of the term 'event': "The 'constants of externality' are those characteristics of a perceptual experience, which it possesses ... when we apprehend it. A fact, which possesses these characteristics, namely these constants of externality, is what

we call an ‘event’” (Whitehead quoted in OED, 1989:459). From the French *e'vent* [ad. Fr *eventer* OF. *esventer*, *ex-* + *vent*, wind] translated as “to expose to the air; hence, to cool. **b.** *intr.* for *refl.* To vent itself, find a vent” (OED, 1989:459). This rendition does not displace the notion of ‘issue’ or of ‘to come out’, nor of the sense of ‘material’, or ‘subject matter’ in the French and Latin translations.

Analogously the British linguist and historian addressed certain curious evidences embedded in our words:

[S]uch a purely material content as “wind” ... and ... such a purely abstract content as “the principle of life within man or animal” are both late arrivals in human consciousness. Their abstractness and their simplicity are alike evidence of long ages of intellectual evolution. So far from the psychic meaning of “spiritus” having arisen because someone had the idea, “principle of life...” and wanted a word for it, the abstract idea “principle of life” is itself a *product* of the old concrete meaning of “spiritus”, which contained within itself the germs of both later significations. We must, therefore, imagine a time when “spiritus” or “pneuma”, or older words from which these had descended, meant neither breath, nor wind, nor spirit, nor yet all three of these things, but when they simply had their own peculiar meaning... (Barfield, 1965:80-1)

Certain features of the world irrespective of cultural differences transcend the dissimilitude of the terms used to express that feature such as the term ‘event’. Hence, in establishing the redefined ontology of STEM as an absolute concept I am using the term ‘event’ as ‘material’, ‘subject-matter’ in line with the Whitehead’s ‘constants of externality’. For the purposes of ideational conveyance ‘event’ stands in approximation to Roderick Chisholm’s notion of abstract universals. He says: “all discourse that is ostensibly about events may be reduced to discourse about states of affairs, relations and properties, and individual things ... properties and states of affairs are eternal – or abstract - objects” (1981:11). I say approximation to draw a distinction between Chisholm’s Platonic view (Forms/Ideas) from one recognising that the nature of universal energy as defined by quantum theory (i.e. law of conservation of momentum-energy) would necessarily be amorphous. The redefined concept ‘STEM’ represents the physical features of the universe effectively integrating the subjective and objective realms of experience.

The concept of energy is itself an elusive term that requires a richer metaphor that will enable us to penetrate the conceptual extremes and multiplicity of senses of current usage in the physical sciences. The concept STEM metaphorically extends beyond the particular when employed as an intransitive verb, (not governing an object). STEM refers to a process that incorporates the change and motion of an event whose measured duration can be arbitrarily defined given the *context* of acquisitional requirement i.e. exploratory or experimental work, as also with dispositional psychophysical states.

The concept of time is associated with the mass of an object, which of course is the measure of inertia whose influence is directly responsible for physically effecting the curvature of space-time as defined in relativity theory. Significantly, the degree of curvature of spacetime is thus proportionally related to the inherent energy (mass) of the object of association. Matter, as has already been noted according to relativity theory is reducible to energy. The concept of time, we want to say, is a constitutional part of the very fabric of the Universe. The fabric of the universe, at least in an empirical sense, is fundamentally physical. In what sense could time be anything other than something physical? If time is physical, it is reducible to energy according to relativity theory. If time is not physical, it cannot have any effect on the physical objects of the universe! *Ergo*, time is physical. The role of time, if there is in fact such a thing, is ultimately intertwined with the energy of universal activity. All seemingly diachronic activity (consider evolution), pertains not to time as something external by which reality is measured against. Indeed, time relates directly to the processes of the elements, the inherent energetic properties generally associated with an 'event', as they unfold in and from the perspective of any observing, that is, conscious being.

Time and measurement are handmaidens and in many ways, there is a direct relation between these concepts and energy. The most accurate measuring procedure or device is the atomic clock - a generic term for a variety of timekeeping devices based on the regular vibrations associated with atoms. The standard form of atomic clock nowadays is based on caesium atoms. The spectrum of caesium includes a feature corresponding to

radiation with a very precise frequency – 9,192,631,770 cycles per second. One second is subsequently defined as that amount of oscillations of radiation. The caesium clock is one part in 10^{13} (one in 10,000 billion), or one second in 316,000 years accurate (Gribbin, 1998). In physics, Planck's Constant is described as the constant proportionality between the energy emitted or absorbed by an atom and the frequency of emitted or absorbed light as an electromagnetic wave (Jibu & Yasue, 1995). Planck's Constant suggests that energy and frequency and consequently 'time', as far as measurement is concerned, are all interrelated concepts. Indeed, as John Maddox (1998) explains *the greater the frequency, the greater the energy of the quanta*. Energy is indeed the fundamental substance of the universe definable in terms of frequency!

It seems that by subsuming various aspects related to energy/frequency we can, effectively, not only reduce the number of variables concerned but also expand the process of any spatiotemporal investigation. Our concern, with respects to understanding Nature requires a shift in perspective in consideration of her energetic processes. The concept (STEM) constitutes the fundamental aspects concerning measurement through space and time (the physical geometry of reality) in terms reducible to frequency or wave function i.e. energy. Energy is required for any activity to take place, although strictly speaking not in the noun (concrete) sense of the term but in the sense apropos action, the verb! STEM, in this sense is employed as a conceptual apparatus within my own epistemic framework to, in part, define energy given that all the elements of its construction are conceptually reducible to energy. STEM, in its intransitive verb form by definition, has no object yet denotes the universal process of Expressive being. That is, not only of the outer realm but also the inner realm of experience viz. evolved relations between the subsystems of the human body. The idea is not to strictly think in terms of causes but also in terms of relations, of connections, and the interdependence between phenomena from which they take on a causal significance to the observer. Measurement is, indeed a concept we impose from selectively constructed elements of Nature, abstracted and simulated from Nature to describe, control and manipulate our very environment. Of course, the method of measurement itself arises from experience. Experience is the measure of difference and multiplicity. Experience is the measure of

change both internally and externally. The universal impossibility of objective measurement certainty that is the problem of putting ourselves outside of our sensory organs to discover the certainty of the external realm from the situated embodied position of being invokes Godel's Incompleteness Theorem.

Signature-Energy-Frequency (SEF) is a metaphor to describe the coherent activity of separate yet interconnected anatomical structures of the brain in *phase-conjugate-adaptive-resonance*. SEF denotes the energy/frequency relation inherent in all matter as defined by Planck's Constant (see above). It is my contention that the significance of the anatomical structures in the brain purported and ascribed corresponding roles of activities, responsible for specific functions, is only part and not the complete picture. Mental events, such as thoughts, putatively are an agglomeration of interconnected events – such as the composition of the senses, neural plasticity, parallel processing involving memory, vocabulary, spatio-temporal awareness, reason, association of experiences, etc. The brain is constituted from billions of neurons, and glial cells of which large numbers are cross-wired to each other. The living process and the experience of it are indeed continuous, even when we verbally stagger searching for the right word to convey an intended sense. Invariably, there is a feeling tone we recognise in trying to convey that certain sense but struggle to identify or, as it were, retrieve the word we want to use. Neuronal activity along with the electrochemical transmission coheres to produce (presumably) an inner dialogue. The sense we make of the world whether derived from the sensory modalities, creative imagination or Kantian intuition, has invariably been learnt as conveyed through a relation of energy in the form of frequency transmission. We make our own sense of phenomena and every nuance is formed by layering of SEF patterns within STEM associated containment fields ⁴. What is a human being? The answer from a reductive analysis, is a highly complex concentration of energy.

Conceptually bridging the existence of an evolving species such as human beings with the evolving environment from which the attributes intelligence, consciousness and perception emerge requires grounding concepts of participation and reciprocity. Experience is a continuous process, not restricted to human beings. Sub-events, the

composition of myriad parallel sensory activities contemporaneously occurring form single and compound STEM's, collectively this overall activity, it is hypothesised, forms, and is physiologically etched, canalized ⁵ into SEF's that form memories. Recall Newton's third law of motion, which says that whenever a force is applied to an object, the object pushes back with an equal and opposite force. Now recall Peter Marcer's necessary condition phase-conjugate-adaptive-resonance (PCAR) in that resonance requires a virtual path mathematically equal but opposite to the incoming sensory information about the object. In other words, the incoming sensory information equates to SEF corresponding to the organic systems' relations in STEM. In themselves, these concepts describe possible evolutionary mechanisms; they are not, however, the conscious phenomena - some desideratum is missing.

Notes

1. Descriptive emergentism holds that properties of the whole cannot be defined by properties of the parts.
2. Must the present be zero duration? Augustine's reply was presented in a dialogue that goes something like this. In attending a concert one is asked, "What is the orchestra playing now?" The reply received is "The Eroica Symphony". The Eroica has four movements of which all four movements cannot possibly be present now. The original claim has to subsequently be narrowed to "the first movement is now being played". But the first movement is comprised of hundreds of measures which cannot all be present now. Eventually one is forced to reduce their claim to less than a single beat of a bar of music rendering nothing in the present. The present, as Augustine claimed is an 'indivisible instant'.
3. The quantum length, commonly known as the Planck length named after the physicist Max Planck (1858-1947) refers to the length scale at which classical ideas about gravity and space-time cease to be valid, and quantum effects dominate. It is roughly 10^{-33} cm, about 10^{-20} times the size of a proton.
4. What I mean by the notion of containment field specifically forms, in conjunction with the concept STEM, activity simultaneously occurring as in a non-local event, and by extension an event between percipient and the object perceived. In addition, it retains the commonsense description of parameter or field, sensory or otherwise.
5. C.H. Waddington proffered the concept *canalization* to refer to the field concept with the idea of "individuation fields" associated with the formation of definite organs with characteristic individual shapes – an *epigenetic landscape*. In a sense, a field is considered to be the condition whereby a living system owes its typical organization and its specific activities. The field idea was later extended into the concept of the chreode, or developmental pathway. Chreodes are canalized pathways of change analogous to valleys or paths that lead to particular developmental end-points (Sheldrake, 1988:100).

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