A MODEL OF MIND FROM THE PERSPECTIVE OF TEMPORAL STRUCTURALISM

Stephen M. Pike

University of Canterbury

Supervisor: Dr. Philip Catton

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Abstract

Symmetry and symmetry-breaking have, in the last one hundred and fifty years, become incorporated as central explanatory concepts within the natural sciences and mathematics. An abbreviated review of the incorporation of symmetry within the disciplines of mathematics, physics, philosophy and biology, provides a frame within which to develop of a model of mind. This thesis combines the framework provided by symmetry and symmetry-breaking with a structural understanding of self-referential dynamics in examining the implied Kantian model of mind. It considers that Kant's assumption of a transcendental self unnecessarily isolates consciousness from being understood as a product of complex natural processes. Kant's structural model of mind is examined and reformulated in terms of a more fundamental form and process. The space required for any non-reductionist model of mind is proposed as being generated through an enfolding of dimensionality in the occurrence of categorical level symmetry breaking during evolutionary development. The temporally extended function is accounted for in terms of self-referential structural dynamics operating within the primary temporal asymmetry. The model of mind proposed is created through application of naturalistic explanations incorporating symmetry and has attributes that may prove of interest to non-reductionists. The phenomenological geometry established provides a framework to understand the experiential phenomenon of qualia while conforming to the requirements of a natural explanation. Information is conceived as being transmitted in waveforms propagated across spaces of enfolded dimensionalities through structural frames demarcating nested spaces and condensing in the synthesis of unity in the object of attention, or image, and returning to distribute, the now reformulated, information outward across contextual frames and spaces. This simplified dynamic is considered to operate at all levels of natural phenomena and involves the reintroduction of Bohm's concepts of implicate and explicate order. The result is a model of mind employing a minimum structural form and self-referential dynamics that has potential for integration across the discipline theoretic frames of the natural sciences while retaining, for the domain of conscious phenomena, an independent causal significance in terms of a temporal structuralism.

Keywords: mind, consciousness, symmetry, symmetry breaking, Kant, Bohm, Layzer, structuralism, time, temporal extension, evolution, quantum theory, EPR, self referential, nonreductionistic.

Contents

Chapter 1

Introduction to the Philosophical Frame

To embark upon an enterprise of constructing a model of mind and developing an understanding of mental and conscious phenomena is formidable under any consideration. Nonetheless, this is the intended project of this thesis. Any model of mind must, it seems, address multiple complexities of each of the disciplinary domains that prescribe the nature of the space reserved for consciousness, the mind, and mental phenomena. Quantum physics, in its various theoretical orientations, constrains the requirements of the mental and these constrains are especially refined in the engagement of quantum theory's interpretation with the restricted structural complex of the various forms of the Einstein, Podolsky and Rosen (EPR) experiments (Einstein, Podolsky and Rosen, 1935; Bell, 1964; d'Espagnat, 1979, 1981, 1987, 1989; Aspect, Grouyer and Roger, 1982a; Aspect, Dalibard and Roger, 1982b; Aspect and Grangier, 1990; Conway and Kochen, 2009). The biological and neurological sciences constrain how conscious phenomena must interface with neurophysiological and biochemical processes. Claims of the many-world interpretation of quantum physics (DeWitt and Everett, 1973) require consciousness to determine temporal trajectories and the neurological research of Libet (Libet, Freeman and Southerland, 1999) seems to require consciousness to always follow physiological changes. The task in developing a model of mind and an understanding of consciousness is to so construct the model so as to conform with the constraints imposed upon the space by the nexus of relevant disciplines while expanding upon the structure to allow translation from one discipline space to another through the frame of the model. Such an undertaking is, I believe, what Roger Penrose (1994) is referring to when he says:

> It is also my own belief that any genuine progress in the physical understanding of the phenomenon of *consciousness* will also need as a prerequisite - the same fundamental change in our physical world-view (p391).

To begin a philosophical exercise with the intent of developing an understanding of consciousness and its place in the physical world we must, it has been suggested, begin at the examination of the space of the mental within the interfaces of experiences and therein from the Kantian perspective. Kant (CPR, 1781/1965), establishes the framework for all modern critical analysis of mental phenomena though he appears to never explicitly describe a theory of mind as such. Nevertheless, he attempts to describe an understanding of the process of thought with a minimum of ontological assumptions. Furthermore, it is a process that accommodates the experiential interface with the world and therefore focuses upon the most interesting and the important aspects of any theory of mind. Without the significance Kant affords the experiential interface, inclusive of the historic preconditions, the mind is left unrestrained from any fantastic imaginings of causal significance.

The Kantian structures and processes that I consider relevant for the purpose of this thesis are those involved with the threefold process of synthesis. As elements in a theory of the mind, these are primarily described in the Paralogisms of Pure Reason (in CPR). Kant envisions a process whereby the senses produce an apprehension of experience which is then synthesised into a manifold through reproduction that then is synthesised into a unity of a concept, that, in its place within the structure of other concepts yields understanding.

> All our knowledge starts with the senses, proceeds from thence to understanding and ends with reason, beyond which there is no higher faculty to be found in us for elaborating the matter of intuition and bringing it under the highest unity of thought. (CPR-TD, A 298-299, B 355)

There is for Kant, a matrix of categories that define the space in which intuition and synthesis function. The categories are a priori and define the dimensionality of the space of the mind accordingly. Additionally, the primary dimensional aspects of space and time are taken as fundamental; “Neither space nor time, however, is to be found save in us.” (Paralogism of Pure Reason, CPR, A 373)

For Kant the categories are transcendental and necessitated by there being thought at all. The process of sense experience being translated into a manifold arrangement of these categorical dimensional states and then to a unity of synthesis in thought or concept is carried by intuition and imagination in service of the self that synthesises temporally distinct iterations into a unity within its extended duration.

There are sufficient ambiguities in the non-explicit theory of mind which Kant approaches from several aspects to provide lively analysis and refinement of possible understanding for many future generations of graduate students. I do not feel compelled toward such refinement of Talmudic analysis, rather, I am interested in directing attention toward three aspects of Kant’s general understanding of mental dynamics:

1. The givenness of the transcendental self
2. The synthesis of the manifold
3. The synthesis of the concept

1) Kant positions the self as a given space of temporal extension within which a kind of structural chemistry of thought transpires. It is possible that the transcendental space of being is reflective of Kant’s personal religious beliefs (Kant, 1781/1965, preface 2nd edition CPR). Regardless of his personal religious predispositions, he understood the need for a temporally extended domain and found no way of generating such a phenomenon other than presupposing it as a given. Space and time (even before the categories) are the primary aspects of the domain that brings unity to the experience and, without that unity, he can see

no sensible understandability of space and time. For Kant, it is the self which brings space and time into the world by virtue of its duration and synthesis of unity. To take as serious such an assumption requires us to adopt either a transcendent idealism or a religious perspective that dislocates the mental from an evolutionary biological process and begs the questions as to the metaphysical and ontological aspects of such a position. For there to be an identity that has intuition of duration, or spatiotemporal extension, there must at least exist the duration of some aspect of that which is referential such that there can be claimed a continuation of the space under translation. If the space in which the self is embedded changes essentially upon each iteration of experience, there could be no sense in which the transcendent self could claim a continuity of spatiotemporal extension. If there is no reference to permanence there can be no sense of duration. Even if there is a space of transcendental self that extends into infinity as an identity, it could gain no sense of permanence of being if at each instance of its experience it encountered discontinuity of the geometry of the space in which it is embedded. The a priori categorical matrix holds only insofar as there corresponds any experience whatsoever which confirms it. Chaos, in terms of temporal asymmetry and spatial regularity, provides no place for such categories to find purchase and as such could reduce them to pure imaginings of a mind that speculates upon a possible world of stability with respect to the categories.

What I suggest is an understanding of the self that conforms to general principles of biological evolution and might also explain the temporal extension, which Kant rightly sees as necessary, as a particular manifestation of a more general dynamic. Duration, rather than being the privileged quality of the self, is understood as a necessarily ubiquitous phenomenon of both physical reality and of mental reality.

2) The synthesis of the manifold appears problematic in so far as the mechanism for unity seems to function without the benefit of the “I” that Kant positions as producing the

synthesis of unity in the concept and extending it into understanding. If the manifold can be synthesised from the complex of sensory experience without the benefits of the attention of the transcendent self, why can't the process be extended into the synthesising of the unity of concept? The manifold is, in a sense, a complexity of divergent experiences brought into a frame of reference within the categorical matrix. It is an ordering of experience from which a unity will be synthesised within the context or function of the transcendental "I". The "I" provides the contextual relevance to the unity of concept, but appears to play no significant part in the production of the ordering of the manifold. Nonetheless, the manifold synthesis is not random, but appears to provide some orderly transformations of experiences through time and, under usual conditions, maintains a coherence and integrity.

How, then, are we to consider the synthesis of the manifold in Kant's understanding, without the requisite implicated identity of the transcendental "I"?

Again, I am inclined towards understanding the process of synthesis not as a privileged aspect of mind, but as a general principle of the process associated with being and becoming. If an understanding of general dynamic processes may be formatted that requires synthesis as a ubiquitous phenomenon which locally manifests within mental dynamics, then the confusion of the synthesis of the manifold without the transcendental "I" dissolves while maintaining the structural and relational model Kant appears to be entertaining.

3) Conceiving a model of mind that takes as given mutually defining interdependent spaces undermines Kant's apparent desire to utilise the transcendental self as an explanatory tool for understanding the synthesis of unity from a complex of distinct experiences. To his benefit, he gets an a priori explanation of the irreducible givenness of space and time and a certain coherence with his preexisting beliefs, but the cost is high. By extracting the self from its context of the world, we lose a general understanding of interactive dynamics and

are pressed into, infinitely regressive, wilful formulations and, tautological explanations of the function of imagination as that which produces unity.

> Synthesis in general, as we shall hereafter see, is the mere result of the power of imagination, a blind, but indispensable function of the soul, without which we should have no knowledge whatsoever, but of which we are scarcely ever conscious. (CPR, A78)

If an assumption is made regarding the location of the primary categorical dimensions of space and time to be one necessarily distributed throughout the space within which mental phenomena are embedded; then there remain the two structures of the manifold and the unified concept to be accounted for. These two primary structures of mental phenomena may be considered in more general understanding as corresponding to the frame of reference and the image, or, object of attention. We have, however, lost a functional space upon the reclamation of the transcendental self into a natural phenomenon. Kant provided the extended space of relational intuition and a functional space of imagination as dynamics for transmission of states of complexity into unity of concept. What is to replace the relational dynamics that Kant takes as transcendental? Certainly, a structure without relational dynamics provides only partial explanatory potential. What is required is an understanding which allows for, the generation of a space for mental phenomena and the temporal extension that provides duration for invariance under translation (i.e., identity). Not only is it necessary that the manifold relate to the production of the unified concept, but that the entire process maintains coherence through time. This was what Kant seems to undertake and attempts to account for in the extension and duration of the transcendental self, or "soul." This thesis will argue that a primary dynamic might be utilised toward understanding the generation of the space of the mental as well as the mechanism for temporally extended coherence. The

cost of such a shift in perspective is loss of the transcendental self, but what may be gained is an understanding in service to the synthesis of unity.

The process of synthesis moves from the physiological to the phenomenological to thought and returns upon the same course in reverse. The space for the mental is provided by the collection of broken symmetries prescribing the parametric values of that space and correspond to a rather more complex arrangement of categorical dimensionality than Kant entertains, but functions in a similar manner. The energy projected through this manifold of dimensional states converges into the image, or unity in concept presented as the object of attention. What goes in must come out. The constructive energy pattern, altered by its journey and self interference, now travels back outward through the same manifold as an expressed effect of the occurrence of the synthesis of unity in the image and this expressed effect is experienced as understanding.

Obviously, the details of this simple formulation will involve some degree of complexity as it relates to each of the discipline defined frames of reference involved at various orders of phenomena. Nonetheless, the essential aspects of the model are simple. Kant's insights and genius regarding the requirements for rational understanding and, by implication the understanding of mental phenomena, may be seen within such a perspective as fundamental.

The Kantian position is somewhat like a Copenhagen interpretation of the mind. It concentrates on what is immediately knowable and takes that as the most which may be said. The structure is three fold: the experiential interface, the manifold, and the conceptual unity. There is a sense that a structure is available for translation into a more general, and perhaps modern, interpretation of sensations. A structure ordered into a kind of projected manifold of values along dimensional categories, and finally the object of attention. Within this language of the model I am suggesting, the frame of reference stands for any and all complexes

defining the object of attention. In my understanding, the manifold that Kant imagines is simply the most proximate referential structure in a complex space of multiply nested frames. Each frame is structured as a dimensional complex created as a result of a break in symmetry.

Kant proposes that the structured states of the manifold be translated to the unified concept by way of the functional dynamics of imagination. The translation of the empirical state to the orderly manifold configuration of category states is conveyed by way of intuition as a functional dynamic. Both of their functional dynamics appear to me, to be incomplete in terms of providing explanatory understanding. Again, I think Kant perceives a truth, but that he fails to understand that it is more fundamental than he can consider. The dynamic of translating a complex state of a dimensional manifold to a focus of synthesis is a primary dynamic which appears to function at each level of organisation of reality. As such, it achieves a place of structural significance. It is simply that space that allows for the transmission of information from one structure, that of the complex manifold, to the unified synthesis of the concept. Allowing for such an elemental structure alleviates the need to invoke ill-defined phenomenalistic forces with origins in idealistic transcendence. In its place I suggest a simple waveform dynamic, the expression of which is dependent upon the particular manifold complex that is generating the information. It is, in my thinking, a more natural and simplified dynamic and one which can best account for intuition and imagination. Furthermore, such a primary structure that allows for the relationship of the two other primary forums, namely, the contextual frame of reference and the object of attention, can also account for the remaining functional dynamic presented in Kant's thinking, that of spontaneity. Kant's exploration into the understanding of thought and consciousness is, in my judgement, more profound then he allowed himself to understand.

This is a model with marked similarity to the Kantian proposal, but one which seeks a higher-order of simplicity and a reduction of structure and dynamics to a form that finds

application at all orders of phenomena. The question posed is simply: Is there a way to formulate a model of mind which will account for the process and structure Kant envisaged without appeal to inherent properties of consciousness?

Kant proposes that there must be an inherent unity to consciousness and that this unity is manifest in both spatial and temporal forms. As such, consciousness comes as a given and carries the dynamics as functional mechanisms. To my way of thinking, assigning inherent attributes and functions provides little in the way of explanation. The model offered will seek to locate the dynamics within a natural context and the generation of consciousness and its aspect of extended unity within a self-referential dynamic. It is a proposal that provides emergence and a non-reductionistic perspective while maintaining a form of deterministic naturalism.

Kant locates the complex dynamics necessary for the synthetic process within the conceptual space of consciousness. Consciousness comes with space and time, consciousness comes with spatial and temporal unity, consciousness comes with intuition, apperception, imagination, and spontaneity. I find this to be an unnecessary burdening of the concept of consciousness and fails to provide an adequate analysis of how such functional dynamics might be understood to arise through natural processes and how, finally, consciousness itself might be given an explanatory origin in the form of natural primary dynamics.

Kant has an intuition regarding the structure and dynamics necessary to account for the generation of a unified concept as object of attention from a complex manifold of spatiotemporally related phenomena. In its basic form it is reducible to a contextual frame of reference, the image or object of attention, and that which relates the two. His commitment to a separation of the self from the realm of natural causal phenomena necessitates the inclusion of the process dynamics he proposes as functional aspects of the space of a

givenness of consciousness. He cannot see his way toward an understanding that allows for the generation of consciousness which distributes the process dynamics such as intuition and imagination. His commitment to will and to an agent-oriented perspective contains the design of his conclusions.

Kant's inclusion of space and time as inherent attributes of the transcendental self are problematic for many reasons. Nonetheless, his observation of their primacy and irreducibility is illuminating. The model I am presenting relocates these necessary aspects of experience into the contextual space of consciousness and accommodates them in terms of a naturalistic understanding. In so far as they are no longer seen as primary aspects of the transcendental self, the function that they serve in Kant's theory must be reformulated in terms of the model presented. How to generate an extended space within which consciousness may be located and how to generate temporally extended phenomena, must both be explained. Relocating space and time to the ground in which consciousness is embedded and from which it emerges provides a natural understanding but at the expense of loosing the benefits of Kant's explanation of their origins in a transcendental givenness. What will instead be suggested is that the spatial attributes of consciousness are to be accounted for through the process of symmetry breaking and the temporally extended aspects accounted for in structurally self-referential dynamics. Both of these processes are understandable within a naturalistic assumption. Together they may provide for the spatiotemporal attributes of conscious experience within the model offered for consideration.

It is easy to become entangled within the ambiguity and the elegance of Kant's thoughts, but this myopic perspective fails, I believe, to appreciate the fundamental insights he brings to understanding the process of generating unity from multiplicity in the synthesis. The age of enlightenment sought a new certainty from which to advance understanding. It is easy for those of us who have grown up in the age of indeterminacy to fail to fully appreciate

a world that assumed that certainty was available if only they could get the theory “right”. Kant seems to me to be seeking such certainty through integration of both the rationalist and empiricist perspectives.

What I intend to propose in the following chapters is a model of mind, wherein, the structural aspects and functional dynamics of Kant’s implied theory of mind may be repositioned into a natural context. In doing so, I hope to demonstrate that the structure perceived by Kant is more functional than he allowed himself to imagine and that the processes he imagined to be part of the givenness of consciousness are simply extensions of a general process seen to be working across all domains of physical phenomena.

Chapter 2

Symmetry

> Symmetry, as wide or as narrow as you may define its meaning, is one idea by which man through the ages has tried to comprehend and create order, beauty, and perfection.
>
> Weyl (1952b, p5)

Symmetry and symmetry breaking is personal. It defines the context of our being in the world. We generally favour our right or left hand. We stand erect, vertical and in alignment with the axis of gravity and perpendicular with the ground. A culture may be seen as a collection of symmetry breakings. Which side of the road to drive upon, which way the writing will flow, how many days are in a week, how many months in a year, Greenwich mean time, which groups we belong to and which we abhor, which flags we salute and which we vilify, all result from symmetry breaking. It is a process of making a distinction from within a higher-order symmetry. In making such distinctions a domain of dimensionality is established and phenomena, previously unavailable, are manifest after the break. Writing and language evolves in the space of the order imposed by the break in symmetry as to which way the words will be ordered. Driving becomes a thing assumed of everyday life because of the order that those going in one direction will remain on their side of the road. Symmetry breaking differentiates the self as the person within the family and within the community and within the country and within the world. Symmetry breaking is what has occurred at some point in history to provide a base ten number system or the twelve numbers on the clock. These are at some order of understanding, arbitrary distinctions made from within a preexisting symmetry. They have, in any case, combined to produce the structural frame for the culture and in turn this person and in turn this activity of thought.

Symmetry, as a concept, extends at least to the Greeks and their appreciation for aesthetics and geometry. Symmetry, as a concept with explanatory potential, has been utilised in the scientific realm at least as far back as Pierre Curie (1894). The principle is that a phenomenon obtains precisely when an earlier symmetry is broken. The principle's significance as an indicator for explanatory models is manifest, for example in Pasteur's observations in 1848 that living systems prefer one form of optical isomers over the other, even though nature seems to prefer no such asymmetry, as (except in chemically much ramified circumstance of living organisms) the isomers are generally chemically produced in equal quantities (Kauffman and Myers, 1998). Thus the living / non-living distinction is itself bound up (richly) with symmetry breaking.

Symmetry as an explanatory concept now stands central to quantum mechanics, to general relativity, and consequently to cosmology (van Fraassen, 1989). The physicist Hermann Weyl (1952b) begins his consideration of symmetry by reflecting upon symmetry in art forms and patterns. He senses that symmetry is in some essential way an elemental, ordering principle. In epistemology, theories that purport to establish a causal understanding of some ontological reality are treated as true and as exhibiting verisimilitude if there naturally is a corresponding mapping of the elements and functions of the theory to observed reality. If by means of such a natural mapping there is a symmetry between the theory and the observed reality, the theory is taken as true. Symmetry seems not only to serve as an ordinary principle in the world, but also to be functionally established in the world and in our consciousness.

There has been much philosophical debate on the nature of consciousness and the relation of the mental to the physical. The reductionist perspective has largely succeeded in relegating competing perspectives, such as dualism or emergent interactionism, to the periphery of the debate. It has also reduced the focus of the debate to the subjective

experience of qualia (Chalmers, 1996a, 1996b), the explanatory gap (Levine, 1983), and rules for emergence in biologically complex systems. Kim (2000) appears reluctant to accept that the over-determinism arguments concluding that theories of mind developed from the assumption of dualism or epiphenomenalism are inadequate and what remains is a materialist reductionism. Materialistic reductionism is however unsatisfactory in explaining the qualia of mental phenomena to physiological mechanisms. Materialistic explanations of the mind and of consciousness are not necessarily dehumanising or cause for philosophical despair. Indeed, the dominance of such reductionistic theories has provided intriguing paradoxes. Natural physical scientists such as Stuart, Takahashi and Umezawa (1978, 1979), Goswami (1990), Sperry (1991, 1993), John (1967), Eccles (1966, 1977), Edelman (1992, 2004), Pribram (1971), and Libet (Libet et al., 1999; Libet, 1993, 2004) argue for an emergent domain of the mental, while philosophers such as Dennett (1991), Churchland (2002), and Armstrong (1968) argue that the mental is either identical with the physical or a supervening epiphenomenon. Indeed, the involvement of consciousness in the formulation of the *many-world theory* of quantum mechanics (DeWitt and Everett, 1973), or, the more romantic interpretation of the Copenhagen perspective of quantum theory, suggests that the physical sciences are rather accommodative of a non-reductionistic domain as an elemental aspect of ontological reality.

Kim (2000) appears to be a decidedly reluctant materialist;...[T]he real bad news is that some mental properties, notably phenomenal properties of conscious experience, seem to resist functionalisation and this means that there is no way to account for their causal efficacy within a physicalist scheme. Their properties are not able to overcome the supervenience argument" (pp118-119). Although he argues for the significance of qualia and the value of "preserving the mental as part of the physical world" (p120), he sees little reason for optimism that a significant causal robustness can be formulated for the mental phenomena

having effects upon the physical. Applying Samuel Alexander's (1920) criterion that what is real hinges upon causal significance, Kim asserts that the mental either is eliminated by the physical explanation or is reduced to an epiphenomenon of no causal significance.

From my perspective, the dilemma presented by Kim in the closing chapter of his *Mind in a Physical World* (2000) arises from a somewhat restricted understanding of the physical domain. It may be that there is a perspective of understanding the physical that allows for the emergence of mental phenomena with causal significance. Pressing understanding into the nature of the physical materialistic realm, results in an encounter with complex dynamics and geometries, topos mathematics, bundles and sheaf geometries, state space geometries, group symmetry equations, phase transitions, bifurcations, enfolded dimensions, vibrating strings, branes and entanglements. Physical reality seems to me to be far more complex and variable an idea than how it appears to be accounted for in the debate between materialistic reductionists and those who would hold for the irreducible significance of the mental. It seems entirely plausible to me that the physical can yield a phenomenological domain that complexly maps onto the various levels of the physical while resisting being reduced to an inconsequential identity relationship.

Traditional understanding holds that emergence is an order of phenomena arising from a substrate in complex dynamics. I suggest augmenting or replacing this with the following understanding: the domain of mental phenomena arises from an accumulation of evolutionary steps, each of which breaks a preexisting symmetry condition at some categorical level and results in the corresponding enfolding of phenomenological, axial dimensionality. The phenomenological space in which the consciousness of any organism functions as being in the world is the result of the phylogenic history of that organism. It is the accumulated complex of enfolded dimensionality associated with each of the breaks in symmetry demarcating evolutionary steps in the development of that organism. In humans, a

rather spectacular collection of enfolding, axial dimensions, nested and self-referential, produces a space in which mental phenomena operate and are qualitatively experienced subjectively.

Furthermore, such a complex phenomenological space provides for temporally extended phenomena, the essential characteristic of consciousness. Temporally extended phenomena map across successive and multiple physiological state conditions and are not reducible to any particular state. A perspective of complex physicalism necessarily yielding a domain of causally significant mental phenomena invites a modelling of relevant dynamics with field geometries, simplectic geometries, structural topologies, and sheaves theories. It also provides for potential understanding of psychological phenomena and the temporal delays observed by Libet (Libet, et al., 1999; Libet, 1993, 2004) and Koch (2004; Koch and Tsuchiya, 2006), between neurological states and conscious awareness of those states.

Human consciousness is the current manifestation of a phenomenological space resulting from the cumulative evolutionary history of the organism. Each step in the evolutionary history is demarcated by an identifiable breaking of a symmetry and results in an enfolding of an associated axial dimensionality. The resulting phenomenological space is far more complex than is accounted for by the neurological system alone. It is the result of the historical trace of that species as it is manifest in any individual organism.

Such a change in perspective vis-à-vis our understanding of the physical may allow for resolution of the restrictive issues presented by the physicalists while providing persuasive reason to accommodate and embrace the value of the subjective experience, the qualia (Chalmers, 1996a, 1996b), of mental phenomena as a necessary and irreducible aspect of the physical.

These rather extensive claims hinge upon the explanatory potential of the concepts of symmetry and symmetry breaking and the application of such concepts to biological systems.

However, they are concepts which have demonstrated enormous utility in physics and math. Both quantum physics and general relativity apply the explanatory potential of symmetry to the development of central concepts and arguments. Cosmological theories assume symmetry and symmetry breaking to be central to the understanding of the evolution of the physical universe (Layzer, 1975). In biology, the idea of symmetry has been extended from the utilitarian service of taxonomic classification into the realm of evolutionary development and genetics and biochemistry. In mathematics, the idea of symmetry has been applied to group theory and pattern formation and the determination of the solvability of complex equations.

Symmetry and symmetry breaking hold significant explanatory potential in central issues of physical and mathematical science. It seems at least prudent to explore the potential applicability of these concepts to the issues which confront us in philosophy of mind. Application of these central concepts will likely extend beyond the traditional boundaries of the disciplines involved and require that philosophical arguments be joined to those found in physics, biology, neurology, and mathematics.

Symmetry in Mathematics

> The theory of Groups is a branch of mathematics in which something does something to something and then compares the result obtained from doing the something to something else, or something else to the same thing.
>
> James R. Newman (2000, p180)

Symmetry is elegantly defined as invariance under a specifiable, non-trivial, transformation. The transformation is a specified operation that maps or translates structural space from one location to another and may involve complex rotations, amplifications/reductions, or simple mapping from one location to another in space or time. If, in the translation operation, congruence is maintained between the initial form and the resultant form, then a symmetry is said to exist between the two-forms. It is a concept with potential applicability between orders of spaces as well as across spaces.

An object is said to exhibit bilateral symmetry if the structural elements arranged on one side of the defined medial plane can be congruently mapped onto the opposite side. An object may have multiple symmetries under a variety of symmetry transformations. An equilateral triangle can be shown to have bilateral symmetry across a line defining the bisection of an angle and its base, but it also exhibits rotational symmetry around its centre point. It could be rotated 120^0, 240^0, and 360^0 (degrees) around its centre point and retain its symmetry. Together, there are six symmetry transformations associated with any equilateral triangle.

The collection of all the symmetry transformations for any object defines a group. Groups are a central and important concept in mathematics with specific attributes. Groups must exhibit:

1. Closure: All products of the combination of any elements of the group must also be a member of the group.

2. Association: The outcome of the operation upon the specific member of a group is not dependent upon the parenthetical ordering of those members.

3. Identity Element: Any element which when combined with any other member of the group leaves it unchanged.

4. Inverse: Every member of the group has an inverse which when combined with the member results in the identity element.

For any given spatial configuration, those automorphisms or translations which maintain congruence and leave the configuration unchanged define a group and this group the symmetry possessed by that system or configuration.

Frequently, the configured space is descriptive of some complex set of relations or systems or the rotational transformation appears to approximate a confused Rubric Cube, but the anchoring of group theory to symmetry operations provides an ordering principle that contributes both clarity and order. "Symmetry forbids. Forbidding imposes order.", according to Icke (1995, p103). It is the order or rather the higher-order structure of the symmetry groups which opens to analysis of complex systems. It is the geometry of the problem that becomes important. To paraphrase Weyl (1952b, p133), for the great mathematician Felix Klein, geometry was defined by a group of transformation operations and given to the task of analysis of the invariants under the transformation of that group.

Symmetry transformations defining a group and the group satisfying defining properties, allow for complex systems to be reduced to simple sets of operations (Du Sautoy, 2008). Such was the case in Galois' (Livio, 2005) approach to proving the unsolvability of quintic equations. Algebraic equations of simplified forms had been well established for solving complex equations involving squares, cubes, and quadratics. However, the simple

formulation of a solution strategy which might be applied to equations involving quintics (e.g., $ax^5 + bx^4 + cx^3 + dx^2 + ex + f = c$) had not only failed but also produced confusing results involving degree six (Presic, 2003). Galois approached the problem from the perspective of symmetry properties of the equation. Arthur Cayley had demonstrated in 1878 that every group of systems is isomorphic with a group of permutations of corresponding number of elements. In other words, the group of permutations of a set of three elements, for example, is isomorphic with the group of symmetries of a triangle. This merging of permutations of group elements with symmetry groups provided a framework from which Galois was able to prove that the quintic equations are unavailable to simplified formulaic solutions. Galois also established in his efforts a foundation to group theory in symmetry that would produce a merging of geometry and group theory by Felix Klein (1924/2004) and eventually the merging of group theory, geometry, and physics with Lie groups.

The significance of symmetry as an explanatory and ordering concept in mathematics is profound.

Symmetry in Physics

> Group theory is the mathematical language of symmetry and it is so important that it seems to play a fundamental role in the very structure of nature. It governs the forces we see and is believed to be the organizing principle underlying all of the dynamics of elementary particles. Indeed, in modern physics the concept of symmetry serves as perhaps the most crucial of all. Symmetry principles are now known to dictate the basic laws of physics, to control the structure and dynamics of matter, and to define the fundamental forces in nature. Nature, at its most fundamental level, is defined by symmetry.
>
> Leon M. Lederman and Christopher Hill (2004, p21)

Group theory's central involvement in modern physics, both in providing symmetry groups used in quantum physics and in underpinning the quantities utilised in general relativity, attests to the utility of symmetry in mathematics having remarkable applicability across disciplines.

Physics itself has a long history with the explanatory potential of the concept of symmetry. Although the idea of symmetry as an ordering function of some significance can be extended back into Neumann's use of the concept in the deduction of elastic constants in 1832 (Katzir, 2004), it is generally accepted that the formulation of a principle of causal symmetry by Pierre Curie in 1894 is the first application of the concept to physical phenomena. Previously, taxonomic classification in the geometrical study of crystals formed by minerals had successfully applied types of symmetry as an ordering concept, but this does not seem to have risen to a general principle of abstraction applicable to a wide range of physical phenomena. It is Curie who observes and asserts that the "symmetry of the cause is always preserved in its effects" (Ismael, 1997, p167). It may be that he was influenced by the principle of energy conservation as Katzir (2004) argues, but the significance of his

perceiving that the apparent asymmetry observed in the phenomenon of the effect is the result of a deeper level symmetry, appears prescient when viewed from modern cosmological physics. From the modern perspective, phenomena observed as elemental to reality are understood as resultant of symmetry breaking during phase transitions. It is perhaps reflective of an intuition of an ordering function operating behind the observed and yet determinate.

Sophus Lie, a Norwegian mathematician, both expanded and sharply focused the application of symmetry in group theory by providing an analysis of groups of continuous symmetrical transformations, such as slip translation or rotation in space, in his works published between 1888 and 1893 (Hawkins, 2000). This work resulted in a theory of groups which accommodates a differentiable manifold and which can therefore smoothly map the continuous symmetry of a given mathematical structure. The development and application of these Lie groups by Killing in 1888 (Hawkins, 2000), Cartan in 1894 (Hawkins, 2000), Weyl (1952a, 1952b), Gell-Mann (1962) and others, generally forms the organisational foundation and structure of modern particle physics. The “eight-fold way” model proposed by Murray Gell-Mann (1962) utilised the Lie group SU(3) (i.e. the special unitary group of degree 3) not only to provide an order to the “particle zoo” confronting physicists but to predict the discovery of a particle that must exist according to the Lie group formulation.

The structural model of particle physics that confronts us today has evolved and developed through successive applications of Lie groups to the symmetries reflected in the forum associated with each of the particle families. Currently, the Lie group designated U(1), SU(2), and SU(3) satisfy the explanatory requirements of quantum physics (Icke, 1995). Each of these groups describes a gauge symmetry group of the forces involved as a corresponding dimensionality (Cao, 2003). Unitary group of dimension (1) describes electric charge of + or - as one unit. Spatial unitary group of dimension (2) addresses weak forces associated with the W+, W0, W- particles while the SU(3) group accommodates the symmetry of the three

colour states carrying the strong forces. The product of the three Lie groups U(1) x SU(2) x S(3) describes the full theory of colour strong interactions and the weak and electromagnetic interactions. There remains the disturbing absence of gravity in the elegant formulation of physical forces through symmetry groups and this has prompted considerable speculation as to the inclusion of yet another Lie group in the form of SU(4) or SU(5) to complete the model, but thus far the efforts have not produced satisfactory results.

As central as the idea of symmetry groups appears to physics, there is perhaps a more significant involvement of symmetry in the case of conservation laws. Emmy Noether was a remarkable German woman mathematician of Jewish ancestry. She overcame the bias and bigotry of her culture to demonstrate her talent and brilliance. Her adroitness in abstract mathematics eventually gained her the attention, respect and assistance of one of the greatest mathematicians, David Hilbert. Eventually, Noether provided foundational mathematics for both Einstein's theories and the theories of quantum physics.

Noether's theorem (1918/1971) connects physics to symmetry and symmetry to physics (Brading and Brown, 2003). The theorem essentially states that for every continuous symmetry of laws of physics, there must exist a conservation law. Furthermore, for every conservation law, there must exist a continuous symmetry. The first theorem addresses the symmetries of first dimensional Lie groups and connects continuous global symmetries in Lagrangian dynamics and conservation principles while the second theorem focuses upon relating the first theorem to the general understanding of continuous local symmetries depending on arbitrary functions of spatiotemporal coordinates. What is presented, is a knitting together of symmetry with conservation laws and as such the opening to analysis of physical systems involving continuous symmetries by group, the mathematics of symmetry groups, Lie groups, and a general geometry of groups. She prepares the way for the laws of physics to be defined by symmetry principles.

Conservation laws state that for any given physical system, there exist physically measurable quantities which do not change as that system changes. In high school physics classes, the conservation laws generally discussed are those involved in theories of energy, momentum, and angular momentum.

There are several conservation laws in physics, underlying electron numbers, colour charge, baryon numbers, charge and parity. Each manifests as an embedded symmetry of the space we inhabit and each reflects a corresponding physical law. Each law is essentially defined by symmetry principles (Lederman and Hill, 2004, p98).

The embracing of group theory and especially Lie symmetry groups by quantum physicists has proven exquisitely useful at guiding them to an elegant organisation of the complexity of particles confronting them. It has also provided predictive power from the models to physical observation. The assumption required is that the space in which the physics of the particles are observed, is itself embedded with certain dimensions of symmetry that impose an order of conservation (Lange, 2007). Conservation laws constrain or dictate the order and transformation of the physical state through time and space.

The question naturally arises as to the origin of the embedded symmetries. The answer, usually, resolves into an appeal to natural perturbation or original fine grain asymmetries existent at initial conditions (Layzer, 1975). The process of their becoming evident is described in various scenarios of symmetry breaking.

Symmetry Breaking

Imagine, if you will, a bowl of water. Analysis of one part of the space defined by the water will discover it to be identical in all relevant respects with any other sample. The water may be said to be symmetrical in that all directions are indistinguishable from any others. Now, assume that the temperature of the water is dropping. When the temperature approaches 0°C (32°F), small crystals of ice begin to form as a spontaneous arrangement of water

molecules in a lower energy state. The crystals form planes of molecular plates eventually crystallising into ice. The symmetry of the water becomes spontaneously broken in the process of phase transformation from liquid to solid. The plane and axis of the crystal is spontaneously chosen from the space of the whole. Symmetry is reduced and order emerges. The hidden order of water becomes manifest in the symmetry breaking.

David Layzer (1975) used such an image to describe the relationship between phase transition and symmetry breaking in the developing Universe. As the Universe cooled from its initial symmetry conditions of the "big bang," the symmetry was broken and resulted in the emergence of the gauge symmetries and conservation laws we observe to be operating in the world. Each phase transition symmetry breaking in physical reality is demarcated by the condensation of a family of particles. The energy required to establish the previously existing symmetry condition dictates the translation energy relationships between particles and forces of one family to another. Initially, the Universe is conceived as a near infinitely dense and near infinitely hot space in which photons dominate. Between 10^{-43} and 10^{-12} seconds after the beginning, and including what is referred to as the inflationary period, it is theorised that particles such as quarks, electrons, muons, neutrinos and gluons freely move about chaotically but do not begin to form more complicated orders of groups of particles until the deceleration era (Herman, 2008; Weinberg, 1977, 2008). Bosons and mesons similarly emerge from the symmetry of energy and space somewhere between 10^{-12} and 10^{-4} seconds from the beginning (Herman, 2008; Weinberg, 1977, 2008). As the Universe continues to cool, order emerges in discrete steps where the previous symmetry is broken to reveal a new set of particles and forces and conservation laws.

Another example of phase transition symmetry breaking that is commonly presented involves the negative polarity of a common ferromagnet. When heated above a critical temperature of around 777° C a ferromagnet loses its magnetic order (Ruetsche, 2006). There

is, at this temperature, no preferred axis of magnetic polarity of the collection of atoms comprising the magnet, and it may be said to exist in a state of symmetry with respect to "magneticness"; all directions are similar to all others. As the material cools, however, the atoms become spontaneously aligned and define an axis of polarity determining the positive and negative extremes of the magnet. This ordering occurs as a result of symmetry breaking at critical phase transitions, and is non locally extrinsic. The axial ordering, i.e., the embedded symmetry, is pervasive throughout the space of the magnet. The particular order of axis directionality is arbitrary, however, and usually explained to chance perturbations or hidden organising of the "fine grain" microscopic ordering as an initial condition.

In particle physics, the particles exist within a sub group of symmetries, limiting and defining the characteristics and relational dynamics of those particles in gauge transformations. Order and coherence of the spatial conditions are maintained by the overlying structure of operators and symmetry states which smoothly translate or complex manifold through space and time. Each particle formed is the result of a phase transition symmetry breaking that resulted in an asymmetry state and in turn created an embedded dimensional gauge symmetry.

Symmetry breaking in physics is frequently explained using the metaphor of the "Mexican hat". Imagine a three-dimension structure in the shape of a Mexican hat and describing energy states of the space it defines. Now, imagine a ball placed in balance upon the top of the curve of the hat. In perfect balance the ball may remain in a symmetrical state. The slightest disturbance or imperfection in the balance and the ball will roll off the top of the curve and into the trough or brim of the hat. Symmetry is broken when the ball falls, and it assumes a stable lower energy state. For the system to remain symmetrical, it would have to exist at a higher and unstable energy state. Symmetry is broken in the process of assuming a

stable lower energy state. The phenomenon observed as an ordered state is the result of a reduction of symmetry.

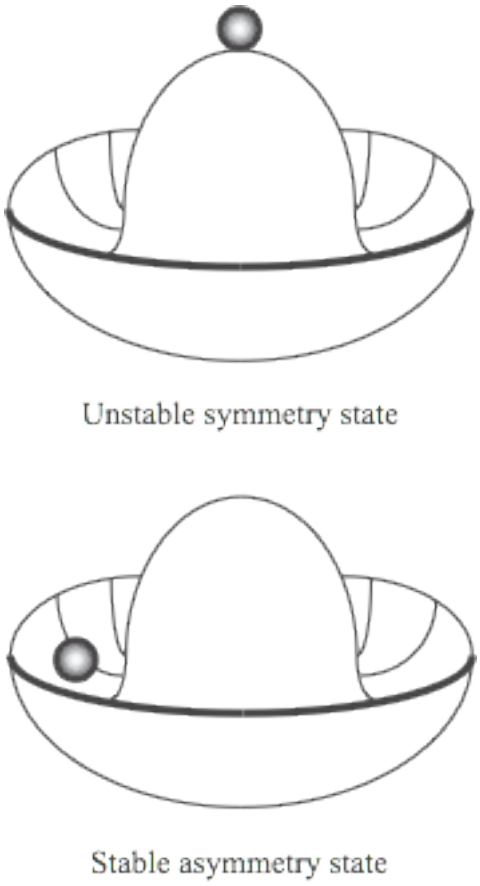


Figure 1. Mexican hat symmetry. Symmetric state of ball is inherently unstable. Any variation results in ball moving to lower energy state and an asymmetric location (after Shea Ferrell in Lederman and Hill, 2004, p200).

Symmetry and Philosophy

There seems to exist an apperception that accompanies the exploration of symmetry as an explanatory concept. There is a sense that there is something fundamental at work and yet something beyond the capabilities of the tools applied to the description. This is most clearly the case in the earlier writing on the idea of symmetry in physics. Hermann Weyl (1952a, 195b) and Eugene Wigner (1961, 1963, 1967) perceived the potential of symmetries and symmetry groups in the understanding of quantum physics; they understood the

mathematical potential. However, they write beyond the utility of the mathematics toward some sense of elegance or mystery. They indulge the philosophical and poetic when entering upon the domain of symmetry and its central role in unifying mathematics to physics. They seem to intuit that consciousness, physics and symmetry are somehow in an irreducibly entangled condition.

The concept of symmetry is fundamental to biological systems. It is a prerequisite ordering of the world for the organism that perceives it. When translated into mathematical precision, it becomes a conceptual tool, a mechanism of topology that follows specific forms through tangles of space to allow for the illumination of alternative routes.

Weyl (1952b) defines objective reality as that which remains invariant under translation. That space of complexities which remains invariant when translated from one mind to another is the ontological reality toward which the symbolic expressions attempt to explain or describe. It is for Weyl a foundational concept for the epistemological enterprise.

Symmetry is another one of those ideas that has imposed itself upon philosophy from physics. It has philosophical history as elemental to aesthetics and the symmetry or asymmetry of logical arguments. It also intrudes from group theory and mathematics. It would seem to be a concept of considerable philosophical development but for which projects are only recently emerging. Earman, (1989, 2004), Chalmers (1970), Fine (1986), van Fraassen (1989), Ismael (1997), Brown and Harré (2003), Brading and Castellani (2003), and Debs and Redhead (2007) are examples of those who have risen to the challenge to understand and investigate complexities of group symmetries in quantum physics and general relativity. Their focus is largely concerned with the use of the concept of symmetry and how it is applies in physics. Brown and Earman have demonstrated a remarkable skill and comfort at digging into the complexity of core concepts of symmetry as used in modern physics. Redhead also demonstrates a command of the complexity required by quantum physics when

he examines the invariance principle proposed by Weyl and concludes that it requires argumentation and clarification in light of quantum mechanics of entangled states.

The caution encountered is in the application of the concept as explanatory to the ontological reality one experiences. In analytical fashion, location of the symmetry is debated as is the universality of the concept. What is not generally encountered is the exploration of the potential of the idea for creation of models to address philosophical issues such as the origin and nature of consciousness. The limited exploration by philosophers of the concept of symmetry and its explanatory potential is highlighted by Earman when he states, "Philosophers of science have barely scratched the surface of the topic of laws, symmetries, and symmetry breaking" (2004, pp1239-1240).

Physics proceeds to develop the ideas of symmetry and symmetry breaking and extends those concepts into conjectured ontological philosophy and epistemology. Zee (1986) and Greene (1999) attempt to seek a grand unified theory in a super-symmetric model that would be inclusive of gravity and have profound significance for developing theories of mind. A small group of philosophers have waded out into the deep waters of string theory, quantum mechanics, and general relativity and have demonstrated mastery of the concepts, but these have been, in general, reactive responses to the intrusion of physics into a domain perviously assumed to be the rightful domain of philosophy. History has repeatedly demonstrated that physics and mathematics do not wait for permission from philosophy before advancing understanding into the nature of reality.

If philosophy is to avoid being relegated to the role of a grammarian checking the sentence structure of the theories proposed by physicists, who are more engaged in the predictive utility of the concepts and largely indifferent to the critiques, it needs to join the process of the dialogue with physicists in developing ideas which have potential.

Understanding the explanatory concepts of physicists and mathematicians provide an opportunity for creative conjectures and not simply an exercise in analysis and refutation.

Symmetry in Biology

In physics, the idea of symmetry has allowed for a merging of group theory and quantum mechanics. Its function as an organisational principle for observed regularity in crystalline forms has extended into an ordering of abstract, operational spaces and conservation laws.

In biology, the idea of symmetry remains largely within the domain of taxonomic algorithms or developmental descriptors. There are, however, indications that the utility of the concept for biological systems and cellular forms and dynamics is beginning to be entertained within a deeper order of understanding.

Biological systems manifest the collection of symmetries and asymmetries that have entangled during the course of evolution. Louis Pasteur in 1861 observed that there is an essential asymmetry with respect to the chemistry of living systems. His discovery of a preference for one form of optical isomer over another in the fermentation process opened a profound chapter in structural chemistry. Molecules can form in such a manner that although the individual composition is identical, the structural arrangement of the molecules are mirror images for one another. The physical effect of the structural differences of chemically identical substances is often profound.

Consider, as an example to illustrate the idea, the single amino acid. It can be modelled as a tetrahedral form, with the hydrogen atom establishing the top point of the tetrahedron and the carbon atom the centre of the form. How the remaining carboxyl COOH group, methyl group CH_3 and the amino group NH_2 are attached to the bottom three points will determine if it is the left-handed version or the right-handed version of alanine molecule.

The two-forms are not interchangeable but are rather mirror images of one another (Close, 2000).

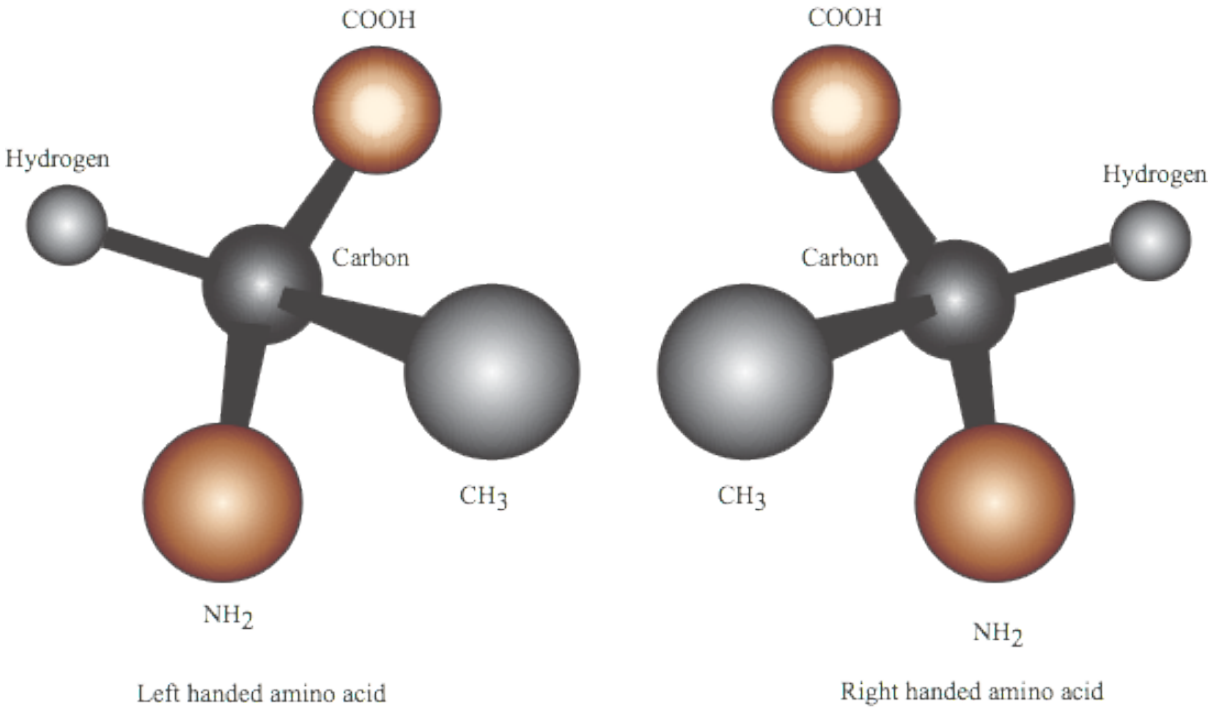


Figure 2. Amino acid chirality. Generic amino acid schematic showing levo (left handed) and dextro (right handed) asymmetry.

No amount of rotating the structural form will bring it into automorphic congruence. The properties of such structural differences can be quite significant even though chemically they are equivalent in composition. One of these differences can involve how light becomes polarised when passed through a crystalline form. Pasteur (1861), building on research by Jean Baptiste Biot (1844) compared the polarising properties of a racemic acid which was a product of wine fermentation. After carefully separating the crystals obtained from dehydrating the solution and testing them for right or left polarisation of light, he placed each group into separate beakers and rehydrated the compound. When he then sent light through the liquid he found that each mixture rotated the light by exactly the same degree but in

exactly opposite direction. This discovery was that tartaric acid came in two forms, a right-handed and a left-handed structural form. The racemic acid, that did not rotate light passing through it, was, in fact, a mixture of equal portions of the right and left handed forms of the tartaric acid.

Nature is fundamentally symmetric with regard to the chemical production of molecular structures which can come in either right or left-handed forms. It is in living systems that nature creates an asymmetric preference or dominance. Further, Pasteur discovered that when a mold such as penicillin, which eats tartaric acid, was introduced into the mixture, it would consume only the right-handed forms and leave the left-handed forms. Biological systems are structurally asymmetric with respect to chemistry. All the amino acids which form the basis of the chemistry of life come in both a right-handed and left-handed form, but the left-handed or *Levo-amino* acid form is found to be functioning in the overwhelming majority of living systems on this planet. There are some exceptions in the form of right-handed or *Dextro-amino* acids in bacterial cell walls and in certain mollusks, but these are the rare exceptions (Volkmann and Heck, 1998).

Clearly the preference for L-amino acids occurred very early in the evolutionary process. Life has apparently emerged and developed through the breaking of a symmetry. The symmetry broken is that of mirror-symmetry. The biochemistry of living systems exhibit homochirality in that the amino acids for almost all living things are all the left-handed or L-amino acid form while all the biologically produced sugars, which also occur naturally in both structural forms, are almost exclusively of the dextro, or right-handed form (Salam, 1991).

Small differences in mirror-symmetry breaking can become amplified over time through the chemical processes and can lead to chiral amplifications. A small difference in dominance of L-amino acids at a critical moment could well have become amplified in effect

and over time allowed for chiral transmission and asymmetric synthesis (Palmer, 2004). In any case, the result appears to be that life has developed from a breaking of symmetry. The chemical soup from which life emerged contained a racemic mixture of stereoisomeres and exhibited a symmetry with respect to the structural forms of the chemical. Somewhere in the early formation, an autocatalytic process during nucleation established dominance for L-amino acids and dextro-sugars and was amplified and transmitted into the vast array and complexity encountered in biological systems.

When one reflects upon the process of mitosis or meiosis, one cannot help but become intrigued by the elegance of the symmetry and symmetry breaking observed. Cellular division of higher eukaryotes (i.e., nucleated cells) involves the centrosome or microtubule-organising centre (MTOC) that is located external to the nuclear envelope. The centrosome consists of nine groups of short microtubules arranged in a circle. Each group of the nine consists of three microtubules aligned as spokes in a bicycle's wheel.

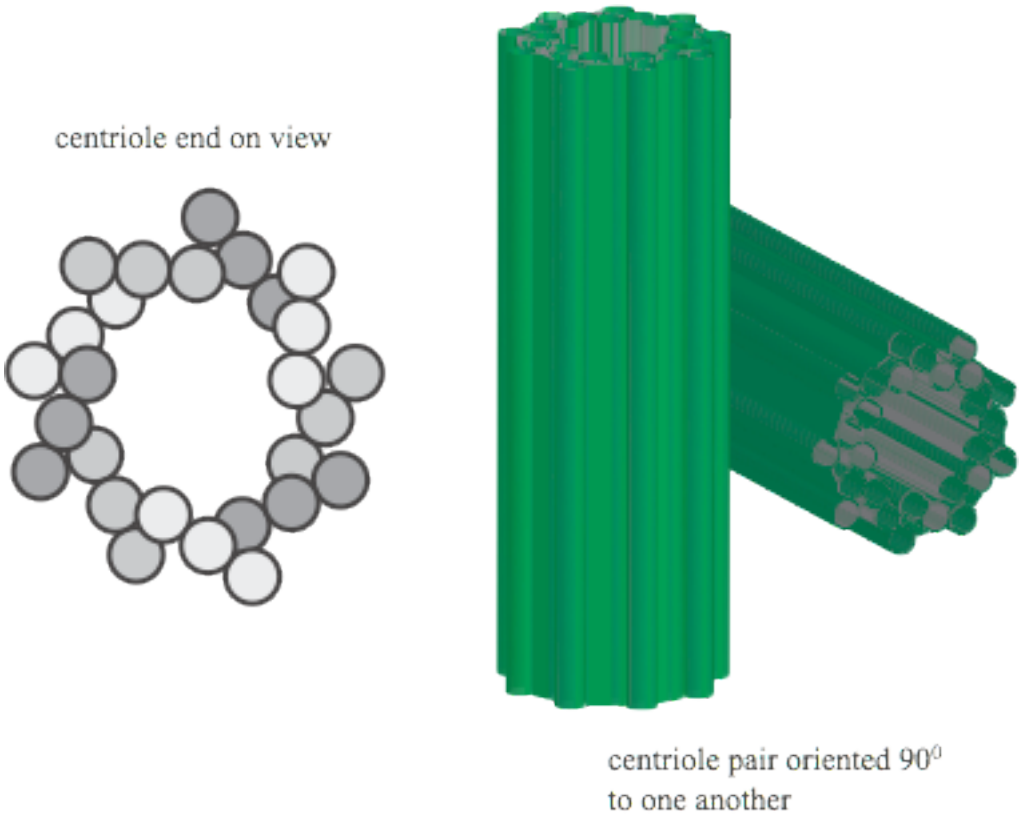


Figure 3. Structure of the centrioles showing ordered regularity and symmetry. The centriole pair are always oriented at right angles to one another. The end on view shows the microtubules arrangement and regularity.

Microtubules are hollow cylinders composed of the protein tubulin and featured a placed of central importance to the Stuart Hameroff and Roger Penrose theory of consciousness (1995). In addition to composing the centrioles, which are short, barrel-like configurations of microtubules, microtubules also extend throughout the cytoplasm to contribute, along with actin filaments and intermediate filaments, to the cellular cytoskeleton. The extended mictrotubule structure terminates at the centriole and are there negatively charged with the distal terminus exhibiting positive charges (Alberts, Johnson, Lewis, Raff, Roberts and Walter, 2002) and as such establishes an internal-external charge polarity as well as providing a structural integrity to the cell.

In cell division, the centrioles replicate and migrate to establish polar points in the cell and define a planar symmetry (Gilbert, 2003). The centrioles begin cell division by replication of themselves. The centrioles begin by separating from each other by a few micrometers and then growing a "daughter centriole" from the base of each "mother centriole." The daughter grows at right angles to the mother centriole and replicates the perpendicular, axial geometry of the original pair. As the cell moves into early prophase of cell division, the centriole pairs separate and move to polar axis of the cell where it begins to nucleate its own microtubule array. The microtubule spindle filaments radiate from each centriole pair across the nucleus of the cell allowing for the chromosomal alignment along the filaments defining a plane of symmetry during metaphase. The replicated chromosomes separate and bind to the centriole microtubule through the kinetochore that roughly designates the axis of the chromosomes. As the kinetochore microtubules shorten, each of the daughter chromosomes are pulled toward the pole of their respective centriole during anaphase. Once the chromosomes are collected in the proximity of the centriole, the cell divides through a "contractile ring" and the two new cells reorganise themselves in structural similarity with the initial cell prior to division. Nuclear membranes form and the chromosomes become de-condensed and each cell enjoys the relative respite of interphase inactivity before the process begins again.

In meiosis, the procedure is initially similar, with the exception that the chromosomes do not replicate themselves and the resulting cells have at the end of the process half of the chromosomes required, or a haploid number of chromosomes, while mitosis results in a diploid number of chromosomes.

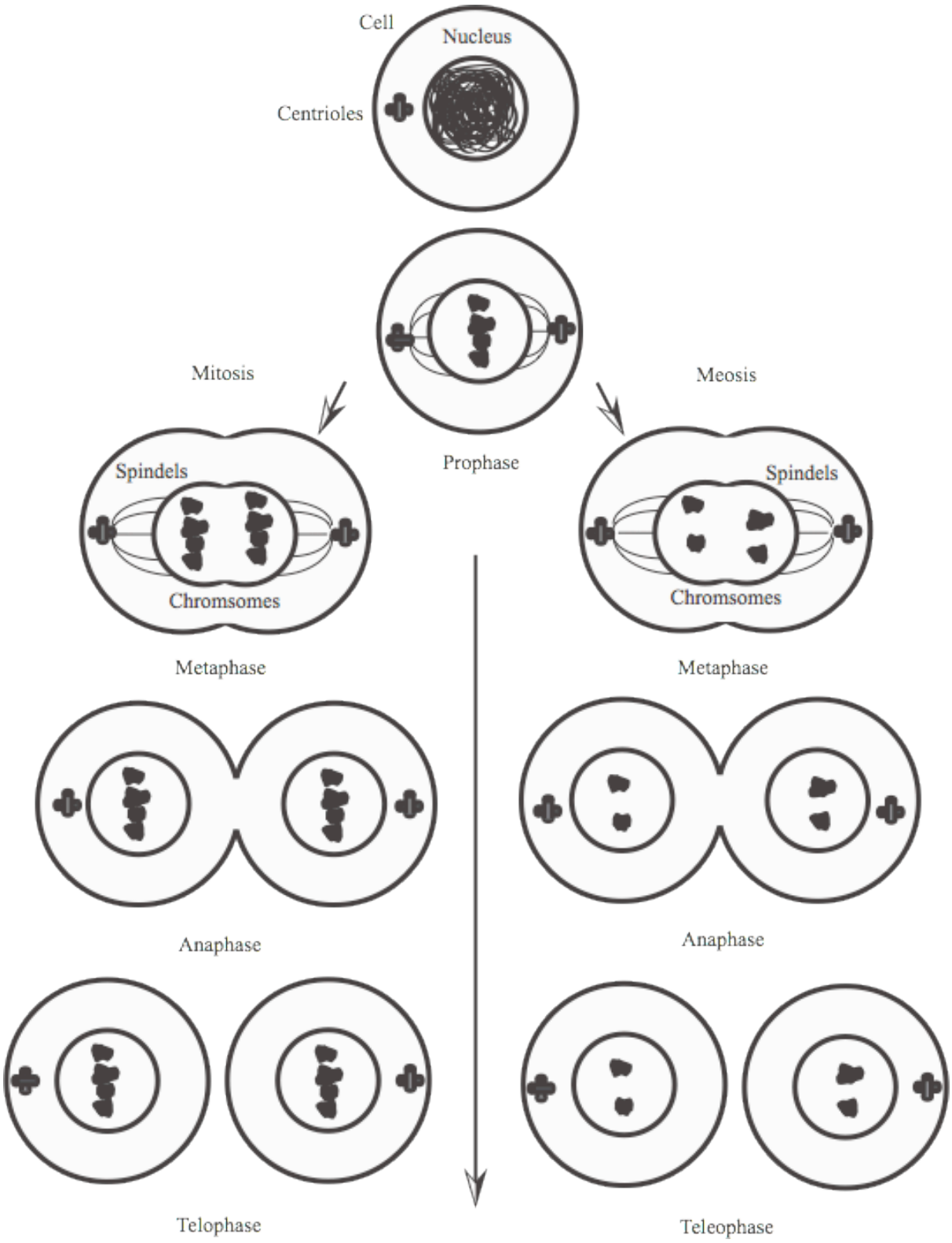


Figure 4. Cell mitosis and meiosis illustrating cellular incorporation of symmetries and symmetry breaking (after Hardin, 1966, pp38-39).

The geometry of the enterprise of cellular division is profoundly manifest. The structure of the centriole, the symmetry of their replication, the movement of the centriole to define polar points of the cell and a planar symmetry, the chromosomes replicating and aligning themselves along the defined plane and the symmetry of the chromosomes being pulled toward their respective axial pole defined by the centriole, all describe a process which reflects fundamental geometric operators in a space the axial dimensionality of which is replicated and reflected in the cell's process and organisation.

In meiosis, the cell is preparing for sexual reproduction of the organism and as such is creating a genetic variation in form with a similar haploid cell from another similar organism. In meiosis, the process reflects the symmetry and geometry of the cell division previously described, but breaks the chromosomal symmetry in the division. The chromosomes collected by the centrioles in each of the daughter cells are not identical but are rather half of the original chromosome pair. Sexual reproduction begins with a biological embrace of asymmetry. The two haploid gametes unite to form a new diploid cell with a new arrangement of chromosomal material that is the combination of the parent organisms and reclaims an order of symmetry previously lost. Sexual reproduction is the incorporation of asymmetry into the biological process at the level of the organism. The advent of sexual reproduction was a breaking of the preexisting symmetry of undifferentiated organisms in their asexual reproduction.

Upon fertilisation, the process of cell division and differentiation begins. It is in general, though not specifically, a recapitulation of the form of the organism that has developed through the evolutionary history of that species through the breaking of symmetries and unfolding of a complex geometry. Most interesting, for the purpose of this thesis, is the observation that mammalian cells have three planes of cleavage instead of the two of Echinoderm and Amphibian (Gulyas, 1975; Gilbert, 2003). Mammalian life begins

upon the incorporation of a geometry of three planes of symmetry. It also appears to begin with an incorporation of an extended sense of time. The interval between cellular cleavages in mammals is between twelve and twenty-four hours apart and is one of the largest interval cycles in the animal kingdom. Development in mammalian blastocysts is markedly asynchronistic in that not all the cells divide at the same time and do not multiply exponentially but often are observed to have an odd number of cells (Gilbert, 2003).

The mammalian genome reportedly takes over cellular development and zygotic control earlier than almost all other animals. The process shifts from the external maternal control to the internal autonomous mechanism of protein generation and cleavage regulation of the zygote itself. “In the mouse and goat, the switch from maternal to zygotic control occurs at the 2-*cell* stage” (Piko & Clegg, 1982; Prather, 1989; cited in Gilbert, 2003, p366).

A particularly interesting difference in mammalian zygote development occurs in the phenomenon of compaction. Through the eight-cell stage of development, the cells remain in a loose grouping similar to what is observed in almost all other animals. The next cleavage stage results in a remarkable altering to the entire structure. The cells suddenly arrange themselves in a tightly compacted spherical form that seals off the inside of the ball of cells from the outside. At the earliest stages of the developing mammal, it appears that the cells organise themselves in a geometry of internal-external polarity and three intersecting and orthogonally oriented planes for division.

Development of the organism from zygote to maturity is a series of geometric structural arrangements resulting from breaks of symmetry at critical points in time. In his paper, “Symmetry Breaking in the Egg of the Xenopus Laevis”, Gerhart (2004, p341) considers that the egg of an unfertilised frog “has cylindrical symmetry around an animal-vegetal axis, visible in terms of the polar body spot at the animal pole, the uniformly pigmented animal hemisphere, and the non-pigmented vegetal hemisphere.” The egg has the

potential for bilateral, axial symmetry in any direction (Elinson, 1975). It is in a symmetric state. The entry site of the sperm determines the orientation of the developmental axis. The entry of the sperm into the egg breaks the symmetry and in so doing, determines the eventual axis of bilateral symmetry of the tadpole and frog. Exactly how this occurs involves the organisation of the microtubules in the process of cortical rotation whereby the surface of the cell prior to the first cleavage begins to spin, dragging and aligning the microtubules along its surface. In doing so, "...the cortical rotation is a symmetry-breaking process operating in the first cell cycle of the Xenopus egg. It is normally essential for the transformation of the egg's initial cylindrical symmetry into a bilateral symmetry...and hence the orientation of the eventual body axis of the tadpole" (Gerhart, 2004, p350).

The eventual symmetries observed in the organism are the result of subtle asymmetries accumulated from conception. In the mouse egg, the animal-vegetal axis is observed to be aligned with the path taken by the meiotic spindle, and so there is a combination of the oocyte asymmetry with the sperm entry site which contributes to establishing both the axial forms.

Determination of axial symmetry establishes the orientation of the future development of the organism. Bilateral symmetry and the anterior-posterior, dorsal-ventral orientations of the organism will provide the geometric scaffolding for the development of the mature organism, and that form will reflect each of the evolutionary breaks of symmetry of that species. A geometric modelling of the organism along axes of the anterior-posterior, proximal-distal, and dermal-nondermal, has been observed to be functioning in fibroblasts that appear to be organised by the cells interpretation of their location within a coordinated system established within a set of positional identifier genes (Rinn, Bondre, Gladstone, Brown and Chang, 2006) and polarity of the developing blastocyst. The form of the organism

which is encountered is the reflection of the history of that species, as is the structural dimensionality within which the organism orients itself as being in the world.

Speciation is understood by Golubitsky and Stewart (2002), as a process of evolution and a form of spontaneous symmetry breaking. Such a model does not require discontinuous environmental factors or abrupt changes in ecosystems to facilitate the emergence of a new species. “A speciation event (bifurcation) is triggered if environmental changes render the uniform state (a single species) unstable, so that the symmetry of the uniform state breaks. Such an instability occurs if the organisms can survive more effectively by adopting different strategies, rather than by all adapting the same strategy, (subject to genetic feasibility)” (Golubitsky and Stewart, 2002, p22). The significance of symmetry breaking in speciation and evolutionary development is echoed in Palmer’s (2004) examination of the origin of various asymmetrical external and internal structures across species.

Biological systems seem to require a merging of symmetry and chaos in any attempt to understand complex systems that exhibit fluctuations over time. The potential implication for development of models of chaotic determinism will be ignored for the moment and focus maintained on the task of describing the applicability of the concepts of symmetry and symmetry breaking to the evolutionary process of speciation. Small perturbations in the initial conditions could easily lead to the emergence of new species in a symmetry oriented perspective of speciation, where the groups of organisms remain “intermingled” throughout the process and are not selected for by environmental conditions. In such instances, “continuous and uniform causes” can cause the discontinuous bifurcation or symmetry breaking, resulting in a new species. Throughout organic evolution, there is observed a process of structural or operational symmetries which have been inherited being broken and establishing a new level of stability, new levels of complexity, and new, higher-order phenomena (García-Bellido, 1996).

Symmetry breaking in classical systems, that is, non-quantum systems, has been suggested as a possible mechanism for emergence by Chuang Liu (2003). The use of symmetry breaking to explain the process of speciation would seem to move it beyond the realm of suggested possibilities.

The Structural Form

I am proposing an idea about the interface of the mental with the physical which is not exclusively dependent upon the neurological explanation. I do not mean to suggest that the neurological systems do not have profoundly significant relevance to the particulars of the mental experience, for clearly they are critical. Rather, I am suggesting that the origin of the domains of space containing and allowing for the mental experiences rests in a more fundamental process of symmetry breaking. As such, the domain of qualitative experiences and correlating spatiotemporal dynamics is necessarily distributed, with respective augmentations and restrictions, across structural spaces. Organisms, from this perspective, operate in the world within a phenomenological space defined and constrained by nested and enfolded axial symmetries accumulated through the evolutionary stages each organism defines. In humans, this space is made significantly more complex by the asymmetries and self-referential aspects of the endocrine and neurological systems, but the origin and location of the interface or living dynamics between the physical and mental is not found solely in the neurological complexity mapping upon that space but equally within the physiological and phenomenological structure resulting from the extended evolutionary history.

The initial cell, at some imagined condition of the origin of life, occurs by natural physical processes as a film of phospholipids around a small space of the primordial, chemical soup. The formation of the subspace of the cell within the larger space of the primordial chemical soup is a break in symmetry. The chemical processes occurring in the larger space, replicating amino acids and a range processes reflecting organic chemistry, are

contained within the boundary of the initial cell. There is, however, a difference, the membrane defines a boundary condition which dampens and regulates variability and fluctuation that occurs in the surrounding space. It takes time for changes to have effects upon the condition within the cell as it must traverse the membrane surrounding the cell. The membrane provides a stable subspace that allows it to have temporally extended states and endure changes which may disrupt or destroy the chemical process that gave rise to its occurrence. The cell is essentially a break in symmetry (Turing, 1952). It establishes a bifurcation of initial symmetry of the space of the primordial soup. The occurrence of the cell creates an enfolded dimensional axis of inside-outside. It is, in this sense, a spontaneous symmetry break. The cell or organism is oriented in the world as inside-outside, and evolution proceeds from this primary relational space.

Spontaneous symmetry breaking has previously been attributable to phase transition dynamics, preexisting embedded fine grain asymmetries, and random perturbations, and that may still be considered to be the impetus for the symmetry breaking involved in the evolution of biological systems. However, an alternative process may be entertained from the perspective of chaotic systems. When looking outward into the physical world, we see the process cooling and passing through critical states of phase transitions, but when looking inward and going through the biological processes, we can see the breaking of symmetry occurring as the result of the far-from-equilibrium, chaotic system dynamics. Order can spontaneously emerge from far-from-equilibrium chaotic systems (Prigogine, 1980, 1997). The occurrences of order from chaotic symmetry is a symmetry breaking event. Such a chaotic view perceives the asymmetry of a distinction of order arising from unseen but nevertheless determinate, though not obvious, symmetries of the dynamics. In any case, the symmetry breaking results in an enfolded dimensionality which manifests in the new phenomena resulting from that asymmetry.

With the advent of motility, directionality and spatial dimensional orientation become relevant to the organism. With the inclusion of a propeller in the form of a flagellum in the cellular membrane, a symmetry is broken with respect to the dimensional space of the cellular organism. Motility enfolds the dimensionality of towards and away. It is a precursor for bilateral symmetry development as the form comes to reflect the forces acting upon it. The organism now operates within a space of inside-outside and towards-away. It is a primitive phenomenological space. At stages of higher-order complexity, the symmetry breaking results in axial dimensionality such as anterior-posterior, dorsal-ventral, distal-proximal, right-left handedness, male-female, with implications for the development of the psychological dimensionality of pleasure-pain, approach-avoidance, dominance-submissiveness, etc., reflecting still higher-order symmetry breaking and complexity.

Enfolded dimensionality results in a complex topological space of nested complexes of parametric axial frames. Each axial dimensional enfolding may be scalar with combined resultant spaces being vectored and tensored. These are issues to be considered at a later time, after the acceptance of the initial premise that there is an enfolded space operating within the organism and resulting from the accumulated symmetry breaking events defining the evolution of the species.

The organism that contemplates the nature of its own conscious experience is a complex arrangement of nested systems and feedback mechanisms. Each level of the organism which emerged at a specific evolutionary step has an associated complex of enfolded dimensional axes. Any stimulus to which the organism is exposed conveys information to the appropriately receptive complex of systems and, in addition to providing physiological information, provides axial state information that propagates through the internal geometric space. Depending upon the intensity and duration of the stimulus, it will propagate through successive levels of internal spaces until the initial energy stress is

distributed in the transformation of the geometric state configuration. If the energy is sufficient, or if it has a particular resonance with the structural form of the internal space, it will proceed to focal awareness and present to conscious experience as a mental event. It then continues outward, back through each of the axially defined structural spaces, imparting relevant information to each level until it is spread throughout the entire space in changes that alter or initiate physiological mechanisms corresponding with each of the levels of axial spaces.

Simplification can provide some illumination of the idea I am proposing, but it also fails to convey the complexity of the dynamics involved. Stimuli do not come in neat, discrete events but in a cacophony of mixed and overlapping events. Similarly, the organism is not a static complex waiting for intervention. Rather, the complex of stimuli overlaps in hierarchical significance and meets with the feedback of the preexisting state dynamics. The result is a complex of interference patterns and manifold geometries. Viewing the process from the temporal axis perspective, the image considered is one of nested, enfolded axial forms linked to the corresponding physiological systems and resulting from the relevant evolutionary symmetry breaking. The information presents as waveform dynamics moving through each frame altering the geometric state of that form, moving on to the next level and eventually to the constructive interference pattern which presents itself as the object of attention, a unified concept, an image, a thought, a perception. The unified concept draws its significance and relevance from the total complex of the frame of reference both internal and external.

Alternatively, from the perspective orthogonal to the temporal axis, the entire enterprise appears concentrating upon the internally enfolded complex of axial dimensionality, as a set of sheaves or bundles in space and time. The vectored forms containing bundles or varying degrees of temporal extensionality. These bundles provide

congruence and continuity of experience through time. Disruption of any particular level of axial dimensionality by malfunction of the corresponding physiological system has obvious implication for understanding the dynamics of psychopathological experiences.

The temporally orthogonal perspective does not see the internally enfolded space as isolated from the larger physical system. The axial dimensionality that has become enfolded into space-time through spontaneous symmetry breaking in phase transition are also seen as external sheaves or bundles of spaces with nested gauge spaces and thermodynamic spaces containing those of the complex organism.

The stimulus transfers from one form to the next across a space at degrees of incidence reflecting the relative transmission rate of that particular level of physiological system. Different systems process at different rates, and this variation allows for cross correlation and multi-system interference. The transmission waveforms are themselves interfered with by other waveforms. Again, as each ensemble of information waveforms encounters a particular axial frame it alters the state of that geometry and is either absorbed or transmitted onward to the next level. Waves passing through the geometry of the axial dimensionality alter and carry the effects or information regarding that levels geometric state, outward to the next and on to physical manifestation in cellular state alteration, endocrine changes, or neurophysiological action.

Accounting for the energy exchanges will require further development of the model. It seems to me that if the model works, and complies with both physiological and phenomenological requirements, then the energy accounting will be resolved. It may be that the information relevant to the enfolded dimensional space may coexist with the physical waveform energy dynamics. Relational, tessellated or structural information may be obtained for free as the energy requirements have been accounted for in the physical dynamics. In this

sense it is an informational dualism that emerges from spontaneous symmetry breaking. Otherwise, a simplectic geometry may allow for the transmission and translation.

Chapter 3

The Primacy of Self-Referential Systems

Self-referential systems, minimally, must involve a structural space that maps back, through an operator dynamic, upon the structural space from which it was generated. I will argue that temporality itself is ultimately a function of self-referentiality of physical systems. An objection might be raised that attempting to explain the very temporality of temporally extended phenomena, through the application of a mechanism that presumes the endurance of a generating structural space such that that-which-it-generated may find it available for reference, fails to address the apparent preexisting temporal extension necessitated by the model. Such a criticism fails on two counts.

First, time is taken as the primary dimensional asymmetry. The simple modelling of self-referential dynamics generating temporal extension has utility for explanation of temporal extension of phenomena at cascading levels of physical reality and as such may be applied in successively higher-orders of phenomena. Eventually, it explains the endurance of a maximally reduced phenomenon through a minimal unit of time within the primary structure of a contextual frame and that which relates the unified object to the contextual frame. This extended application of the dynamic results in a kind of minimal thickness time unit. It is a frame of dimensionality determined upon the advent of symmetry breaking that generates condensed events through waveform dynamics within the defined field and which, in turn, reflect their extended states back upon the contextual frames. For a thing to exist it must exhibit relative difference and this difference is conveyed back upon the frame by the returning waveform dynamics. This pulse and return is the minimal temporal extension.

Secondly; the breaking of symmetry that occurs with the advent of the biological establishes a domain of a structural space with a stability not exhibited by the space in which

it is embedded. Ignoring the self-referential dynamic of RNA (ribonucleic acid) and DNA (deoxyribonucleic acid), one could still understand the bounded state of the original cell as a temporally extended space. The space of the earliest cell had temporal extension relative to its contextual space in so far as changes in the contextual space were muted and buffered by the transmission of those changes across the cell membrane. As such, it seems to me, a defining characteristic of biological systems is that they exhibit temporal extension relative to the contextual frame from which it was generated. Indeed, with added complexity of RNA - DNA, organelles, symbiotic inclusions, organismic structures, neurological systems, etc., the biological system defines multiply nested, subspaces exhibiting various degrees of temporal extension. In any case, the proposal that we regard self-referential dynamics as a mechanism of temporal extension seems, at least, to warrant consideration.

Returning then to the model: self-referential dynamics involve a given space referring back to the space that generated it through a mapping operator. It is a simple two-step process of minimal time duration. How then can such a mechanism be applied to the generations of complexity of mental activity we experience? The answer, again, requires an expansion of the concepts. The generating structural space, within the simplified model, is itself, a generated space at a higher-order. As such the generating space may be considerably complex in its structure. Indeed, it reflects information regarding the states of all the contextual frames within which it is nested. The generating space will always have an extended implicate complexity while the condensed object space will be maximally simplistic.

Let us consider a scenario that is both simplified and familiar. The liar paradox has been the subject of innumerable philosophical expositions and might well serve our purpose in the present instance. How would the self-referential dynamics proposed address the perplexing sentence? The generating space is a complex structural space of the linguistic

idea of the sentence: “Everything I say is a lie.” The translation of information is necessarily from a structure in which the information is distributed across a space to one in which the information is distributed between iterations along a vertically oriented temporal dimension. The sentence must be generated in iterations of successive unities in coherent order for the idea to become explicated and evaluated in terms of truth values. I propose that this might be accomplished through successive applications of the self-referential dynamic. The result of which is a state of superposition that is reflective of the temporal extension of the expressed idea. In a reduced form, the generating structural space generates a condensed space in the object of attention which then reflects back to its origin and then is remapped out to the same structural location on the original condensed space that is also mapped onto the same structural location by virtue of the simple successive time function. The result in regard to the truth value is two condensed spaces mapped onto the same space that is oriented within the dimension defining the minimum translation through time and resulting in an extended space of the superposition. The space of superposition describes a temporal extension orthogonal to the plane considered. Schematically the diagram in the figure below shows the idea presented. The resulting complex condensed space is temporally extended and as such contains both states of the truth value of the paradox in a single superposed state with temporal extension. Structural analysis of the paradox reveals it to be a product of the temporal extension which is seen to be operating throughout. It is the temporal extension that is expressed as a superposition of both truth and falsity of the paradox and it is the mechanics of the structural geometry that keeps us from falling to an infinite logic loop and instead moves us to a higher order context of the two values existing in one temporally extended space.

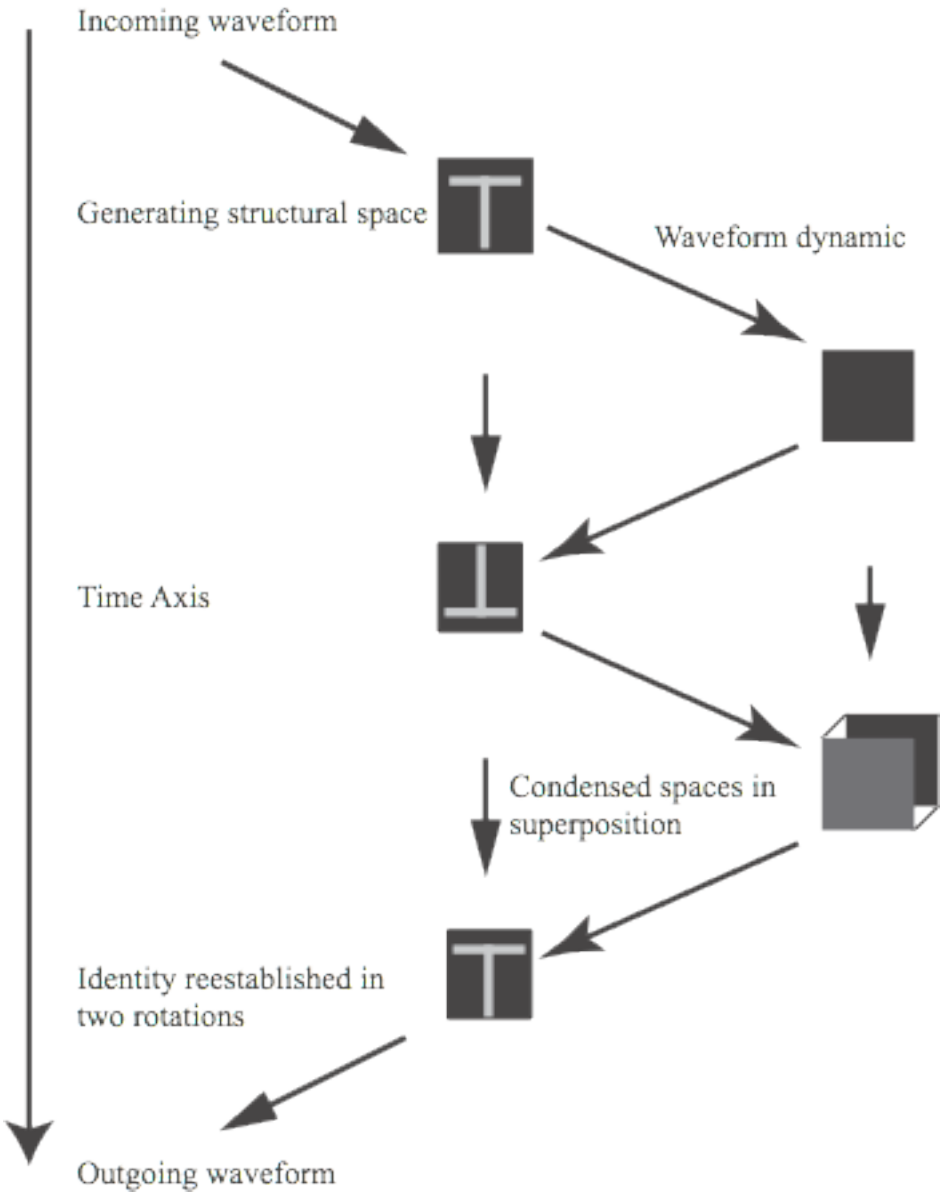


Figure 5. Generation of superposed state with temporal extension. The generating space is rotated through its symmetries of truth values in the paradox until unity is reestablished.

Increasing the resolution of the dynamics of the mechanism may provide additional clarity. Consider then the generating structural space as a complex geometry reflecting the conditional states of the contextual frame which generated it. The generating structural space then proceeds to generate the condensed or unified space as a function of the successive ordering of the explicate words. Beginning with, “everything” and proceeding to “I” and

then to “say” and on through all the words. The generation of each word then reflects back to the space that generated it to prompt it for the generation of the next until the sentence is completed. What accounts for the orderly progression, what is the mechanism which marks each iteration and what is the mechanism for completion of the process such that the idea is closed and a new generating space obtains? Various cybernetic automata might be hypothesised but these seem ad hoc solutions and I am more interested in developing a mechanism that could account for the alteration or rotation through dynamic processes already proposed. Consider that the generating space is a complex geometry with polarity along the time function of the operator which generates the condensed explicate space. It seems to me that this is the situation; reflecting each iteration back upon the generating space establishes a kind of symmetry rotation with respect to the temporal polarity and as such, the production and the succession of words in the sentence reflects each of the symmetry rotations of the complex geometry of the generating space until all are expressed and identity is established, simultaneously establishing a symmetrical relationship between the two spaces, and thereby requiring an order shift to generate the next geometry space.

Why might such a scenario be compelling? Consider again the geometrical structure of the generating structural space in terms of an implicate and explicate order (Bohm, 1980). Two possible mechanisms are presented as holding potential for explaining the orderly unfolding of the implicate order into the explicate determination. The first involves putting a condition upon the reflective mapping operator such that upon reflection the structure of the geometry is rotated a given interval and this rotation results in a reorientation of the polarity of the generating space such that the next aspect presents itself. There is, however, I think a simpler mechanism that might be employed.

A temporal exclusion principle might be proposed which simply states: “No two states may occupy the same state space at the same time.” Such a principle would mean that

once generated, the space mapped reflectively back to the generating space establishes a condition wherein the reflected generated space occupied the same structural state space of the initial geometry and as such violates the exclusion principle. What happens when two states appear to occupy the same state space? To rectify the situation the two states must be considered to be one state in a higher-order state space. Such an order shift within the complex geometry of the generating space now moves it to its next ordered state and in its next generation of a condensed space reveals this shift in the generation of the next word. As the sentence unfolds, the condensed space becomes an explicate ordering of successive states superpositioned in the same structured location and therefore a temporally extended idea. Again, once completed the final reflection back upon the generating space yields a condition of identity that is essentially two state spaces occupying the same higher-order state space and thereby requiring a shift to a higher-order frame which then generates a new primary geometry space and by extension a new condensed space as the object of attention. In this manner a broken symmetry is reclaimed in its temporally extensional expression. Once the identity is established the "gate" is open for the reflective operation to travel on to a higher-order generating structural space. Such a mechanism allows for transmission of information between spaces by way of mapping operators to be modulated by a gate-keeper of the symmetry sensitive temporal exclusion principle. When such a model is expanded into enriched complexity, a tapestry of temporally extended spaces and constrained mapping dynamics provides a suggestion of intriguing inferential potential. What is imagined is a temporal structuralism.

Consider symmetry in terms of its relevance to the temporal exclusion principle. Symmetry is invariance under some, simple or complex, translation. A given structure when acted upon by some function is translatable into the resulting augmented structure. When all difference between two spaces is absent, at least along some given axis of translation, a space

may be said to be symmetrical relevant to that space. The distinction is lost. In state space geometry, each location of any point in a given space is defined by an assigned state space that allows for two states for any given event. The state space is a unit of significance, or rather a structure that provides information of significance, at fine grain level of analysis. An event may be positive or negative in some charge aspect and such bipolar potential can be configured in a state space wherein one cell of the space is filled if the event is positive and the other cell is filled if the event is negative. Generally, state spaces geometries are considered to be oriented along the spatiotemporal plane of the manifold of events condensed and provide two-dimensional information they seem as applicable along the temporal axis. For information to be present a state of asymmetry must exist. Differences exist when symmetry is broken. In a two cell state space, the filling of one of the cells indicates the event is in one state or the other. If on the other hand, the inspection of the state space reveals that both states are filled, then we are confronted with a space that is symmetrical and providing no information as to difference. A condition such as this invokes the temporal exclusion principle to reestablish a state space configuration that contains an asymmetry of information. The shift in state space orientation is required, however, as the information contained is for a higher-order phenomenon. In such an instance the generated state space is orthogonal to the plane of the manifold. The two state-space fillings are similar to the complete symmetry rotation of a given polygon resulting in those rotations defining a group of symmetries and therefore a concept of higher-order significance.

For simplicity, the schematic offered indicates the operators that transmit information as simple arrows. The angle against the vertical is intended to suggest that the entire process proceeds along the primary axis of time while traversing the space across the structural space. Clearly the situation is actually composed of complex manifolds and waveform dynamics which carry the operator through the nested frames of context as well as across the space that

those frames prescribe. Transmission rates and other properties of the given field will result in slow or quick processes of transmission yielding a model wherein information in one domain being transmitted far more quickly than in another and the information being carried falling in-phase and out-of-phase. Additionally, the particulars of the geometries of each of the contextual frame spaces will determine not only the waveforms which emerge as they pass through that space but determines corresponding characteristics of the waveform carrying the state space information.

To provide a model that is more accurate, we need to withdraw from the two dimensional schematic and move to a three-dimensional form. The generated space which marked the end of the path of informational operator and the beginning of the return feedback operator is now placed in the centre of a conical space with each of the contextual frame spaces being described by concentrically arranged nested circles of some thickness, denoting the fact that these contextual frame spaces are composed of a set of geometrically related dimensional values. The form is conical to reflect its being time dependent and is oriented along that primary axis. From this perspective, the wave enters into the structure at the limit boundary of the space and continues to constructively define the final form. As the wave proceeds, it passes through each of the contextual frames, imparting information relevant to that geometry and exiting in a waveform that carries information of the state of that contextual frame. I continue in this manner through each of the frames until constructively self-interfering into a form that reflects all the conditional states of the contextual frames traversed. At that point the model requires an inverted conical shape reflecting the outward transmission of the waveform and its eventual effect upon all the contextual frame states and finally emission.

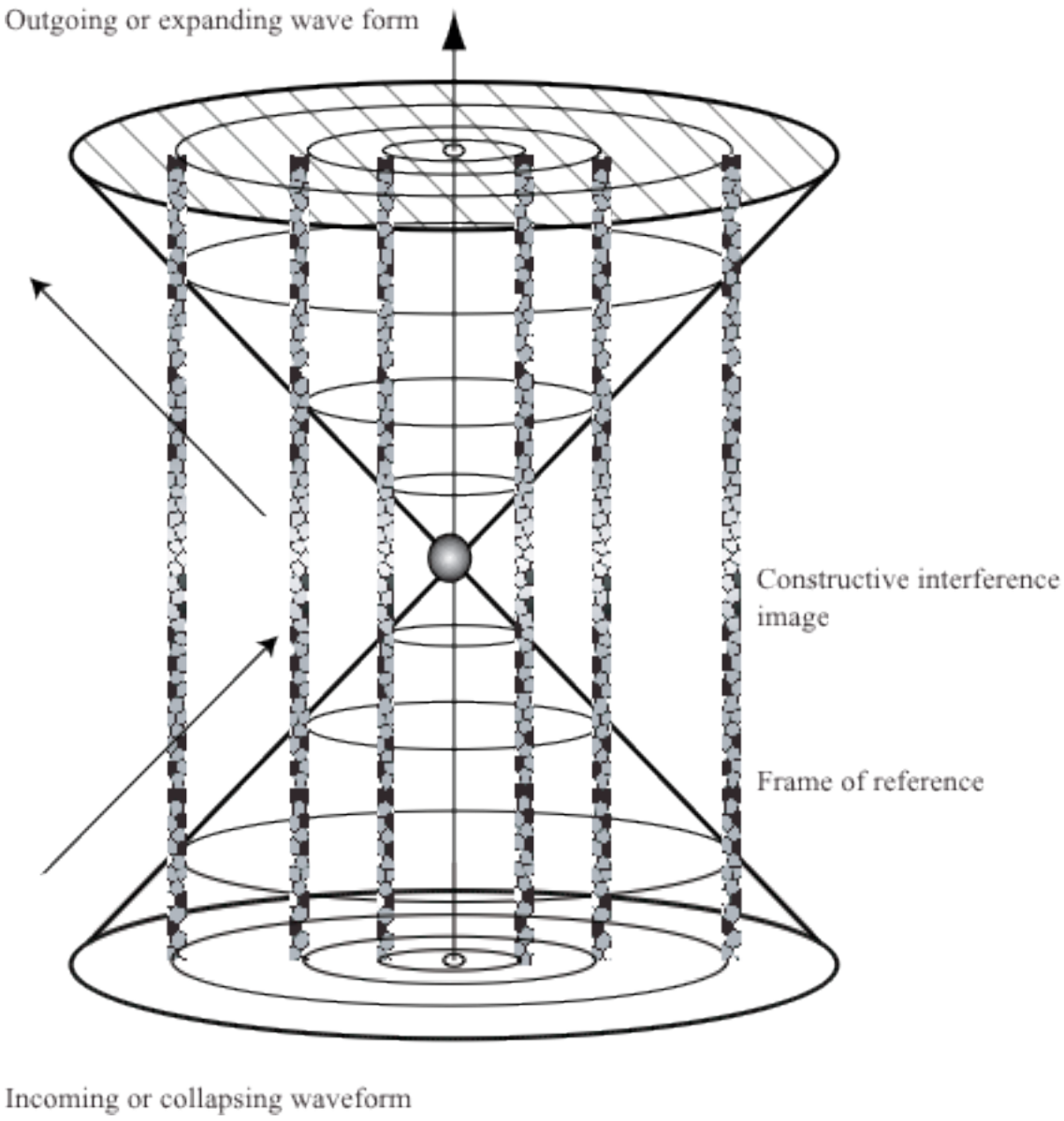


Figure 6. Collapsing waveform through extended frames of reference to image and then expanding outward through frames.

Again, variation in transmission rates due to the parametric value states of contextual frames and the particular transmission mechanism of any given field will result in a rather complicated vectoring of waveforms that fall in and out of phase with one another. Further complexity is required when remembering that what has been thus far described is the

generation of but one form of a generated space and there are many such overlapping processes ongoing.

What is important is a general sense of the structural dynamics which might be employed in explaining the generation of a thought and the maintenance of that thought as a coherent phenomenon through time. The reflective feedback waveform operator will distribute the expressed effect of that generated form across the structure of the contextual frame, thereby altering that frame's geometric structure and setting the conditional states of the next thought.

Self-Referential Dynamics

It has become evident that my use of the term "self-referential" is somewhat unique in its degree of abstraction. In philosophy, the term generally refers to a statement or condition that refers back to the originating source of a psychological self or to the statement itself. In general terms, the "self-referential" dynamic is one in which the generating structural space produces a secondary space through a temporally sensitive operator. The secondary space then maps back on the original generating space that then produces a second iteration of the secondary space. Structural space is understood as a complex of interrelated dimensional values.

Definition of Self-Referential System

A self-referential system is composed of a structural space which generates a secondary condensed space that in turn refers back through time to the generating structural space thereby setting conditions for production of its next iteration. All self-referential systems are dynamic and exhibit temporal extension. This dynamic requires a minimum of three steps to be completed. Minimally, it must involve 1. an implied generator, 2. the product which points to the implied generator and 3. the second product that may or may not be altered by the mapping process.

If the mapping of the secondary space onto the generating space is not homomorphic but rather alters the initial condition of the generating space to produce in the second iteration a secondary space which is not isomorphic with the first iteration or original structural space but is relationally identical in terms of the structure of the system, the second iteration produces a superposed state that is dimensionally extended. Such is the case with self-referential, paradoxical statements wherein both truth values coexist in the same structural relationship. It is tempting to argue that a self-referential system that results in superposed states establishes a temporally extended space and let it go at that. And, it may be that such a dynamic does in fact describe the essential characteristics of temporally extended spaces, but there does seem to be more to be developed to provide a sufficiently rich model.

Self-Referential System Dynamics in Thought

When we have a thought, we do not produce it as a linear summation of the individual words that are generated to describe it. We have the idea with more or less completeness and then search for the words to describe it. Indeed, most of the enterprise of science and philosophy appears as an ever-refined effort to describe what is known and the interaction of those descriptions in complex value impregnated analogs. What occurs then is that the idea generates words. The idea operates as the generating thought and contextual frame for the generation of the string of descriptors.

However, the thought is itself embedded in a hierarchy of phenomenological structures defining the contextual framing, branching Quine indeterminacies, and ineffable biological heuristics. Initially, the thought is embedded within some larger structure of thought which has both generated it and has provided significant referential context. How is it that the thought might endure through an extended period of time such that the individual string of descriptive terms continues to refer to it? If I were to restrict the context to a self-

referential statement paradox without the continued existence of the implied generator, the paradox would be lost and the significance of the statement would be lost.

When schizophrenics exhibit word salad, they are observed to generate a string of words that seem to shift in contextual reference many times before the phrase or sentence is completed. Schizophrenics lose the endurance of the referential context, the guiding thought. At each instant, they are exactly communicating an idea of intent and significance, but the context keeps changing before they can complete the idea. The result is confusion on the part of the listener and often frustration on the part of the schizophrenic.

Perhaps the most defining aspect of consciousness is its temporal extension. Consciousness may be described as a temporally extended phenomenon. Schizophrenics, whose minds can change the context moment to moment and frequently exhibit randomness and incoherence, will be judged as lacking in a coherent consciousness. They may be aware, but they cannot be said to be coherently conscious (and are deemed legally irresponsible) because they do not exhibit the coherence of directionality and intentionality. I do not mean to say that they lack access to the descriptive words to communicate, but rather that they are adrift in the randomness of the space of their awareness such that words, if any are formed, appear random and refer to a context which was lost before the words expressing them have been completed.

How is it that coherence is maintained and there is ordering succession of contextual frames congruent with environmental conditions?

Somewhere between the ages of two and five we become the person we will be for the length of our lives. We become situated (Popper and Eccles 1978; Piaget 1954, 1973) in the world of other human beings and the family. We begin to organise our thoughts and experiences within the linguistic and cultural structures of that familial world. Alteration, augmentation, and incorporation of new experiences will refine and expand the blur of self in

the world, but it is from within the context of the self that we will encounter the world and identify, define, and organise our memories. Our existence is self-referential to the degree that we can say we are the same person throughout the extension of a timeline of our body. Any sentence we generate is relevant not only to the immediate context of the guiding thought but also to the complex nesting of contextual frames of language and experience and to the context of the self that we are in the world: the plans, intentions, hopes, fears, friends, family, schools, and country attached to that self.

The self may be conceived of as a geometrical structure that reaches a critical state, closes in a geometry reflective of a lowest energy organised structure upon a space of awareness, and endures as a complex of enfolded axial dimensional states values. But there is more: one must consider the dynamics of the geometrical structure as they affect focal awareness. It is not simply duration that must be considered, but duration with change. Thought exhibits duration with change. A thought presented comes into focus as object of attention and recedes into the background as another thought replaces it. Words proceed in orderly fashion to occur, be expressed, and fall away into history of intent. The duration of the contextual thought may be dependent, as Lewin (1976) suggested, on the elastic and plastic properties of the field of awareness within which it is embedded. Clearly, thought seems dependent on the elasticity and plasticity of physiological conditions for duration. For example, anomalies in neurochemistry might result in rigid fixation on an idea or in rapid exchange of one thought for another with subsequent loss of coherence and deficit of attention. Generally, however, completion of the description initiates the replacement of one thought for another. The sentence completed, the next idea arrives; the paragraph completed the next paragraph arrives. The guiding thought maintains its position until the dynamic is completed, symmetry reestablished and another guiding thought is generated.

Let us consider a possible scenario for this dynamic in terms that are suggestive of group theory. The thought presents as a geometric structure reflecting the structural state of the axial dimension that generated it. When the thought generates the string of descriptors, it sets up a self-referential dynamic such that each word expressed the thought rotates the structure by a certain degree until the identity function is established and unity is restored. When the thought has completed its rotation through time, the referential mapping is directed to a higher-order contextual structure and the next idea is generated in turn to provide the next thought in the sequence. When all lower order thoughts have been expressed, the higher-order contextual or, guiding thought, resolves into unity and the mapping function goes to a still higher-order of thought. Alternatively, the process may be interrupted by the dog's insistence that it is time to be fed.

In attempting to make our first mark on paper, we require complete attention and patience. Through time, as we gain experience, we come to master the movements that will deliver the mark we intend. We have come a long way from that absolute focus of intent and of the senses to where we can allow the hand to attend itself and we can be off several levels higher exploring new ideas we wish to explain.

Self-Referential System Dynamic in Two-Dimensional Schematic Waveform Representation

The object of attention, our *focal awareness*, is the result of all the contextual frames, both physical and enfolded phenomenological, being translated through time. There is a lag time, or rather several lag times depending on the systems involved, from external conditions being translated into internal states and vice-versa. The contextual frames are omni-directional with respect to the focal awareness. Because of the omni-directionality and the continuous space defined by the phenomenological dimensionality, I would argue that a waveform is the most appropriate descriptive operator.

A waveform carries information regarding location of origin as well as intensity and duration. Its rate of transmission depends on the qualities of the space it traverses. A waveform will both distribute state space information to a particular contextual structural frame and carry information about the contextual structure frame it passed through on its way to focal interference. It seems that application of waveform dynamics will provide the model with a simple transmission mechanism.

The entire process, the environmental changes, physiological stimulus, leading to a specific focus of attention and back out to a behavioural physical response can be envisaged as similar to a light-cone.

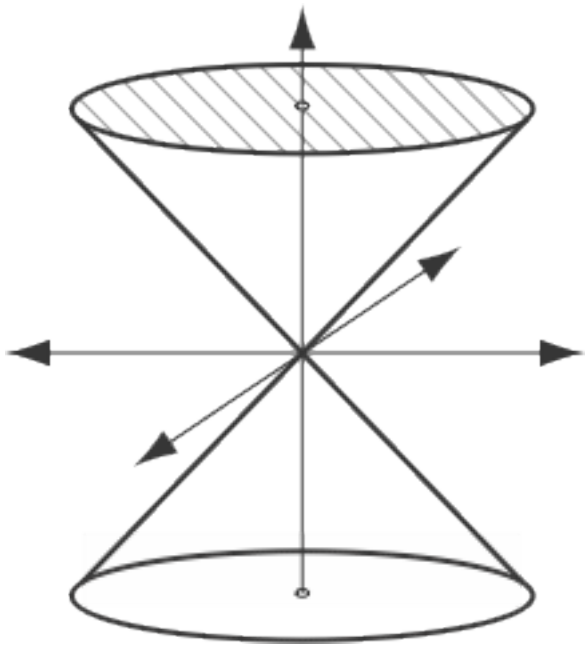


Figure 7. Light-cone image describing a waveform collapse and expansion along the time axis.

However, the wave, as a function of time, traverses a complex geometry of nested, hierarchically arranged frames of enfolded axial dimensionalities and, as such, presents a significantly more complex form than the idealised light-cone. The path accelerates and

decelerates depending on the transmission variables of the particular space being traversed. Several waveforms may be generated by a given stimulus, all arriving in phase or out of phase at the point of focal awareness and carrying with them the state space information of the frames encountered.

Such a system would create not only overlapping waveforms collapsing toward the focal point of awareness, but also a complex of outgoing waveforms expanding from earlier focal attention events, that interfere with the incoming waves and augment their conditions. Such interference suggests a complexity of waveform dynamics over successive instantiations of focal awareness.

I have omitted the particulars of neurological structures and psychological structures in order to focus on the primary dynamics and the interface of the phenomenological with the physical. This structurally dynamic model suggests a space in which second-order phenomena related to the relevant symmetry breaking might emerge as the result of interference patterns of the waveform dynamics. The dimensional parametric axial structures are determined physically while the thoughts that develop within the defined spaces come and go in time.

For simplicity, I will ignore the overlapping waveform dynamics and focus on a minimal self-referential system. The generating space occupies the contextual frame or guiding thought location. The waveform that is emitted from the frame of the generating space collapses to a focal minimal waveform before expanding back outward toward the frame of the generating space. As the waveform encounters the frame, it maps onto the structural space. If it is identity homomorphic, then the wave passes outward to next level. If it is not, then the generating space is altered or rotated by a given degree, and the waveform returns to focal attention. The process continues until the generating space's rotations and generations are completed, and the thought and its expression are completed.

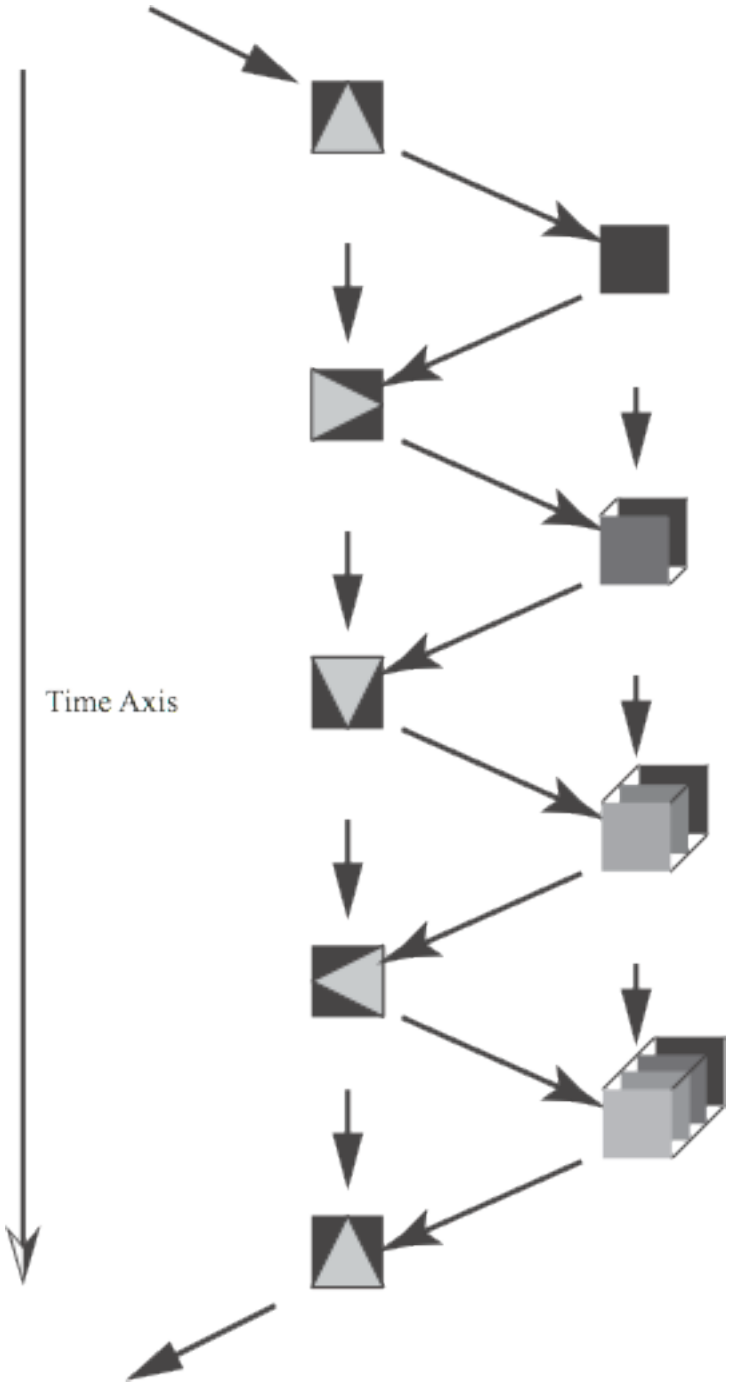


Figure 8. Diagram of a self-referential structural dynamic with generating frame re-establishing identity through rotations and the resulting superposed condensed space of the image.

The Structure and Dynamics of Conscious Experience

Thought has temporal extension and phenomenological coherence. The fact that thoughts may be held over a period of time and that they operate behind or at a more fundamental level than language tells us something significant about the structure and dynamics of the domain of conscious experience. Under the normal range of biochemical and neurophysiological processes, the thought emerges and is maintained over time until it has been expressed or replaced by some more immediately significant idea. The phenomenological field allows for temporally extended phenomena that are spatially separated, at least in some sense of complex topological geometry. Moreover, the thought that generates the object of attention not only provides the contextual frame, but must adjust and alter its form as the result of the occurrence of the produced image. Such a mechanism is not instantaneous and must, therefore, reflect some omni-directional feedback mechanism, or waveform dynamic. The minimal structural form for dynamic phenomenological experience consists, then, of (1) a frame of reference, (2) a continuous translational space, and (3) a focal image. Given that the frame of reference is likely to be multidimensional and hierarchically ordered, it would follow that the potential complexity of the focal image is considerable.

Self-Reference

Assuming only a primary structure in nature of a relatively meagre, requisite original richness, I shall demonstrate how phenomena can arise in a nature that exhibits self-referentiality. Numerous authors link consciousness with self-referentiality but fail to consider how much more ubiquitous in the natural order than consciousness these self-referential structural forms may be. My purpose is to link to self-referentiality the very quality of phenomena *that they endure.* That is to say, I attribute temporal extendedness itself of any phenomenon to the presence of self-referentiality. By shifting philosophical concern in this way, I will nullify both the question how consciousness fits within the natural order, and

the question how consciousness possesses its unity. Over against the latter question, I urge that we need not study how, to a prior manifold, *unity* is brought. Rather, our study should be of how, to a prior unity, the condition (of temporal extendedness) for *manifoldness* is brought. Over against the former question, I make out that the key underlying dynamic for this, which involves self-referentiality, has ubiquitous expression in nature. We see it expressed wherever we see temporally extended phenomena.

Concerning, specifically, the phenomena of conscious awareness, the problems that such a scenario attempts to resolve are: (1) what makes possible the sense of duration of an object of attention over a succession of temporal intervals, and (2) what is the mechanism both for the orderly progression of experience and the higher-order shifts in contextual frames. Additionally, it is a scenario which necessarily models from the object perspective of the primary structure. A complete modelling would address not only the self-referentiality within certain phenomena of conscious awareness, but also in juxtaposition with this self-referentiality within the gamut of underlying phenomena reaching back through biological evolutionary history, chemistry, physics, and cosmology. All this would be required to trace the phenomena of conscious awareness themselves out through the primary structural forms.

Nonetheless, a modelling of self referential dynamics in a minimal form that can be extended in complexity holds some potential for clarifying our understanding of natural phenomena. We who understand phenomena as natural do so consciously. The perspective offered allows us to see this itself as natural. The question as to how there can be conscious phenomena is not essentially harder than the question how there can be temporally extended phenomena of whatever other varieties at all. And self-referentiality is proposed as key to the answer.

Model and Theory

The model of consciousness is both structural and dynamic. It is a model which implies a theory. So let me clarify my distinction between ‘model’ and ‘theory’. I am inclined towards Margaret Morrison’s (2007) perspective regarding the relationship of models to theories and the unique utility of each. From my perspective, models operate as a form of structural emergences to the extent that they facilitate the investigation of theory to empirical realities. The model explores the interface between the physical and the mental and adjusts the mental to accommodate and integrate the structures of reality. Contrariwise, a model can alter an understanding of a collection of physical structures into a perceived order onto which a theory can map. Within the space of the interface between theoretical understanding and physical ontology, the model operates to determine the adjustments in either, as both to allow integration if that is possible and, indeed, otherwise, to illuminate the impossibility of integration, and/or the necessity for reformation of the theoretical frame. That is to say, theory provides a structure for the generation, ordering and application of models.

What is more important, however, is that a theory provides a structural order of understanding that maps onto experience and empirical evidence. Theories provide manifold translatory mechanisms for integration with other theories which are tangential to the particular theory’s domain. In this perspective, a theory has a bipolar function of integration with the experience of the physical world and integration with the extended metaphysical framework.

The model of consciousness that I am proposing suggests several important aspects of a general theory. It is not, however, within the scope of this exercise to explore and develop such a theory. Instead, I attempt to take several primary concepts developed in domains relevant to considerations on the original dynamics of consciousness and combine these into

a model that might illuminate how an emergentist proposal could be reformulated to avoid or address the problems which have previously disqualified it as holding explanatory potential vis-à-vis the mind-body problem.

Because the model proposed utilises primary dynamics and structures and applies these through successive levels of physical organisation and biological development, a rather simple model and elegant dynamic is rendered into an array of self-referential iterations of nested structural spaces and complexities. It should be remembered, as the model unfolds into complexity, that it is essentially simple in both form and function.

Chapter 4

Model of Mind

When developing a model that is interdisciplinary in referential significance, there is the risk of misunderstanding aspects of ideas from any of the specific theoretical disciplines. There will be nuances of misunderstanding of issues within any given discipline that I am either ignorant of, or, unaware of the argument's significance. To that extent, the model reflects my understanding of the information I have encountered while venturing into any discipline's domain to explore possibilities of refutation and confirmation. Through the process of these two dynamics the shape of my understanding has adjusted and come to reflect an incomplete understanding which suggests general principles for integration and accommodation of various aspects of the model and the implied theory. I believe that such a position is unavoidable as each discipline will contain several subspaces of issues requiring the dedication of a lifetime to understand. It is simply impossible for any interdisciplinary model to be developed with full understanding of all the theories that form a referential manifold. I apologise to any and all who I might offend with my misunderstandings or distortions of their discipline's understandings. I invite all suggestions, corrections, and participation as I see this endeavour as a group process. I am offering the model as a suggestion of a strategy of approach through which we might resolve many of the mind-body issues while satisfying all relevant physical requirements. The model is an approximation that maps relatively smoothly from level to level and suggests avenues for understanding certain aspects which interface between the model and the relevant disciplines.

I begin the integration of the model by reviewing the concepts and exploring each of the developmental levels.

Biologically, what is proposed is a mechanism for developing a complex space within an organism such that the organism resides within the complexity of that phenomenal space. The mechanism is a breaking of preexisting symmetries at a categorical level. Symmetry is broken either by self-organised criticality, by the rate of change exceeding the equilibrating process rate, by identity of mapping of explicate geometry onto the geometry of the implicate space thereby requiring dimensional order shift, and by spontaneous or random processes. The initial symmetry break for life was the boundary of the cell. The cell membrane buffered the internal space from the more rapid changes of the outside space and established a temporally extended space in its creation as a breaking of symmetry (Smith and Szathmáry, 1999). Capturing an asymmetrical molecular structure of RNA could have allowed a mechanism for the internal state space to translationally relate to the external. An RNA sequence that produced the right amino acid structure remained through generations of cellular division while those with less value are lost over time. What accrues is a self regulated buffered space containing a collection of protein makers that repair the structure of the cell in response to variations in external conditions. This enfolded internal dimensionality is simply inside and outside.

Addition of flagella or other mechanism for motility, creates a second dimensionality which is described as towards and away. Each of these primary dimensions have polarity and together provide a geometry of the cell and of the world within which the cell resides. That geometry provides translation between the two.

The next level of differentiation involves the progress to eucaryotes and an asymmetry of the cell itself developing into a structurally self-referential system. The DNA maps a history onto the cell to allow for the creation a future state that will adjust and endure. The DNA maintains the stability and temporal endurance of the cell. Not that I am anthropomorphising the DNA, only suggesting the obvious, that if the cell is maintained the

DNA that is responsible will remain in a certain organised state and be transferred into future generations.

The cellular organism evolves into a multicellular organism. The single cell space becomes embedded within a higher-order space of the organism. The organism communicates across their boundaries to the distant others in response to chemical cues that stimulate extensions of their cytoskeleton into microtubule tentacles (Bonner, 2000; Alberts et al., 2002). The tentacles communicate states between cells such that each cell has an extended space of information. This information is transmitted as signals between cells of the single organism. Motility and form flow dynamics eventually establishes a symmetry break into anterior and posterior and any arrangement of symmetry around that axis. The form will eventually reflect the forces acting upon it.

The step into bilateral symmetry allows for a break in symmetry of the space of the organism. Introduction of a neurological system which maps back onto the space of the organism is a further symmetry break of a higher-order. The notochord provides a mechanism for the space of the organism to be mapped and information regarding one aspect of the organism to be communicated quickly to another distant aspect. Neurological signals are signs, they point beyond themselves to an area of the organism. They point one aspect of the organism to another, such that the itch is scratched, or stimulus attended. The symmetry break of the nervous system must generate an enfolded dimensionality that will intersect the preexisting enfolded dimensional structure. Neurological information is conveyed through frequency duration and amplitude of a stimulus. Each waveform contains information regarding the location, frequency, intensity, and duration. Additionally, sexual spaces and sexual dimorphism is to be accounted for. Sex allows for an increase in adaptability through genetic variation, requires a social aspect and provides a categorical space for individual uniqueness (Sterelny and Griffiths, 1999; Sterelny, 2003).

It is easier to imagine the dimensionality offered by the symmetry break into the neurological space once we consider the development of specialised sense receptors and a space of sensate awareness. Nonetheless, there might be some purchase from a review of what necessarily precedes the occurrence of space of sensate-awareness. Before or after has to be a dimensional aspect of neurological systems. There is a temporal order necessitated by the signalling mechanism. In this sense, Kant is correct in assuming before and after are dimensional aspects of a biological system. The temporal asymmetry of the physical must eventually manifest with the phenomenological dimensionality of the biological. Before and after, can be seen as mapping relatively smoothly onto the lower order dimensions of towards and away. The asymmetry of the structural design requires a dimensionality of anterior-posterior, right and left, top and bottom. The neurological space establishes an extended structural space and a temporal axis.

The cellular integrity maintained through variations in the state of the space in which it is embedded creates a temporally extended space. The neurological space of the organism creates a mapping onto that extended space of the organism and manifests the extended nature of the cellular domain through its extended temporal space of before and after. To account for before and after there must be that which relates the two in juxtaposed ordering. Before and after requires an extended space that holds a comparison of the explicate and implicate. Before and after in a three dimensional sensate space allows for localisation in the organism of both incoming stimulus stimuli and outgoing effects. The organism with a neurologically developed chordate system can be seen to function within a phenomenological space of inside-outside, towards-away, male-female, anterior-posterior, dorsal-ventral, right-left, before-after. It may be a more complicated space when accounting for the geometrics of the structural spaces of DNA, chromosomes, and proteins. For the purpose of this thesis, a simplified version illustrates the concept and allow for further development of the idea as we

proceed up the tree of evolution. The complexity of the enfolded dimensionality is considerable, even in this simplified form, and at this early stage of development. The addition of sense clusters for light, or sound, or taste, or temperature sensors all combine to describe a sensate space which provides a complex and extended space projecting outside of the organism. A simplified model of the world in a reduced synthesised form is developed within a structural variation of the basic dimensions available to the organism. A model that provides frame for translation of information from one domain to the other and back. Bright to dark, loud to silent, hot to cold, acid and alkalis, taste and smell, all and each combine to provide a perception of the external space. It allows for the mapping of the external space of sensation and perception onto the space in which the organism is embedded. It need not be exhaustive in any of the dimensions and would seem to gain benefit from reduced ranges of selective sensitivities. At the organism level, this is a beginning of the dimension of self and other. The psychological understanding of these concepts is not fully developed until higher-order asymmetries occur in sexual dimorphism and the social aspects necessitated by such a break in symmetry. Additionally, and perhaps most importantly from a psychological perspective, is generation of dimensional enfolding through the evolution of cerebral hemispheric dominance and its effects on the development of a capacity for language (MacNeilage, Rogers and Vallortigara, 2009). Before such a development can take place, however, the asymmetry of the amygdala and hippocampus prescribes another space that maps down onto the neurological space as it defines the space of the organism (Glynn, 1999). The emotional space prescribed is inclusive of pleasure and pain, anger-fear, hunger-thirst, dominance-submissiveness, introvert-extrovert, active-passive. All of these dimensional spaces are embedded within the structure of the sensate space dimensionalities and project downward through all the dimensional enfoldings which have occurred along the particular trajectory of the organism's evolution. The interior space maps onto a complex space of the

geometry of the organism within its context and as such is a mapping of interior spaces out to exterior and, eventually, social spaces. It is a complex ordering of feelings attached to the perception of the world in terms of relational structures. It inferentially translates the spaces of others with whom we share identity as species through sex. The communication of internal states to external is via the translation of the total geometry of emotions in that complex. Emotions, in this sense, are the reflections of the geometry of relationships. Emotions allow for rapid assessment of which others are threats, which are same as the organism and which are different in any general respect. All this exploration allows for social navigation of the individual within their social context. It provides a geometry from which to operate as a social entity within the world that holds threat and food, pleasure and pain. Emotional space allows for enhanced communication of the various relevant aspects of any given situation vis-à-vis the extended state of the organism and extended state of the environment. It is simply more efficient than the linear analysis of logical pathways unweighted for social values. It is into this space which the asymmetry of cerebral hemispheric dominance and specialisation of brain functions emerges and sets the stage for the higher cortical structures (Sperry, 1968; Jaynes, 1976). The break of symmetry between the hemispheres allows for language to become a complex space that maps down onto all preexisting dimensional spaces. The embedded linguistic deep structure (Chomsky, 1957) gives rise to a variety of social linguistic forms all of which function in a manner as to provide a mapping of symbolic representation onto the internal spaces of the organism and the perceived external structure in which it is embedded. It also provides for a structural dimensionality of self and other with self being the frame of reference of consciousness of the organism and other, an abstraction with variance.

We operate from within the structure of the geometry of self as mutually defined. It is a perception of identity within the complex of the world and the self as organism. Self is

codetermined by the idea of other or theory of mind of the other. It is dimensional insofar as it is a polarity of the self-other dimensionality. The space of language facilitates development of a psychological space that includes dimensions of relationships and provides for an increase in efficacy in transfer of information from one aspect to another aspect at some distance or in some future time. The symbol is a signal within the psycho-social domain.

The complex of the geometry of the self must account for the complexity of the social system in which it is contained. Relational structures of localisation and directionality provide for a complex context, within which operate the primary dynamics of the contextual frame yielding an instantiated state space geometry manifold. That which is the focus of attention is the discreet aspect of the contextual frame being condensed through a waveform operator in time. What presets as figure, or object of attention, is defined by its ground both, in time and space. Likewise, the contextual frame is altered through the expressed effect of the occurrence of the discreet forms through time and space.

The focus of attention is that space where the polarity changes from past to future. It is a twisting interference that reflects back outward through the various structural frames. It distributes information to those structural spaces and continues outward until it expends all its energy or until its informational distinction is lost to discrete analysis.

Now we are within the domain of consciousness and the mind. If consciousness is the result of awareness operating with a self-referential dynamic structure then the self which implies the space of the other is the beginning of mind. What remains is to consider the over-all potential such a model holds for explaining phenomenological experiences and complex operations of thought.

The scenario suggests the integration of this model to specific domains of physiological organisations as they unfold in an evolutionary order. Any one area can

provide for many life times of analysis of detailed mapping of spaces. As I said at the beginning of this discussion, the scenario is a general mapping at a low order of resolution but one that suggests the potential for further refinement of understanding.

In general terms, it is a model which provides for the question of an internal space by symmetry breaking in evolutionary processes of speciation, within this space is a complex geometry of dimensionality that culminates in a geometry of language and a self referential structure producing temporal extension within the psycho-social domain. Within this spatiotemporal complex there is an opportunity for development of a theory of mind that accounts for its relevance and causal effectiveness through a temporally extended dynamic. In such a manner, consciousness participates in the causal reality as a result of natural processes and in compliance with deterministic principles. It is however a structural determinism and of a sufficient complexity that it might be more a accurate understanding to refer to it as a compliance with chaotic deterministic principles.

Mental Dynamics

As stated earlier, exploration of the interface of a model of mind with multidisciplinary implications runs the risk of appearing conceptually inexact. Embarking upon the elaboration of the model into a speculative domain runs the risk of being both inexact and excessively expansive. Nonetheless, the speculative exercise is necessary for suggesting potential development and refinements and is playfully engaging. I do recognise that each creative elaboration needs to have attached an extensive list of caveats and conditions. However, I also view the process of exploring the model as a collective enterprise and welcome suggestions as to refinements and corrections of mistakes. The intent is to develop a model of consciousness and mental phenomena that provides an increased understanding of these phenomena and a smooth translatory geometry for integration of the philosophy of mind with a natural physical ontology.

A benefit of having an enfolded dimensionality associated with any biological symmetry breaking of a categorical level, is that the dimensionality prescribes the translatory geometry between the two spaces. Through the dimensional geometry, phenomena at higher-order are related to phenomena at a lower order and vice versa. The rate of translation across the enfolded space is faster then across the contextual space. Information arriving in one part of an organism exhibiting a nervous system gets transferred at a much higher rate than if the information would have to be translated through a fluid system or circulatory system. The nervous system greatly reduces the uncertainty of the space within which it is embedded. The world is sharply defined in events within an extended space of being. Information defined, becomes reduced to frequency, amplitude and wavelength. These qualities are translated to location, intensity and duration. Together the combination of the value along the dimensions is associated with each neuro-space geometry. This higher-order phenomenon can be transmitted and correlated with other inputs to cause a rapid response to be available.

The body space of the organism I refer to as somatic space. This will be inclusive of each of the preceding dimensions (e.g., toward-away, top-bottom, left-right, front-back, more-less, male-female). Adding to the somatic space is a sensory space which translates particular biological interfaces with external reality into sense data (e.g., touch and taste, smell and sight and hearing). Each space a set of values along dimensional parameters. Each sense is an application of biological geometrics upon the world as translator of one space to another.

Together, the somato-sensory space prescribes a contextual space into which emotions and wants emerge as the structural space of a social being, a space where emotions translate neurological information into hormonal and process abstract information in a pre-rational form. Emotions, if sufficiently refined, might well tell a significant amount of information.

They provide a mechanism to access complex situations in short order and calibrate a response set expressed outward across the neurological space via somato-sensory spaces and across endocrine boundary into hierarchical space of the organism (e.g., active and passive, love-hate, fight-flight, desire-repulsion). The dimensional space of emotions provides the rudiments of assessing the other, a theory of the self of the other if not the mind of the other.

The combination of somato-sensory and emotional spaces provides the contextual space for mind. Mind develops as a structure of consciousness. Consciousness exists as a self-referential temporally extended space arising from the breaking of symmetry in the cerebral hemispheric dominance and specialisation of the brain functions, in favour of language. The linguistic space provides a polarised complex geometry of many dimensions allowing for the mapping of one space onto another. On the inside polarity of the linguistic geometry is self and its internal space of experience. The other polarity provides a translation from and into the external world, an ordering of symbols, cultural symmetry breaks and experience.

Waveform information from neurological, biological, endocrine and a complex of systems, processes through the linguistic frame into the space of thought and carries the states of the structural space perceiving the boundary of this world into the structural space of self and a developed complex of geometries of values, ideas, experiences, memories, etc., which are ordered within the geometry of language. The waveform passes through the geometry and emerges as information about the structural space and the state of the external world. The returning waveform carries internal information, cross-correlated at every level that reemerges into a particular configuration of the external geometry expressed. The incoming waveform moves through complex spaces converging in experience, changing polarity, and moves outward through the geometry into expression.

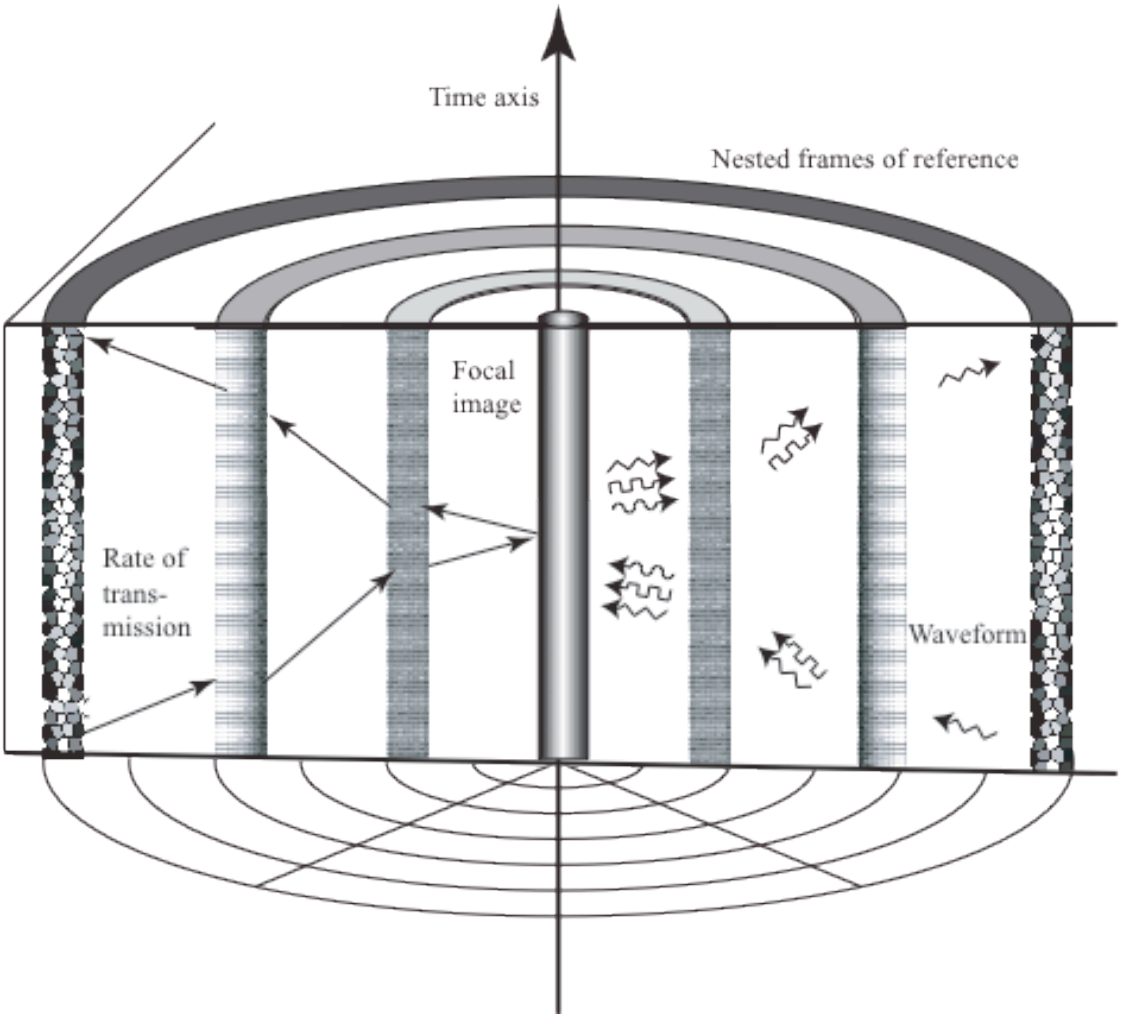


Figure 9. Cross-sectional diagram of structural space across which information contained in waveforms is transmitted at rates that vary according to properties of the particular domain space they traverse. Each waveform carries forward the information of the structural frame through which they pass. The complex waveform is condensed into unity of image and then returns to distribute the augmented information to each of the frame structures.

What happens within the internal space, such that the previous statements make some sense? Well, that depends on how you want to position your perspective within the model. It can be expressed in a metaphor of waveforms and nested filters, with each filter containing a geometry that allows for some adjustment of dimensional variables. The central waveform is eventually obtained as a constructive interference pattern of some duration that then falls into the next succeeding pattern. Alternatively, we could take the perspective of nested

geometries which rotate within and around one another within a primary polarity. An idea similar to those wonderfully carved Oriental ivory nested ball puzzles, with the addition of a kind of tensored stress relationship between each of the geometries. This perspective is from the outside in. Finally, there would be a form of state space geometries operating in such a manner as to generate temporally extended structural phenomena and temporally extended contextual frames. Each of the particular perspectival interpretations requires those aspects of the other perspectives to provide a coherent and complete description.

Let us now turn attention toward consideration of certain required qualities of the structural space being considered. The image is one of a temporally extended space, operating within nested temporally extended structural spaces. Variability in the thickness, or plasticity, of the space would restrict the potential for numbers of iterations in any processing of thought and the potential complexity of the extended contextual space. A narrow space would allow for only the briefer processes of simple thought complexes. A thicker space provides a more complex contextual space. Keeping many thoughts processing at many levels towards a particular resolution is a mark of intelligence. These ideas are similar in form to those of Kurt Lewin (1976).

Waveform information dispersed across the space from every direction travels across the space towards a central axis oriented along the temporal axis. It is along the central axis defining the minimum transmission dynamic through time that the object of attention and the unity of synthesis is produced. Information translates across the space at various rates depending upon the elastic quality of the temporally extended internal space. If the field is inelastic, its transmission rate will approach horizontal immediacy and produce a kind of autistic focus upon a strobing wave without processing content. In the other extreme, an overly elastic space brings the waveform angle of incidence almost vertically aligned with the temporal axis. Processes, that might be completed in unlimited time, stretch back into a

distant past of contextual space and may be understood as struck in an unyielding now of depression.

This space within the contextual geometries of linguistic structure and the boundary interaction of the state configuration of the world, and the cascading contextual frames indicating the evolutionary path it took to get here, creates the complex context within which the process of thought unfolds in time.

I will concentrate on the simplest formulation of the dynamics in its process along the temporal focal axis. We assume a space that extends to its immediate contextual frame which exhibits a moderately extended temporal space allowing for several temporally extended complexes to operate along the same waveform axis.

The immediate structure around the temporal axis includes the complex groupoid space that generates an explicate iteration of the implicate structure. The waveform is transmitted across the space at an angle of incidence reflective of the transmission rate and elasticity and plasticity of the field. As it processes through the immediately contextual complex groupoid space it generates the state space associated with the geometry of the complex space in respect to its alignment to the axis of the waveform. The space generated then feeds back to the immediate contextual structure altering its geometric orientation and creating the potential for the next incoming waveform to generate the next explicate state space along the temporal axis. The process continues until all rotations of the groupoid complex are exhausted and the explicate space establishes a structural symmetry or identity with the implicate structural space. This structure, prior to identity, requires each order of mapping of the explicate state space to be imposed upon a space which contains the state proceeding it. In such a manner the explicate state space is established as a superposition space and exhibits temporal extension. Upon identity being established, the immediate

contextual space resolves into out-going waveform information to the next higher-order contextual space.

The entire process might be understood more readily through application of a metaphorical example. Consider a book. The book contains all the information within its pages. Holding the book, you hold a space, a complex space containing nested hierarchies of ideas and temporally extended processes. Holding the book does not translate that information however, and so the process of reading the book must be engaged to distribute the information contained within its covers. One reads the book, word by word, but it is the order and temporally extended connections between complexes of words that convey ideas. The implicate, complex space of the book is made explicate along the temporal axis. As one reads, the ideas expand out through the reference of the immediate context of the book to various related and occasionally unrelated embedded contextual frames causing several levels of ideas to be processed at various rates. The book is read and, when read completely, it is closed and placed back upon the shelf. The information made explicate has completely mapped upon the implicate space establishing a symmetric identity between your understanding of the book and the physical book. The book, read, may well lead to the selection of the next book to be read and so the immediate contextual frame changes while the embedded frames are maintained as partially processed.

Synthesis Revisited

The benefit of getting it right when constructing an isomorphic mapping translation, is that it then moves into referential frame status and opens a new domain of phenomena and understanding. At identity, the translatory frame becomes embedded within the parametric frame of reference, a gauge like translation, for a new space of obtained phenomena previously unavailable to the reasonable dialogue. Identity is a collapse of complex spaces into unity. It is the process of synthesis that establishes the identity as referential. Identity is

the case in which two spaces of complex structure may be translated one into the other through an intermediary frame of symmetry.

The next step in the analysis requires a shift from the spatial perspective to a temporal perspective. There must exist, if identity in symmetric relational properties can be understood, an extended space of time that allows for the comparative mapping operator to function while maintaining a single sense of being through time. Otherwise, the reference of the initial space is lost. The result of not having a temporally extended space is that one is condensed to an experience of successive, unrelated nows without a determinable trajectory. The chaotic experience would not allow for any meaningful communication or rational discourse. We extend in time to allow for two spaces to be condensed through a self-referential process. That structural space which extends to contain and relate the aspects of the primary structure is generated at the occurrence of the initial symmetry break.

We may argue that a person is simply that trajectory of an identity that unifies all the temporally superpositioned spaces of memories along indexicals. Memories are spatially extended complex structural spaces of experiences that have been condensed to a unity through a temporally extended function. A rotation of a structural space that maintains invariance provides the extended temporal frames through which spatially distinct groups of complex structures are brought into successive explicate order and finally temporal superposition and unity. This seems to me, a description of a mechanism for synthesis.

This thesis is not an attempt to understand the detailed complexities of Kantian thought. Such an understanding would require an extensive and dedicated effort. Nonetheless, it also appears that no effort to develop a model of mind that is consistent with both empirical experience and rational analysis can avoid locating itself within a Kantian perspective. Kant unifies the complex of the categorical manifold of experience through the

action of the transcendental “I”. With this in mind, I wish to direct thought toward a consideration of two aspects of Kant’s implicit theory of mind that appear problematic.

Kant’s model seems to be prescient of a structure for which he had limited cultural concepts or cross-disciplinary models from which to draw upon. He was limited by his place in time for development of a complete description the mind in nature in a modern understanding of such an ambition. He seems to be further restricted by needing to indulge a biased faith in the functionality of a transcendental “I”. Kant seems unable to see a passive dynamic interpretation of the phenomena he is attempting to analyse because it violates his commitment to the idea of will.

Kant perceives there to be a primary structural form involved in any conceptual understanding of thought and experience. He proposed the domain that generates the apperception and he has the synthesis of recognition and he has that which relates the two and translates the one into the other through the function of intuition and imagination. Each of the structures would seem to map smoothly out to the primary form, i.e., frame of reference, constructive objects of attention and that which relates the two through time. The “I” Kant entertains stands in front of the space available to a future reduction while locating the self in a space of minimal temporal extension. From my perspective we are temporally extended by virtue of our self-referential structure. It is an admittedly outside-in perspective, but one that is necessitated if we are to have any object of attention.

Application of the “I” as the mechanism for synthesis of divergent spaces seems to beg infinite regress in that the “I” would have to have the idea of what it was working toward in bringing unity and so there would be a space within the “I” which must already have done what must be done through the application of the “I” and so ad infinitum. Problems encountered by the involvement of a wilful “I” can, it seems, be avoided by both displacing the identification from the thought to the field that relates the manifold to the thought and

from the eternal temporal extension of a transcendental “I” to a minimal temporal extension and passive process.

The temporal extension of consciousness such that it is able to unite multiple complex spaces into superposition in time, is achieved by self-referential dynamics. The process is one of conveying the complex state of structural spaces defined by state values along the complex manifold of the categories. The specifics of the collection of categories may be debatable, but the process remains the same under any case. The structural relationship of the immediate frame of reference manifold is maintained within the field from which it emerged. The waveform carrying the information of that structure to a collapse of dimensionality at the focus of attention expands outward from the unity of temporal superposition. In this returning waveform the effect of the constructive interference is structurally embedded and carries the synthesis information back into the immediate frame manifold. The returning waveform carries information across the structure of state values of the complex of categorical dimensions and moves the unfolding into the next iteration that will then determine the information embedded in the next incoming waveform and determine the next focal image constructive interference pattern. The process continues until the contextual frame has moved through all of its symmetry rotations and identity is established between the referential frame manifold and the temporally transcribed synthesis in thought. Two spaces are collapsed and the returning waveform no longer is transmitted through its structure. The experience moves from explicate order out and into an implicate order.

Under this perspective, imagination becomes a dimensional aspect of the field of consciousness, but in a parametric form with memory forming the anticipated vector. What would correspond to the transcendental “I” of Kant, is a structural form of complex spaces defining a deeply embedded form reference of the self? Self is contextually structural and provides a temporal extension defined by the social dimensions. Imagination may be

engaged by an indeterminate number of processes and as such becomes a dimensional value which when applied to the formation of the immediate contextual frame manifests as a possible future state considered now.

The idea that Kant's manifold must be, at least somewhat, a self-forming synthesis is not a new idea. Hurley (1994) and Thomas (1997) both seem to argue that the manifold must independently reduce the world to some degree to bring a form of order to the empirical interface.

Each aspect of the primary form can be mapped onto the structural requirements of Kant's theory. The apperception or intuition is the ground state, the contextual frame of reference that is most immediate to consciousness. It is the manifold domain defined by the values of states along particular categorical dimensions. Reproduction becomes the collapsed form of the manifold into a temporally extended form of superposed states. Recognition may be seen as the effect of the returning waveform upon the embedded structures of the complex of frames of reference.

If the "I" relinquishes its claim to unique transcendence and is repositioned as an aspect of a particularly deeply embedded frame of reference, then the image becomes homologous. What must be added, and is essential from my understanding, is a field which separates the frame of reference and carries the structural information of each upon the inward waveform pulse of time across the structure. Kant's attempts to fulfil the function of the field and waveform dynamics with a transcendental idealism of will fails. Still, he seems to apprehend some sense of the elegance of the form even though he did not have the concepts available to assist him in forming a complete descriptive understanding of both the form and the dynamics. Time must, for Kant, reside within the space of "that which perceives it" instead of within the form itself.

A description of the primary dynamics might bear repeating. The exogenous waveform crosses each frame of reference at each level of hierarchical arrangement. The information is spread out into the complexes of nested spaces until the energy and or information that wave contains is smoothly distributed and exhausted. Upon each passing of the waveform through a referential frame, the information relevant to that frame is distributed and the resulting augmented form structurally imprinted upon the emerging waveform as information about that particular level that will be conveyed to the next frame. Information regarding the state space geometries of the manifold of dimensionality is carried into the constructive form of the object of attention and back out into being distributed as change within each structure of the referential frames. In such a manner information contained in memories becomes spread throughout a variety of structural frames at a variety of nested and hierarchically arranged levels.

Free Will

In a paper entitled "The Strong Free Will Theorem" John Conway and Simon Kochen (2009) challenge quantum theory to accept the logic of the reality it imposes upon our understanding of the world. In short, they demonstrate that if free will is granted to the experimenter in any Einstein-Podolsky-Rosen (EPR)-like experiment then free will must also be allotted to each particle and, through further extension, each and every particle event in the universe. This position appears to me to beg several questions, but is a rather elegant method for confronting physics with the philosophical consequences of their theories. I will examine what appears to be a paradoxical outcome generated by accepting Conway and Kochen's argument for strong free will.

What I take to be a choice for any event, would entail selection of one of several projected outcomes and applying it toward a real state obtained. Without the choice and projection functions, the decision between alternative paths is reduced to nothing more than

random state generators. The quality of free will invoked in a choice is that within which the event can project a selected path into a time line of realised states.

Ignoring the problems of infinite regress that might impose themselves upon any discussion of free will, the problem becomes one of projected intentionality. Each scenario is the set of possible outcomes from within which a choice could select an intended projection of desired future state. The future state necessarily involves the contextual relevance of the event embedded in an ensemble of invariant manifolds elements. There can only be choice if the event is selecting a state for itself vis-à-vis the contextual ensemble of the space assumed to be continuous. The free will choice, in a sense, must assume a lack of free will regarding a collection of other events that make up the imagined outcome scenarios of the choice. If the event, we are considering, is indeed "free" then its selection and projection will necessarily constrain those external events which are background players in the projected selection. To the degree that any event is free to choose, other events are constrained in their possible outcome selections.

If we grant some form of commutation function across the space of all events then the allocation of freedom to any one event creates a cascade of constraints upon all other events.

Conversely, if all events are granted free will, according to the Conway and Kochen theorem, then there would seem to be an infinite constraint exercised upon each event in mutual codetermination. Each event, in selecting a possible outcome that is not empty save for itself, constrains all other events in the ensemble and, as there are near infinite number of events performing a selection, the restrictions must approach infinity as well. The paradox appears in that if the strong freewill theorem is true, it is false. One seems unable to chose the geometry of choice.

Escape from the necessity of a strong free will theorem requiring deterministic mechanics seems to be relevant in any many-worlds interpretation of quantum physics. From

this perspective, the choice in each event, necessitates the generation of an entire universe completely divergent from all other events which coexist at the time of decision. In this manner, all events can freely choose the scenario to project into a future realised state without imposing constraints upon any of the events involved in the ensemble defining the contextual frame of the future event within its realised selected state. Generating an infinite number of universes as each iteration of a choice manifold seems to be a considerable price to pay for the privilege of retaining the concept of "free will".

Consideration of a choice without a past resulting in a multiply solipsistic universe is only the front half of the problem. The historical constraints upon the selection of a projected state from within a set of possible timeline scenarios, is equally problematic. The event, such that it may be said to have choice at all, must have a temporally extended space that might allow the set to coexist, examined, and with one scenario selected and projected. This is a rather complex space requirement for even the simplest choice. An all-together all-at-once model would deprive the event of any real participation in the selection process and could be accounted for in weighted statistical fields imposing a selection upon the event. No, to retain "free will", it must select from possible outcomes as to project into a future space. At some critical point, however, the information available, even for generations of the selected possible state set, falls off into chaos and so, historically at least, free will would have to be constrained in some fundamental manner, as the dynamics of the embedded information unavailable to discernment must still influence and affect the net of generated possible outcomes in the process of selection and projection.

Additionally, the idea that choice requires a space to contain the set of possible outcomes, and that the set of possible outcomes are themselves a subset of the event and as such events of events with their own potential for choice, are, if not excluded from the "strong free will" domain, existent and operate as independent phenomena within a space that

allows for orderly translation of the ensemble manifold along some function of temporal projection. Either the internal process for choice selection is involved in determination of all the relevant aspects of the process for generating the set of possible outcomes from which it will select a state to project, or it is passive in the process. If active, each choice would require an infinite number of choices to transpire before the relevant choice is made, or the process of choosing is devoid of free will and so that aspect to which we ascribe choice is so constrained as to be meaningless, as the passive process continues through the selection into the projection of a future state and no free will might be determined. Any historicity of context and dynamics would seem sufficient to relinquish the event of its attribute of strong free will.

We seem, then to be constrained with respect to possible outcome of understanding. Either the strong free will theorem is correct, and therefore false or we must relieve the experimenter of freedom to select as well as the particle and embrace a chaotic determinism.

By substitution, "if quantum mechanics is true then it is false," requires us to consider a reformation of the problem such that the truths revealed by quantum mechanics, and relativity theory, are reframed as potential truths of a larger understanding. Restricting ourselves to the nonromantic interpretation of these truths, we encounter an understanding that differentiates being from knowing and attributes the paradox and limitations not to reality but to the symbolic geometry of any language system that attempts to formulate a complete and consistent model of reality.

The limitation of knowing encountered in the paradoxes of Gödel (1931/1992), Heisenberg (1958), Einstein (1922, 1994), and Wolpert (2008), reflect a structural limitation of a geometry oriented towards the point-like aspect of the primary structure. In each domain, the boundary of the symbolic as it intersects reality, points to a space which extends beyond the potential for our description of it. Nonetheless, reality appears to resolve into

discreteness in manifold interactions while requiring the extended space that does not resolve into discreteness of description. The contextual frame and that which translates it into discrete iterations are both outside the realm of point-like descriptive geometries. Any system of language that attempts to completely account for those aspects will of necessity encounter its own paradox.

To account for those aspects within a primary structure of any model and allow for any descriptive system that is capable of assuming the perspective of any one of the aspects of the primary structure will eventually encounter a necessary incompleteness in attempting to explain the whole. The descriptive perspectives are complementary and individually incomplete. The primary structure is an irreducible unity of all three aspects.

Philosophy

The proposed approach to modelling phenomena is simple; both in the sense of being unprecedented, and in the sense of embracing all temporally extended phenomena whether conscious or otherwise. The primary structure is already geometrical, but creates richer structure that invites attention to an even richer geometry. Space is generated as enfolded dimensionality consequent to the advent of a symmetry being broken at a categorical level. Time is considered a primary dynamic and as such, the theory implied by the model is background-dependent. Temporal extension becomes an aspect of self-referential systems operating within the primary dynamic.

The phenomenal space results from an accumulation of nested and hierarchically arranged enfolded dimensionalities arising from the symmetry-break along the organism's evolutionary history. Understandably, consciousness requires a reconstitution of perspective into an interior space. Consciousness results not solely from any neurological mechanism, but from the total accumulated enfolded geometry of the organism.

A symmetry is broken either by spontaneous occurrence or in some other manner. The space now defined in the broken symmetry event establishes a new domain of a bounded symmetry space. This space, in turn breaks and establishes a sub-domain within that space.

The connection of mind and consciousness to physical systems has been debated and explained in one form or another since humans have been able to reflect upon their own mortality. Kim (2000) describes the present mind-body problem as follows: "our mind-body problem - has been that of finding a place for mind in a world that is fundamentally physical (p2)." The relationship that has been proposed by one theorist or another appears to basically account for mind as an irrelevant by-product of a causally complete physiological explanation. Alternatively, dualistic theories of mind, appear to, imagine it as mappable onto the physical system or system status or, perhaps, as an ancillary causal-language dual-aspect of a physical substrate. Neural networks (Rolls, 1997) and quantum brain mechanics (Stuart et al., 1978) as well as microtubule quantum computation models (Hameroff and Penrose, 1995, 1996) have all been applied to the effort of explaining the physical domain causal phenomena to consciousness and experience. This gap in causal explanation, that of physical state dynamics into the domain of phenomenal experience, is referred to by David Chalmers (1996b) as the "hard problem." It is the problem of the explanatory gap (Levine, 1983).

Materialists require a thesis of closed causality. Only physical events can effect physical change. The challenge, from this perspective, requires an explanation as to the causal efficiency of mental phenomena, such as thought, when they are not regarded as physically reducible events. Chalmers' challenge flips the question regarding explanatory completeness and asks, how can physically reductionistic models explain the creation of the qualia of experience?

I should like to suggest a further consideration of the idea of "the hard problem". It is a kind of polarity shift of perspective to the problem. The question proposed is best outlined as follows:

1. Physicalists assume closed causal thesis.
2. Quantum physics determines higher-order physical systems.
3. The brain is a physical system the state of which determines mental state experience.
4. Quantum states are determined by conscious observation.

If brain states are determined by quantum mechanics and quantum mechanics are determined by conscious observational choice then it would appear that the physicalists are stuck within a logical loop. Escape from such a loop would appear to necessitate the existence of an independent domain of consciousness or a distribution of consciousness in a kind of Spinozian dual-aspect monism (Spinoza, 1981). In the first instance, the problem of origin, evolutionary interpretation and a host of metaphysical issues are imposed along with a spatiotemporally extended consciousness independent of the physical realm. The second instance requires, as Conway and Kochen (2009) have so wonderfully explained, that ostensible attributes of consciousness, such as free will, if they are to be assumed real, must be ascribed to all levels of physical phenomena.

If it is incumbent upon the emergentists to explain the mind in causally complete language of physical systems or fail, then the physicalists are in no better a position when having to explain the determination of quantum states of a physical system through its interaction with the consciousness of the observer that is itself determined by the physical system of the brain. It seems to me that the hard problem does not only designate a limit boundary and challenge to the explanatory potential of a reductionist model but also contains

an equal challenge to the connection of the physical to consciousness within the closed causality thesis.

From the perspective of the model I am entertaining, the indeterminacy of the quantum theory and the domain of conscious phenomena as causally significant factors are both resolved in temporally extended manifolds. Here the distribution of conscious choice leads us to a world where the idea of choice loses its distinction and thus utility. Here, the chaotic determinism I am suggesting allows for overlapping bundles of temporally extended spaces to have causal effects long after the physical conditions which initiated a state have been transformed. In such a manner, there may be at least a possibility of retaining the concept of choice as a complex of the total effect of the state and the total effect of the state and waveform dynamic of a nested bundle of temporally extended spaces.

Chapter 5

Problems and Curiosities

I am describing a model of consciousness that provides a structure and dynamic to the mental. It attempts to describe (on the one hand) the phenomenon (in us) of awareness and (on the other hand) the very existence of the phenomenon (in nature) of which awareness (in us) obtains. To do this I have turned to understanding the processes involved in generating such a space as I describe which allows for the mechanisms and dynamics and structure of the mind. Invocation of the concepts of symmetry and asymmetry and the spontaneous breaking of symmetry in the generation of spaces that in turn allows for the manifestation of phenomena reflective of the parametric constraints of that space, positions the understanding of primary concepts and dynamics. We begin with the structures and dynamics that might provide a smooth translation into the space of mind and a return through an apex in the minimum geometry of time. It is a process that shifts the waveform polarity from before, through now and into the future. Because we can hold within our contextual frame the experience of the flow of events along a polarity of time, we must at least have a temporal extension that extends into those polarities. To get to the establishment of the general model, I consider it appropriate not to address immediately as weaknesses problems as they arrive in the presentation. Sketchiness is inevitable within a picture that unfolds a present phenomenon of conscious awareness ultimately out of the big bang. Playing a while with this picture without demanding specification of every detail is not to avoid the critical considerations which emerge but really just to restrict the kind of reflexive counter reaction to it which would preclude proper critical examination. I will now outline some of the problems that I think need to be resolved before this model could be developed into a full theory.

Problems

Enfolded Dimensionality

The assertion that it is permissible to speak of the parametric values that are associated with a given symmetry break in the standard model of physics as becoming enfolded into space they define does not quite provide a compelling argument for acceptance of the perspective.

The idea of symmetry breaking as explanatory of the emergence of an order of physical reality presupposes the symmetry which was broken, but was invisible prior to the break. The argument has worked backwards from the observed phenomena into gauge field theories and the unification of the phenomena with a higher-order space. The broken symmetry points to the symmetry it has broken.

The question becomes: is there anyway in which to understand the break of symmetry as an enfolding of the structural dimensionality that necessarily refers back to the original symmetry?

Defining a point in a given space as a complex of intersecting dimensional values shifts the interpretation from the figure aspect to the ground aspect. The dimensions provide the space and define it.

Assumption of the materialists perspective, places our understanding at the interface of matter and biology. From such a position, historical analysis of the ontology of the world sees it enfolded in a space with parametric constants and values. We are within the space defined by those dimensioned values. When turning our perspective towards biological systems and their evolution, we perceive it from the outside, or from a materialistic point of view.

Whereas the evolutionary scenario of the universe of physical reality has the perspective of being embedded within the dimensional space, when viewing biological evolutionary history we are in the perspective of being outside of the parameters of any dimensions which might be generated in symmetry breaks associated with the evolutionary steps in categorical distinctions. Biology, from the materialist perspective is contained within the physical world and we examine it from the objective perspective of materialism. Dimensioned generation within the domain of biological systems is contained. Those dimensions that present themselves are enfolded within the complex of material phenomena. If the process of symmetry breaking as a mechanism for explaining the emergence of a category of phenomenon and dynamics is continued into the understanding of biological phenomenon then those dimensions associated with the particular break in symmetry must be viewed as being embedded in the structure of the physical and defining an enfolded dimensionality which, in turn, becomes the complex space from which we engage in this effort to develop an understanding of mind.

Perhaps, if we were to focus upon the relationship of dimensions to symmetry and broken symmetries in some reduced form we could better articulate a principle that will compel into seeing dimensional enfolded geometries as defining a complex space for consciousness and the dynamics of mind.

Symmetry is invariance under some non-trial transformation or translation. Moving one space smoothly into another by way of a translatory geometry establishes a symmetry and in the form of a dragging operation, establishes a dimensionality. Within a complex symmetry space, there are an indeterminate number of dimensional symmetries. A broken symmetry defines what is no longer available in the initial complex symmetry space and in so doing establishes the parametric aspects of the space created in the broken symmetry. If this is true generally, then the application of this understanding to biological systems results in

our seeing the symmetry breaking as demarcating the evolution of life and creating a space, within the material space, defined by the dimensions associated with that symmetry break. The dimensions are those that must be relinquished when moving back to unity. With each evolutionary step, a dimensional enfolding is produced which, in accumulated history with all intersecting dimensions and orders of phenomena, produces a complex, hierarchically ordered and nested space. Such a space is temporally extended. We could reposition ourselves into the Kantian perspective and look down and out through the space of being into the empirical. Instead of demarcating an impenetrable boundary, it assumes continuous applications of primary structures and dynamics. We are within the context of the space defined dimensionally by those breaks in symmetry that produced them. In either perspective, the dimensions are embedded within the space they define and prescribe a solution to symmetry and unity that requires removal of those dimensions considered.

In gauge field theory, the solution is an application of sufficient energy to re-establish the conditions of the next order space. In successive application of orders of energy to a given space, we hope to re-establish the conditions and order of the initial state. Similarly, we can understand what dimensions must be relinquished in moving backward into the evolutionary scenario.

It seems that, if we are to employ symmetry and symmetry breaking as explanatory tools in understanding, then we have already involved the idea of dimensional enfolding. The only thing remaining is what position we take in our perspective towards understanding. The objective materialist position places us between physical reality and biological systems. The psychological perspective places us in the position of being within a biological space which looks out and down into physical reality. Additionally, I think we could propose one other perspective, that of the geometer who views physical reality from without and invites us to entertain many world solutions for problems encountered within our world.

It still seems rather approximate in final consideration of the idea of embedded dimensionality as holding explanatory potential for generating spaces for mental phenomena. I suspect there is an eloquent mathematical solution of which I am, as yet, ignorant. In any case, the argument seems open to refinement and clarification.

Accompanying the views of embedded dimensionality is the assumption that the dimensions are real and not simply inventions of the mind. Indeed, a historically causal understanding seems to require the a priori existence of those dimensional realities the vis-à-vis the occurrence of mental phenomena. It does assume the standard four-dimensional structure of reality, but goes further and sees the characteristics of the specific phenomena associated with any symmetry break as designating a nexus of embedded dimensionalities codetermining that space. Within the four-dimensional structure is a cascading order of spaces defining domains of phenomena that reflect complex intersects of the embedded dimensionality. Along some dimensions it may be an extended set of values that intersect with a particular single value of another dimension, as is the case of our having temporal extension such that we carry a memory of the past into the future through a now.

The Primacy of Geometry

What has been proposed is an idea that asserts that a minimal geometry translates the occurrence of a single distinction of time into a spatial structure. In short, geometry translates time into space. How can this be? Don't we impose geometry upon the world?

When attempting to understand primary dynamics in minimal forms it seems that the geometry is imposed upon us. The primary form comes all-together; it is co-emergent with the occurrence of a distinction. A distinction, that which acts as the ground of the distinction such that it is bounded and that which relates the one to the other dynamically, defines a minimal structural form. The distinction, the open state and the structure that relates the one

space to the other across the boundary compose the primary geometry. It is a structure that does not allow any aspect to be converted one into another, as the operation would simply result in a rotation of those aspects and an identity with the original structural form. As such, the structural form is as primary as the distinction. In any case a relational form that defines a structural space extending across the distinction and that from which it is distinguished, appears to be minimal.

In the instance of the single smallest occurrence of temporal asymmetry, the structure must be applied to the space defining that distinction and results in the generation of temporal dimensionality and spatial dimensionality. There must be that which is lost in the symmetry break of time and there must be that temporally extended space that relates the distinction to that which defines it. As such, we are left with a structural imposition of an exclusion principle such that a single distinction occupying both state spaces must either exist as a single event of a higher-order or as two polarised structural spaces in a lower order.

Coming into space through time establishes the origin of the four-dimensional space-time. I don't know how to disengage the structure from geometry. As it appears the structure is primary; it then follows that the geometry it describes is primary. Is this sufficient? I am, again, fairly comfortable with the idea that some eloquent mathematical solution is available that describes the corner to some geometry of thought, but, as, yet, I am unaware of such a solution.

The Structure of Mental Dynamics

When examining the mechanics of generating a temporally extended space through self-referential dynamics, the immediately contextual, groupoid space is set at a distance from the minimum state space geometry aligned along the temporal axis. This structural relationship seems to me as available to imply results from constructive interference like dynamics within some defined space, up to and inclusive of the vertical temporal axis defining the temporal polarity along that dimension. I suspect, however, that there is more to the explanation. I suspect that the lower level state space aligned along the temporal axis establishes, at fine grain analysis, an exclusionary zone and that the structural imposition is applied at successive levels of phenomena and results in the structural ontology which we explore.

It might be the case that each space extends into a temporal space that maps onto the symmetry space it broke from. Pursuing this perspective would lead toward speculation that the difference between the complex symmetry space and the space of broken symmetry is expressed in temporal thickness reflecting the energy operation necessary to move the lower order back into symmetric unity. As such, the structure that would be imposed is familiar in form. Electron shells are so ordered to impose discrete quantum steps.

In any case, the structure resulting from having a temporally extended space associated with the structural space would provide extended order between levels of phenomena. The immediate contextual frame of reference in the form of the groupoid space is of a higher-order than the state space geometry of the minimal form explicate space. It cannot get closer as the temporal thickness of the minimal form space excludes the possibility. Only the waveform dynamics can enter and transmit the structural information of the immediate contextual frame to the form of a distinction in thought.

Carrying this idea into some creative space, all particles are carrying both spatially and temporally extended aspects. The spatial aspect reduces to what particle antiparticle pair composes it and the temporal aspect describing the thickness of time associated with it. When two such particles collide at low energy levels, they occupy each others extended open space and thereby produce a higher-order from which has a quantity signature to its temporal thickness. We might speculate here that two quarks colliding would establish one meson with a small but real gravity signature in time and allow for quantum mechanical dynamics across the extended spatial structure. Such a translation of time into gravity and mass seems speculative in the extreme at this juncture but at some point the geometry must make a translation in some fashion into physical reality.

It seems that a structure might reasonably be imposed in both temporal and spatial aspects and that the order found in the one is explained through the existence of the other.

Curiosities

Implications for Simultaneity in Relativity and EPR Experiments

The temporally extended dimensionality of consciousness presents a set of curious problems for analysis of simultaneity in relativity. The light-cone depiction of the inertial frame of the observer under acceleration is presented to be point-like. But this clearly cannot be the case. The consciousness involved in obtaining information at two temporally distant signals and ordering them in sequential occurrence requires temporal extension as a condition of the unity of experience. Otherwise, the two signals would always be separately encountered experiences.

A similar condition is encountered when pairing a consciousness that formulates a directed signal, either intending to having an effect upon the person they are signaling or in the anticipation of communication in some related future state. If consciousness, extended through time, requires a self-referential structural dynamic to exist, then the contextual frame

aspect of that structure must be implicated and invariant under temporal translation through space.

But, the argument can continue out into each contextual ordering as each must be temporally extended as well. To function, they must be invariant under that time translation, at least in some identifiable manner, such that, continuity of being could be extended through time and perceive causal events. Where should the line be drawn in determining what must exist in simultaneity with consciousness? If conscious, then temporally extended, if temporally extended, then an extended simultaneous four-dimensional manifold. This would prove a challenge to entertain when considering problems with the conceptual formulation of the light-cone geometry of the relativistic simultaneity experiments. In each case, the thought experiment imagines the inertial frame of the observer as a point. The structural dynamics of the mind of the observer appear to be ignored. If they had been considered, then the light-cone would have to be reconfigured into a space of two intersecting funnels. The temporal extendedness of the conscious observer dictates the extended now, such that the perception of the two discrete events unites the two into a relational space. The point is replaced by a tube. If this vertical space requires the extension of all of its relevant temporally extended implicate contextual frames, then the extension of a four-dimensional manifold reality defines a thick set of parallel three-dimensional worlds. It is a thick set structurally restrained by the extended structures enfolded within the set. It retains identity by restricting variation in translation through time. It is, in short, coherent.

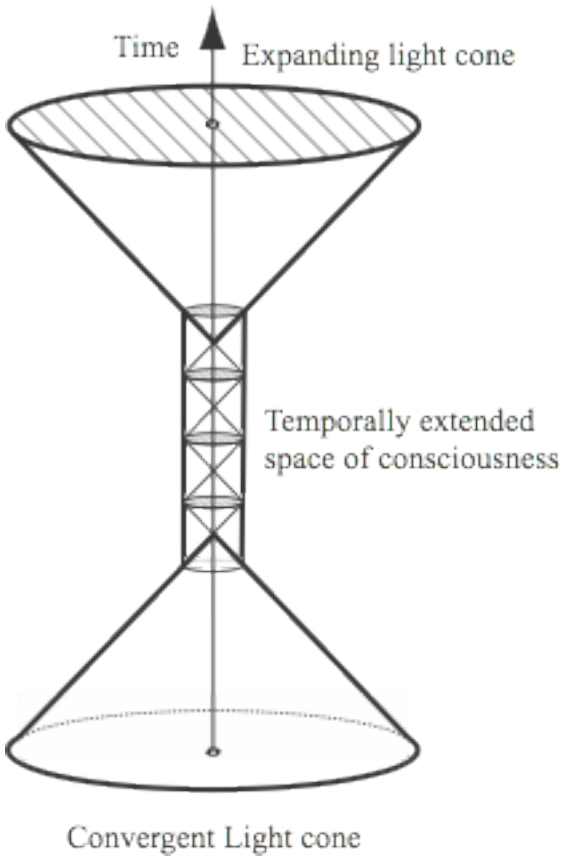


Figure 10. Light-cones augmented by the necessary temporal extension of conscious observer.

We remain somewhat relativistically isolated, in that much of the structure is available only through translation and even then, perhaps a distant abstraction of an implicated order's necessary existence. As such, we are always restricted to the domain of perceptions and thoughts.

We might be able to argue for the existence of the extended structures of a now, but will always remain in a non-immediate experience of the effect of that implicate context. We still send signals out and observe pulses coming back into view. We are at least extended enough to link distant temporal events into a single ordering. Beyond a fair certainty of the immediate structure responsible for such a temporally extended phenomenon, we know only a little.

So what does this mean for an understanding of special relativity? What happens if the light-cone is stretched at the intersect point?

When considering the minimal light-cone pulse of time, I come to the conclusion that the contextual frame must be structurally relevant during the discrete expression of the explicate order. To this end I augmented the primary minimal structure to that of two out of phase light-cones such that the primary structural form is manifest in both temporal and spatial dimensions.

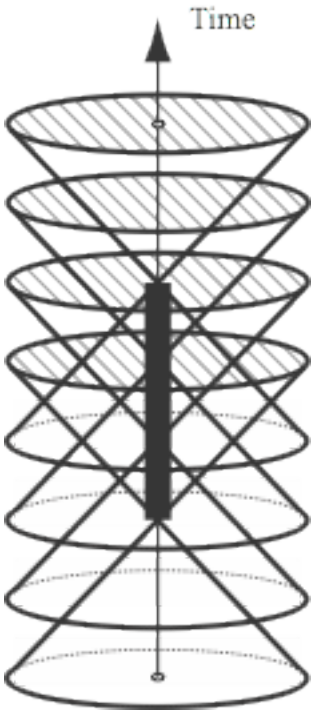


Figure 11. Overlapping light-cones defining a temporally extended space of the conscious observer. The dark area indicates the overlap through time defining the extended temporal space of the observer.

Resolving the relativistic issues along similar lines of thought would result in a world existing outside of our possibility to understandably perceive it (Petkov, 2007). Does this mean that the set of four-dimensional manifolds defining the thickness of the extended space,

sets the simultaneous conditions of the world? If so, does that mean the relativistic thought experiments must be reconsidered in light of the required structural readjustment?

The temporal extension of a now in an inertial frame accelerated is a true minimum unit for that phenomenon. Time moves slower and as such each unit of time is relatively thicker. It is not merely an increase in number of successions of minimal events as viewed from the outside. In view of this observation, it is possible to define a minimum unit of time as being that temporally extended thickness defined by the last instance when the light-cone limit was able to be tangent to any surrounding light-cone limits as it collapses to define the spatially localised event occurrence and the point at which the emerging light-cone defining the limits of expressed effects encounters the event reconnect in tangent with other event light-cones. Such a structure in a non-accelerating inertial frame may define a minimally extended now. Assuming that one might take such a minimum quanta of time and apply it to all levels of phenomena while ignoring the temporal structure of the processes involved in level specific dynamics is to make the mistake of temporal reductionism. Indeed, even the minimum structural configuration offered for consideration changes in relative temporal extension as local frames are accelerated.

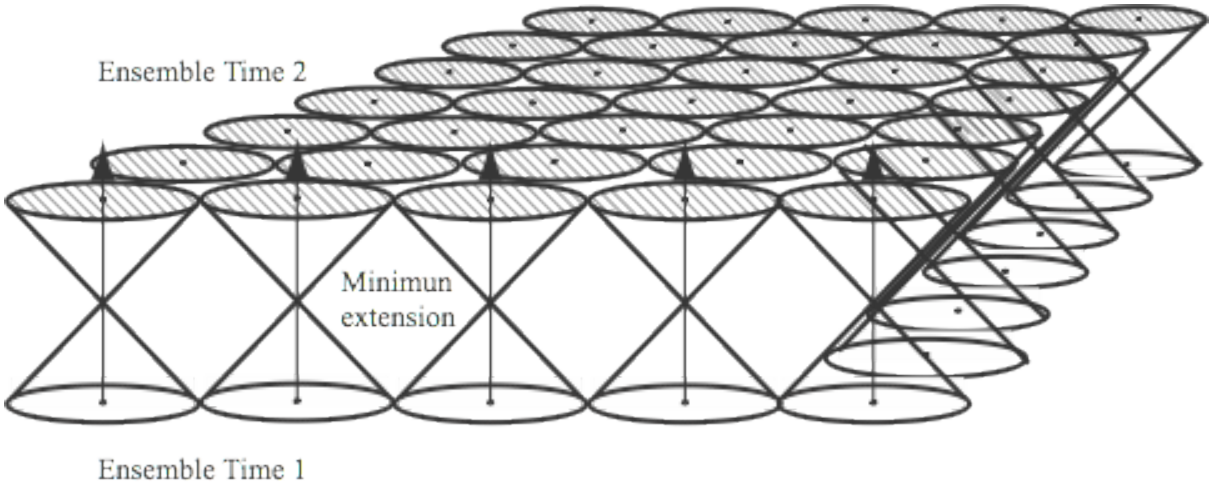


Figure 12. The minimum thickness of a light defined unit of time in relation to the ensemble defining a single manifold iteration. Each cone falls out of range for influence from any other event, condenses into point-like unity and returns to begin to express its effect to the ensemble at the intersect with other cone projections.

A structurally extended temporal space sets events as determinants of their own dynamics. They may splash and twist along the course, but always toward the increase of entropy and along the axis of time as determined locally. The two events are causal if they fill a state space geometry opening to a higher-order. This might suggest that there is an objective linkage between the two events along some relational state space extended through time. The problem remains for the accelerating observers, in that the physics encountered does not let them determine the causal relationship between the two events with certainty, but this is a consequence of order of phenomena that requires the existence of a contextually complex extended implicate order. We are stuck in the limits of the temporally extended space of consciousness. The result would apply to our understanding of the observed phenomena and not to an ontological paradox.

Einstein's simultaneity problem is in many ways structurally identical with the EPR problem of quantum mechanics. Where the quantum EPR experiments have two, spatially

separated, signal readers connected to a coincidence counter, Einstein has two observations in a space ship (M) connected to one temporally extended coincidence counter of the observer. One experiment is correlation of results taken at two distant, spatially separated observations and the other is a correlation of results taken at two distant, temporally separated observations. If the second space craft (N) is added to the formula, then the structure is two spatially separated, temporally extended, spaces encountering the light coming from two temporally separate events, A and B. These two are, however, connected via the geometry of the thought experiment to the observer who is comparing results along different temporal trajectories.

The thinker is connected to the two spaces of the two trajectories of the space ships and the one axis of the events themselves. The thinker is extended in their time frame to include other temporally extended spaces and what those spaces might encounter vis-á-via events A and B. What remains invariant between the translation of AB in M and BA in N is the identity of the AB relationship. It is the identity which inhabits the extended space of the thinker of the thought experiment. It is an identity that cannot exist for M or N as they cannot be aware of the other trajectory except as an abstraction. We rotate around the axis of AB until we find a trajectory resulting in the opposite sequencing of these events. The choice of the angle of incidence is left to the thinkers of the thought experiment. In both the thought experiments of relativistic simultaneity and quantum EPR experiments the resulting divergence of causally relevant trajectories is that of a complex state space geometry which is implicate in the experimental design and is separated along axial interfaces upon the explicate order obtained in the experiment. The structure that diverges from observation is that complex structural state space which continuously remains within the implicate domain but necessarily relevant for interpretation of the observation of the explicate.

Concept of Time

Assumptions regarding the nature of time are a significant source of many problems encountered in philosophy. The idea that time consists of infinitely sliced moments of instantiated manifold fails to incorporate the structural space necessitated by such a consideration and one that was sensed by Kant as a necessary a priori to any consideration of temporal succession. He proposed the idea that there are "...three dynamical relations, from which all others spring, are therefore inherence, consequence and composition" (CPR, p236). From my perspective these "dynamical relations" are equivalent to the primary structure of contextual frame of reference, object, and that which relates the two. In any case the relationship proposed is necessarily structurally extended in time and space. The historical state (i.e., inherence) generates or condenses the spatiotemporally defined event (i.e., consequence). In order that any conception of temporal directionality and succession might be entertained the space that connected the two events in a relational ordering (i.e., composition) must extend across the temporal space defined. The entire structure is a temporally extended dynamic which requires a self-referential mapping of spaces. Such a temporally extended minimal structural dynamic is not limited to phenomenological fields of sentient beings.

Several aspects of physics reveal to those pursuing an ontological understanding that the unit of time is somewhat variable in thickness. Virtual particles come into and out of existence in a sufficiently brief interval that they escape physical restraints that would be engaged beyond a temporal threshold. General relativity and special relativity report that time slows down as a function of acceleration and that in the horizon of a black hole time becomes (almost) frozen in an extended now.

Psychophysiologically, the interval between neuronal flashes of visual images is ignored and the perception treated as a temporally extended now of visual image over

successive manifestations. Auditory perceptions are composed of wave packets, of specifiable wave lengths and amplitude. The note is the entire waveform packet and as such is extended in time and space but treated phenomenologically as a singular event.

In almost any formulation of our understanding of physical reality, the temporally extended unit of process dynamics is either explicitly or implicitly defined. It is a minimum unit of time for a process to proceed by one tick of its relative clock. Because we can abstract or point to processes of briefer duration in another domain we assume the minimum is somewhat attributable to the greater temporally extended phenomena. It can be understood as an application of temporal reductionism and one that fails in its accounting for higher-order category phenomena and their dynamics.

We know, for instance, that linguistic processes must be nested in a complex of temporally extended domains of phenomena and processes and that the production of a sentence through successive orderly generations of words is necessarily a temporally extended process. Nonetheless, when applying analytical operations to understanding the meaning and significance of the sentence time frequently becomes abstracted to an imagined slice of now. Consideration of relational dynamics and temporal coherence becomes a complex of operators and rules at a loss to explain the smooth and orderly transition through time. Assumption of a statistical perspective at an infinitely thin slice of a now allows for infinite potentials for time-line of unfolding and the possibility of an infinitely bifurcated generation of multiple universes. If, on the other hand, time has thickness, and different orders of reality have different orders of process dynamics which in turn have different minimal thicknesses of time, a structural integrity emerges that provides potential understanding of coherence and order. The overlapping temporally extended structure establishes a collection of bundles and sheaves that are aligned along the primary axis of

temporal asymmetry and constrains the possible future projections to a limited set of trajectories.

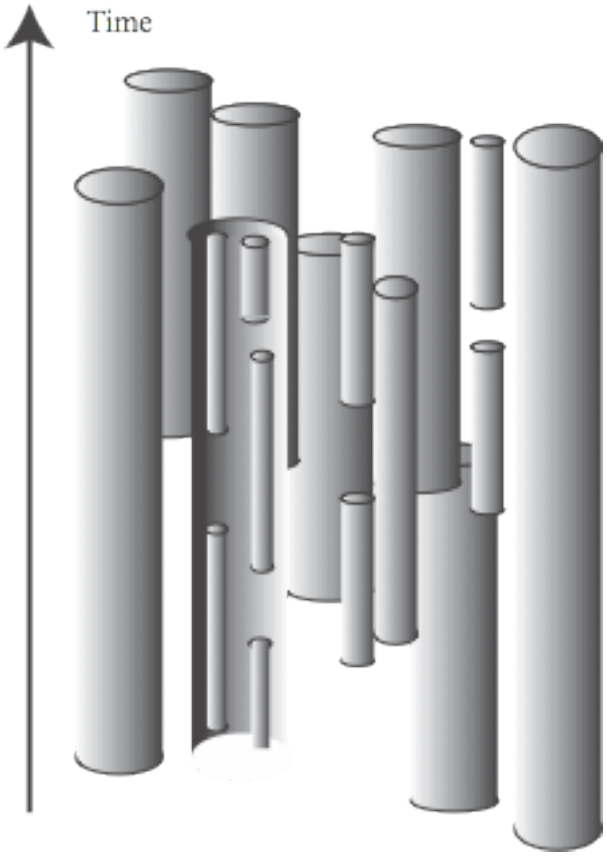


Figure 13. Temporal extension as overlapping bundles and sheaves providing structural coherence. One sheaf has been cut cross-sectionally to reveal nested bundles.

In the philosophy of time, the options change from, the block universe defining all possibilities while the slice of a now moves through it, or the now unfolding into the future without constraints upon its future expression, into one of a model wherein a structurally extended manifold of time is ordered and constrained by the temporally extended bundles of events. These overlapping bundled events can terminate and be replaced by other temporally extending events in such a way as to provide a scaffolding from which to extend itself coherently into the future. The future unfolds at the edge of time in relative order and with constrained probabilities wherein the past extends and eventually is replaced in staggered succession by a whole new set of temporally extended structures. The mechanism for the

transformation could be accounted for in a state space geometry combined with an exclusionary principle.

Understanding such processes as thought and the generation of language structures becomes available upon relinquishing temporal reductionism and replacing it with a model incorporating temporally extended variability.

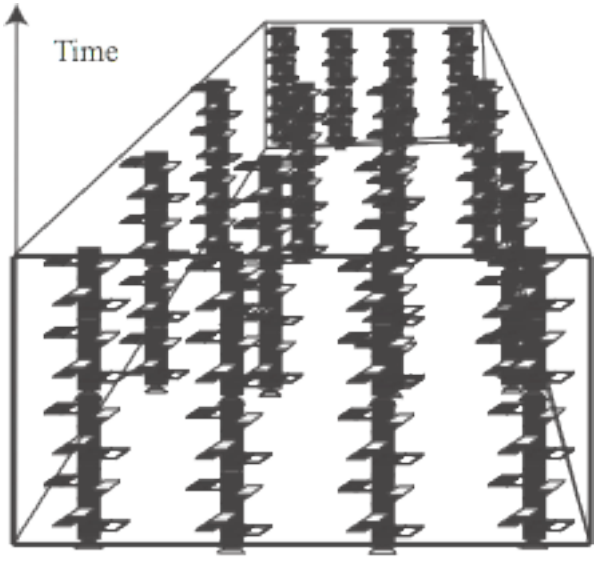
Temporal extension is perhaps the defining characteristic of consciousness. When we think or act or speak, we do so in a domain that holds an intention which presented itself in the past to some series of behaviours and activities that unfold in time while being referenced to the original intent. More fundamental, the self which is conscious, defines itself as a temporally extended phenomenon. It extends in identification of memories and projects forward into an imagined state of experience. We, become who we identify ourselves to be when the symmetry is broken resulting in the enfolding dimensionality of the self at two to five years of age. It is that self that extends through the course of life and is internally and externally maintained until death or some significant disruption of a contextual frame. We are that which extends in time and as such relate the succession of experience into structural ordering of our lives. We are that which extends in time not because of some a priori, transcendent attribute, but because we are the local manifestation of a primary natural process that exhibits structural coherence.

There appears to be argument for overlapping temporally extended manifolds which define a complex structure of time and space operating within any phenomenological extended domain. Incorporating such an understanding into formation of a model of mind, allows not only a better structural integrity and increased explanatory power, but a mechanism of translatory interaction with the physical processes of the biological.

The Parable of the Cyclops

To illustrate the idea of temporally extended perspective regarding quantum physics I invite you to entertain the following scenario (with all due apologies to Edwin A. Abbott, 1884/1995).

Consider a three-dimensional space with parallel temporal axes equally distributed across it. Each of the temporal axes is imagined as a stem to which are attached state space petals that are arranged at various rotational angles and perpendicular to the temporal axes. The stem axis passes through the centre of the structure of each state space as a line intersects a plane. Imagine the state spaces arranged in a spiral along the axis with the state of each state space angularly rotated around their temporal axis.



Temporal axes with state space petals

Figure 14. Temporal axes aligned in block three-dimensional space with state space petals arranged in orderly fashion along them.

Now imagine further that the three-dimensional space intersects perpendicularly with a two-dimensional plane in which an intellectually curious two-dimensional Cyclops resides.

The Cyclops has no depth perception and only sees at the plane of interface with the three-dimensional space.

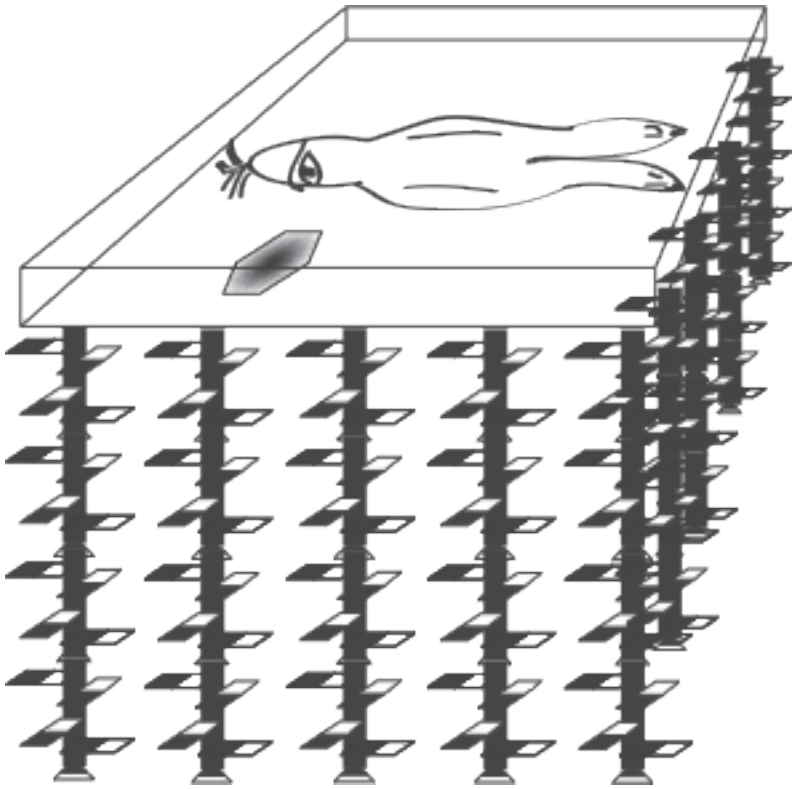


Figure 15. Two-dimensional Cyclops looking down into a three-dimensional manifold of state space geometry.

The Cyclops, looks down the axis of the temporally aligned “stems” and sees an area where the axis is surrounded by a dark area of the stacked state spaces projecting upon the plane as a relatively smooth field and defining a spread of states around the axis.

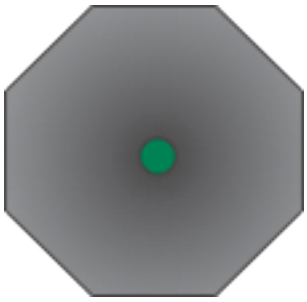


Figure 16. What the Cyclops saw when looking down along temporal axis with state space petals arranged around it and distributed in regular order through time. It is a collapse of a three-dimensional view into a two-dimensional view.

As the Cyclops is very clever, it desires to investigate the cloudy image. He constructs an ingenious machine that is able to slice the surface of the cloudy image as thinly as any two-dimensional space may be sliced. The result is profound for the Cyclops as it discovers a single state space obtained in the mechanism. The Cyclops, upon reflecting on the results of its experiment, declares that the world extending to the plane is composed of clouds of possibilities which, when observed in a certain way, collapse into a single state.

On one particularly bizarre evening, the Cyclops is lifted from the plane and given a second eye and then replaced into its two-dimensional space. The enhanced Cyclops, (now a bi-Cyclops), after recovering from the shock of his out-of-plane experience, looks down the axis as before, but on this occasion sees a depth of time wherein each of the state space petals are observed to have a regular pattern distributed along the extension of the stem. These structures have always existed as temporally extended state space geometries and were lost into a statistical cloud only because of the lack of perception of the dimension in that they are regularities.

Ahh, says the Cyclops either time has depth and structure or having two eyes so distorts the world as to give it an appearance of depth and regularity where none exists. Ahh, says the Cyclops again, philosophy.

Chapter 6

Summary, Conclusions and Implications

I have in this thesis attempted to develop a model of mind which conforms with physical constraints while generating a dimensional space for mental dynamics and phenomena that are not reducible to simple reductionist understandings. In so doing, the model applies a minimum structural form to successive orders of physical complexities and continues into the evolutionary development of organisms. The mechanism for production of the orders of complexity is proposed to be symmetry breaking and is understood as complementary to self-referential dynamics or a self-referential dynamic of a higher-order. Symmetry breaking is a concept with sufficient explanatory potential to find application as central to theories of physics, mathematics, and biology. Symmetry breaking provides a mechanism for the generation of enfolded dimensionalities.

The temporal extension is presented in terms of a primary dynamic of self-reference that operates across all domains, and within the space of the human organism, manifests as consciousness. It is self-referential in terms of an image, or unified concept, which refers back to the frame of reference. The frame of reference is composed of a structural complex of dimensional values. This collapsing of information of the contextual frame of reference to a synthesised unity is a constructive interference and results in the generation of a returning waveform which distributes the information and alters the configuration of the contextual frame of reference. This process defines a self-referential dynamic that rotates the symmetry groups of the contextual frame until it has established a structural identity with the extended explicate order of the synthesised unity. This extension through time of the initial contextual frame through to a symmetric identity, defines the duration of the image.

Time and space, rather than being located within a transcendental space of self, are considered as primary dimensions of all natural phenomena. Space is generated by symmetry breaking while time, or rather duration through time, is produced through self-referential dynamics. The Kantian manifold, in this understanding, becomes translated into a complex manifold of enfolded dimensional values defining the structure of the contextual frame of reference. Kant's intuition is replaced by a general waveform dynamic and the synthesised unity is understood as the result of a more fundamental dynamic of constructive interference at the central focus of the space prescribed by a contextual frame of reference. The Kantian model has remained intact with respect to structural form while the dynamics have been translocated from the transcendental to the natural. Rather than viewed as orthogonal or external to physical reality, consciousness becomes embedded in and congruent with natural processes.

The model demonstrates some degree of applicability and explanatory potential and suggests areas towards which attention might be directed for further refinement and development. Significantly, this perspective invites an expanded sense of understanding the mind and its place in nature. If mind and consciousness is to be located in the space defined by the nexus of interfacing multi-disciplinary theories, then the development of such a model will have reverberating significance for those theories.

The integration of consciousness with the physical has frequently resulted in the suggestion that consciousness will provide some form of additional force or dynamics not understandable in terms of the physical. This does not seem to be the case. There is neither evidence nor reasonable need to postulate such mysterious attributes to consciousness. Consciousness is a product of natural processes. Understanding the world in terms of what is necessary and sufficient to produce such a temporally extended space of duration does, however, change everything. In understanding mind and consciousness we find it to be

embedded in the structure of naturalistic explanations. The unity of consciousness with the world results in an "emergent" phenomenological space; one defined by the complex intersect of dimensional enfoldings through symmetry breaking. We gain unity at the expense of transcendental forces. Such a result, like so many in this approach, is a combination that is "both and neither". It is "emergent" in the sense that it describes a mechanism for production of enfolded dimensional spaces, requiring in exchange a kind of structural determinism. As an answer to Conway and Kochen's strong free will inquiry, it clearly falls to the position that the observer is no more free than the particles. This does not diminish the utility of the assumption of free will in accommodating the indeterminacy associated with the complexity of an order of information or its usage within a social-psychological frame of reference, rather it simply limits the application of the concept to a restricted domain.

The model of mind from the perspective of temporal structuralism generates potential to a variety of discipline theoretic frames. In physics, it implies a reformulation of understanding of both EPR experiments and special theory of relativity as applied to the thought experiments regarding simultaneity. In psychology the incorporation of a temporal structuralism seems to require reinterpretation of theories of psychopathology and mental dynamics into terms of structural dynamics and variation in parametric values prescribing the transmission rates across the space between nested contextual frames. Depression, for example, becomes a phenomenon understood in terms of temporal distortions. Biology, from the perspective of symmetry breaking, reframes an understanding of genetics into a description of translatory mechanisms between orders of spaces. Animal consciousness becomes redefined as a phenomenological space of an organism having at least as much to do with the complex of symmetry breaking defined by its phylogenetic development as it does with neurophysiological refinements. Philosophy would seem to require at least a

reassessment of the ideas of time in light of temporal extension. Neurophysiological aspects of temporal delay in the relationship of conscious experience to physiological changes or the forty-hertz cycle associated with the occurrence of conscious experience (Koch, 2004, 2005; Koch and Tsuchiya, 2006) would seem to involve an examination of the structural dynamics in terms of the phenomenological space. All the disciplines defining the interface nexus constraining and prescribing the contextual frame for the development of an adequate theory of mind would need to account for, accommodate, and/or incorporate the effect of such a model, either in the form of the model proposed or in some more elegant variant.

This particular model may be found flawed in some essential way, but it nonetheless suggests the potential for the development of a model that seeks to integrate mind with body without invoking a reductionism that either invalidates the mental or relegates it to explanatory insignificance. Within this model, consciousness is a natural phenomenon and this entails the accommodation of its causal significance. Any model which eventually succeeds at such an enterprise will have implications for all interfacing disciplines of understanding.

Thank you for your time and patience in reading through and entertaining the play of ideas I have made effort to describe and explain. The promise of such a perspective is that consciousness and mental phenomena become inextricably grounded in the process of being and becoming. We “emerge” from the implicate order of reality into an explicate order determined through nested structures of self-referential systems and symmetry breaks. We move from the implicate to the explicate and return, eventually, to the implicate. We become expressed through the contextual ground of that which is yet to be. It seems to me that this integrative understanding is, in many ways, preferable to the Kantian perspective that positions us within the space of a transcendental eternal separateness.

Works Cited

Abbott, E. A. 1995. *Flatland: A romance of many dimensions.* Norwalk, CT: Easton Press. (Original work published 1884)

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. 2002. *Molecular biology of the cell* (4th ed.). New York: Taylor & Francis Group.

Alexander S. 1920. *Space, time, and diety*: *Vol. 2*. London, England: Macmillan Press.

Armstrong, D. M. 1968. *A materialist theory of mind*. New York: Routledge & Keegan.

Aspect, A., & Grainger, P. 1990. Wave-particle duality: A case study. In A. I. Miller (Ed.), *Sixty-two years of uncertainity: Historical, philosophical, and physical inquiries into the foundation of quantum mechanics* (pp. 45-60). NATO ASI Series, Series B: Physics (226), New York: Plenum Press and NATO Scientific Affairs Division.

Aspect, A., Grouyer, P., Roger, G. 1982a. Experimental realization of Einstein-Podolsky-Rosen-Bohm *gedankenexperiment:* A new violation of Bell's inequalities. *Physical Review Letters,* 49(2), 91-94.

Aspect, A., Dalibard, J., & Roger, G. 1982b. Experimental test of Bell's inequalities using time-varying analyzers. *Physical Review Letters*, 49, 1804-1807.

Bell, J. S. 1964. On Einstein, Podolsky, and Rosen paradox. *Physics,* 1(3), 195-200.

Bohm, D. 1980. *Wholeness and the implicate order.* New York: Routledge, Kegan, and Paul.

Bonner, J. T. 2000. *First signals: The evolution of multicellular development*. Princeton, NJ: Princeton University Press.

Brading, K. & Brown, H. R. 2003. Symmetries and Noether's theorems. In K. Brading & E. Castellani (Eds.), *Symmetries in physics: Philosophical reflections* (pp. 89-109). Cambridge, UK: Cambridge University Press.

Brading, K. & Castellani, E. (Eds.). 2003. *Symmetries in physics: Philosophical reflections.* Cambridge, UK: Cambridge University Press.

Brown, H. R. & Harré, R. (Eds.). 2003. *Philosophical foundations of quantum field theory*. Oxford, UK: Oxford University Press.

Cao, T. Y. 2003. Gauge theory and the geometrization of fundamental physics. In H. R. Brown & R. Harre (Eds.), *Philosophical foundations of quantum field theory* (117-133). Oxford, UK: Oxford University Press.

Cayley, A. 1878. Desiderata and suggestions: No. 2. the theory of groups: Graphical representation. *American Journal of Mathematics,* 1(2), 174-176.

Chalmers, A. F. 1970. Curie's principle. *British Journal for the Philosophy of Science,* 21, 133-148.

Chalmers, D. 1996a. *The conscious mind.* New York: Oxford University Press.

Chalmers, D. 1996b. *Toward a Theory of Consciousness.* Berlin: Springer-Verlag.

Chomsky, N. 1957. *Syntactic structures*. The Hague, The Netherlands: Mouton Publishers.

Churchland, P. S. 2002. *Brain-wise: Studies in neurophilosophy*. Cambridge, UK: MIT Press.

Close, F. 2000. *Lucifer's legacy: The meaning of asymmetry.* Oxford, UK: Oxford Press.

Conway, J. H. , & Kochen, S. 2009. The strong free will theorem. *Notices of the American Mathematical Society,* 56(2), 226-232.

Curie, P. 1894. Sur la symétrie dans les phénomènes physiques, symétrie d'un champ électrique et d'un champ magnétique [On symmetry in physical phenomena, symmetry of an electric field and of a magnetic field]. *Journal de Physique,* 3, 393.

d'Espagnat, B. 1979. The quantum theory and reality. *Scientific American,* 241 (5), 158-181.

d'Espagnat, B. 1981. The concepts of influences and of attributes as seen in connection with Bell's theorem. *Foundations of Physics,* 2(3-4), 205-234.

d'Espagnat, B. 1987. Meaning and being in contemporary physics. In B. J. Hiley and F. D. Peat (Eds.), *Quantum implications: Essays in honour of David Bohm* (pp 151-168). New York: Routledge and Kegan Paul.

d'Espagnat, B. 1989. *Reality and the physicist: Knowledge, duration and the quantum world.* Cambridge, UK: Cambridge University Press.

Debs, T. A. & Redhead, M. L. G. 2007. *Objectivity, invariance, and convention: Symmetry in physical science*. Cambridge, MA: Harvard University Press.

Dennett, D. 1991. *Consciousness explained*. New York: Little, Brown and Company Inc.

Du Sautoy, M. 2008. *Symmetry: A journey into the patterns of nature.* New York, NY: Harper Collins Publishers,

Earman, J. 1989. World enough and space-time: Absolute versus relational theories of space and time. Cambridge, MA: MIT Press.

Earman, J. 2004. Laws, symmetries, and symmetry breaking: Invariance, conservation principles, and objectivity. *Philosophy of Science,* 71, 1227-1241.

Eccles, J. C. 1977. *The understanding of the brain.* New York: McGraw Hill.

Eccles, J. C. (Ed.). 1966. *The brain and consciousness experience.* New York: Springer Verlag.

Edelman, G. M. 1992. *Bright air, brilliant fire: On the matter of mind.* New York: Basic Books.

Edelman, G. M. 2004. *Wider than the sky: The phenomenal gift of consciousness.* New Haven, CT: Yale University Press.

Einstein, A., Podolsky, B., & Rosen, N. 1935. Can quantum-mechanical description of physical reality really be considered to be complete? *Physical Review*, 47, 777-780.

Einstein, Albert. 1994. *The meaning of relativity: Including the relativistic theory of the non-symmetric field.* Norwalk, CT: The Easton Press. (Original work published 1922)

Elinson, R.P. 1975. Site of sperm entry and a cortical contraction associated with egg activation in the frog *Rana pipiens*. *Developmental Biology*, 47: 257-268.

Everett, H., III. 1973. The theory of universal wave function. In B. DeWitt and N. Graham (Eds.), *The many-worlds interpretation of quantum mechanics.* Princeton, NJ: Princeton University Press.

Fine, A. 1986. *The shaky game: Einstein realism and the quantum theory.* Chicago, IL: University of Chicago Press.

Garcia-Bellido, A. 1996. Symmetries throughout organic evolution. *Proc. Natl. Acad. Sci.,* 92, 14229-14232.

Gell-Mann, M. 1962. Symmetries of baryons and mesons. *Physical Review,* 125(3), 1067-1084.

Gerhart, J. 2004. Symmetry breaking in the egg of *Xenopus laevis*. In C. D. Stern (Ed.), *Gastrulation: From cells to embryo* (pp. 341-351). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

Gilbert, S. F. 2003. The early development of vertebrates: Fish, birds, and mammals. In S. F. Gilbert (Ed.), *Developmental biology* (7th ed.), (pp. 345-388). Sunderland, MA: Sinauer Associates, Inc.

Glynn, I. 1999. *An anatomy of thought: The origin and machinery of the mind.* Oxford, UK: Oxford University Press.

Gödel, K. 1992. *On formally undecidable propositions of principia mathematica and related systems* (B. Meltzer, Trans.). Mineola, NY: Dover Publications, Inc. (Original work published 1931)

Golubitsky, M. & Stewart, I. 2002. *The symmetry perspective: From equilibrium to chaos in phase space and physical space.* Boston, MA: Birkhäuser.

Goswami, A. 1990. Consciousness in quantum physics and the mind-body problem. *Journal of Mind and Behavior*, 11(1), 75-96.

Greene, B. 1999. *The elegant universe: Superstrings, hidden dimensions, and the quest for the ultimate theory*. New York: W. W. Norton Press.

Gulyas, B. J. 1975. A reexamination of the cleavage patterns in eutherian mammalian eggs: Rotation of blastomere pairs during second cleavage in the rabbit. *Journal of Experimental Zoology,* 193, 235-248.

Hameroff, S. R. & Penrose, R. 1995. Orchestrated reduction of quantum coherence in brain microtubules: A model for consciousness. *Neural Network World,* 5(5), 793-804.

Hardin, G. 1966. Biology: Its principles and implications (2nd ed.). San Francisco, CA: W. H. Freeman and Company.

Hawkins, T. 2000. *Emergence of the theory of Lie groups.* New York: Springer.

Heisenberg, W. 1958. *Physics and philosophy: The revolution in modern science.* New York: Harper and Brothers Publishers.

Herman, R. 2008. *The first three minutes of the universe.* University of North Carolina at Wilmington. Sourced on 28 December 2009; http://russherman.com/Talks/FirstThreeMinutes_CollegeDay.pdf

Hurley, S. L. 1994. Unity and objectivity. In C. Peacocke (Ed.), *Objectivity, simulation, and the unity of consciousness (pp. page numbers)*. Oxford, UK: Oxford University Press.

Icke, V. 1995. *The force of symmetry* (p.103). New York: Cambridge University Press.

Ismael, J. 1997. Curie's principle. *Syntheses,* 110(2), 167-190.

Jaynes, J. 1976. *The origin of consciousness in the breakdown of the bicameral mind.* Wilmington, MA: Houghton Mifflin Harcourt.

John, E. R. 1967. *Mechanisms of memory.* New York: Academic Press.

Kant, I. 1965. *Critique of Pure Reason* (N. K. Smith, Trans.). New York: St. Martin's Press. (Original work published 1781)

Katzir, S. 2004. The emergence of the principle of symmetry in physics. *Historical Studies in the Physical and Biological Sciences,* 35(1), 35-65.

Kauffman, G.B. & Myers, R. D. 1998. Pasteur's resolution of racemic acid: A sesquicentennial retrospect and a new translation. *The Chemical Educator*, 3(6), 1-18.

Kim, J. 2000. *Mind in a physical world: An essay on the mind-body problem and mental causation*. Cambridge, MA: MIT Press.

Klein, F. 1893. A comparative review of recent researches in geometry (M. Haskell Trans.). *Bulletin of the New York Mathematical Society*, 2(10), 215-249.

Klein, F. 2004. *Elementary mathematics from an advanced standpoint: Geometry* (E. R. Hedrick & C. A. Noble, Trans). Mineola, NY: Dover Publications, Inc. (Original work published 1924)

Koch, C. 2004. *The quest for consciousness: A neurobiological approach.* Greenwood Village, CO: Roberts and Company.

Koch, C. 2005. The movie in your head. *Scientific American Mind,* 16, pp 58-63.

Koch, C. & Tsuchiya, N. 2006. Attention and consciousness: Two distinct brain processes. *Trends in Cognitive Sciences*, 11, 16-22.

Lange, M. 2007. Laws and meta-laws of nature: Conservation laws and symmetries. *Studies in History and Philosophy of Modern Physics,* 38, 457-481.

Layzer, D. 1975. The arrow of time. *Scientific American,* 233(6), 56-69.

Lederman, L. M. & Hill, C. T. 2004. *Symmetry: And the beautiful universe.* Amherst, NY: Prometheus Books.

Levine, J. 1983. Materialism and qualia: The explanatory gap. *Pacific Philosophical Quarterly*, 64, 354-361.

Lewin, K. 1976. In J. De Riveria (Ed.) *Field theory as human science: Contributions of Lewin's Berlin group.* New York: Gardner Press.

Libet B. 1993. *Neurophysiology of consciousness.* Boston, MA: Birkhäuser.

Libet, B. 2004. *Mind time.* Cambridge, MA: Harvard University Press.

Libet, B., Freeman, A., & Sutherland, K. (Eds.). 1999. *The volitional brain: Towards a neuroscience of free will.* Thorverton, UK: Imprint Academic.

Liu, C. 2003. Spontaneous symmetry breaking and chance in a classical world. *Philosophy of Science*, 70, 590-608.

Livio, M. 2005. *The equation that couldn't be solved: How mathematical genius discovered the language of symmetry*. New York: Simon and Schuster, Inc.

MacNeilage, P. F., Rogers, L. J., & Vallortigara, G. 2009. Evolutionary origins of your right and left brain. *Scientific American*, 301, 60-67.

Morrison, M. 2007. Where have all the theories gone? *Philosophy of Science,* 74 (2), 195-228.

Newman, J. R. (Ed.). 2000. *The World of Mathematics, Vol. 4.* Mineola, NY: Dover Publications, Inc.

Noether, E. 1971. Invariant variation problems (M.A. Tavel, Trans.). In *Transport Theory and Statistical Mathematics, 1*(3), 183-207. (Original work published 1918)

Palmer, A. R. 2004. Symmetry breaking and evolution of development. *Science,* 306, 828-833.

Pasteur, L. 1861. *Lec ons de chimie professés en 1860 par MM. Pasteur, Cahours, Wurtz, Berthelot, Sainte-Claire Deville, Barral, and Dumas* (pp. 1–48). Paris, FR: Hachette.

Penrose, R. 1994. *Shadows of the mind: A search for the missing science of consciousness.* New York: Oxford University Press Inc.

Petkov, V. 2007. Relativity, dimensionality, and existence. In V. Petkov (Ed.), *Relativity and the dimensionality of the world* (pp. 115-135). Dordrecht, The Netherlands: Springer.

Piaget, J. 1954. *The construction of reality in the child*. New York: Basic Books.

Piaget, J. 1973. *The child and reality*. New York: Grossman Publishers.

Piko, L. & Clegg, K. B. 1982. Quantitative changes in total RNA, total poly(A), and ribosomes in early mouse embryos. *Developmental Biology*, 89, 362-378.

Popper, K.R., & Eccles, J.C. 1978. *The self and its brain* (Rev. ed.). New York: Springer International.

Prather, R. S. 1989. Nuclear transfer in mammals and amphibia. In H. Schatten and G. Schatten (Eds.), *The molecular biology of fertilization* (pp. 323-340). New York: Academic Press.

Presic, P. 2003. *Abel's proof: an essay on the sources and meaning of mathematical unsolvability.* Cambridge, MA: MIT Press.

Pribram, K. H. 1971. *Language of the brain: Experimental paradoxes and principles in neuropsychology.* Englewood Cliffs, New Jersey: Prentice Hall.

Prigogine, I. 1980. *From being to becoming: Time and complexity in the physical sciences*. San Francisco, CA: W. H. Freeman and Company.

Prigogine, I. 1997. *The end of certainty: Time, chaos, and the new laws of nature.* (Éditions Odile Jacob, Trans.). New York: The Free Press. (Original work published 1996).

Quine, W. V. O. 1951/1961. Two dogmas of empiricism. Originally published in *The Philosophical Review, 60,* 1951, 20-43). Reprinted in W. V. O. Quine, *From a Logical Point of View* (1953, 2nd Rev. ed. 1961). Cambridge, MA: Harvard University Press.

Rinn, J. L., Bondre, C., Gladstone, H. B., Brown, P. O., & Chang, H. Y. 2006. Anatomic demarcation by positional variation in fibroblast gene expression programs. *PLoS Genetics, 2*(7), 1084-1096.

Rolls, E. 1997. Consciousness in neural networks? *Neural Networks*, 10(7), 1227-1240.

Ruetsche, L. 2006. Johnny's so long at the ferromagnet. *Philosophy of Science,* 73, 473-486.

Salam, A. 1991. The role of chirality in the origin of life. *Journal of Molecular Evolution*, 33, 105-113.

Smith, J. M. & Szathmáry, E. 1999. *The origins of life: From birth of life to the origin of language.* Oxford, UK: Oxford University Press.

Sperry, R. W. 1968. Hemisphere deconnection and unity in conscious awareness. *American Psychologist*, 23, 723-733.

Sperry, R. W. 1991. In defense of mentalism and emergent interactionism. *The Journal of Mind and Behavior,* 12, 221-245.

Sperry, R. W. 1993. The impact and promise of the cognitive revolution. *American Psychologist*, 48(8), 878-885.

Spinoza, Baruch. 1981. *The ethics.* Malibu, CA: Joseph Simon Publisher.

Sterelny, K. 2003. *Thought in a hostile world: The evolution of human cognition*. Malden, MA: Blackwell Publishing.

Sterelny, K. & Griffiths, Paul E. 1999. *Sex and death: An introduction to philosophy of biology.* Chicago, IL: University of Chicago Press.

Stuart, C. I. J. M., Takahashi, Y., & Umezawa, H. 1978. On the stability of nonlocal properties of memory. *Journal of Theoretical Biology*, 71, 605-618.

Stuart, C. I. J. M., Takahashi, Y., & Umezawa, H. 1979. Mixed-system brain dynamics: Neural memory as a macroscopic ordered state. *Foundation of Physics*, 9(3-4), 301-327.

Thomas, A. 1997. Kant, McDowell and the theory of consciousness. *European Journal of Philosophy,* 5(3), 283-305.

Turing, A. 1952. The chemical basis of morphogenesis. In B. J. Copeland (Ed.), *The essential Turing* (pp. 519-561). Oxford, England: Oxford University Press.

van Fraassen, B. C. 1989. *Laws and symmetry.* Oxford, UK: Oxford University Press.

Volkmann, R. A. & Heck, S. D. 1998. Biosynthesis of D-amino acid-containing peptides: Exploring the role of peptide isomerases. In P. Jollès (Ed.), *D-amino acids in sequences of secreted peptides of multicellular organisms* (pp. 87-105). Basel, Switzerland: Birkhauser Verlag.

Weinberg, S. 1977. *The first three minutes: A modern view of the origin of the universe.* New York: Basic Books, Inc.

Weinberg, S. 2008. *Cosmology*. Oxford, UK: Oxford University Press.

Weyl, H. 1952a. *Space, time, matter.* H.L. Brose (Trans.), (4th ed.). Mineola, New York: Dover Publishing. (Original work published 1921)

Weyl, H. 1952b. *Symmetry.* Princeton, NJ: Princeton University Press.

Wigner, E. P. 1961. Remarks on the mind-body question. In I. J. Good (Ed.), *The scientist speculates* (pp. 284-302). London, England: William Heinemann Ltd.

Wigner, E. P. 1963. The problem of measurement. *The American Journal of Physics*, 31, 6-15.

Wigner, E. P. 1967. Remarks on the mind-body question. *Symmetries and reflections: Scientific essays of Eugene P. Wigner* (pp. 171-184). Bloomington, IN: Indiana University Press.

Wolpert, D. 2008. Physical limits of interference. *Physica D*, 237, 1257-1281.

Zee, A. 1986. *Fearful symmetry: The search for beauty in modern physics.* New York: MacMillian Publishing Company.