# Hermeneutical Dynamics

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For Hilary Putnam, Morton White, John Rawls, and Robert Nozick who each – in his own way – introduced me to processes of thinking critically about a great many issues ... as well as for Dr. M.Q. Baig who helped introduce me to an entirely different way of engaging many of these same issues.

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Preface

Some of the best books I have read were ones with which I had many disagreements and in relation to which I developed an array of criticisms. Nevertheless, those books challenged me to rigorously reflect on different issues and, in the process, not only helped me to clarify my own thinking about this or that topic, but, as well, induced me to pursue a variety of issues into mental spaces with which I was not familiar or, necessarily, even comfortable. Such books assisted me to push the boundaries of, as well as re-work the contents of, the envelope containing my methods for mapping mental spaces.

Consequently, I don't think it matters whether a reader agrees or disagrees with what is said in *Hermeneutical Dynamics*. As long as what is written here induces a person to work toward becoming more competent in the methodology of the mapping process, then this work will have served one of its purposes.

Many people believe that philosophy is a discipline that helps one to gain insight into how to go about gaining answers to some of the great questions of life concerning ontology, metaphysics, ethics, identity, and the like. I do not share that view of things, nor do I work out of such a framework of understanding with respect to engaging philosophical issues.

Nonetheless, I do think that philosophy – when pursued appropriately – has tremendous practical potential. Issues revolving about logic, thinking, conceptual frameworks, methodology, consistency, proof, analysis, model-building, meaning, belief, and knowledge all have numerous ramifications for enhancing or weakening the viability of the methodological processes through which one seeks to engage experience.

Being able to ask the right kind of question can save one a great deal of time that might otherwise have been spent wandering down fruitless paths of exploration. Being able to develop and apply the right kind of diagnostic system can assist one to repair, replace, and correct processes of reflection that might be dysfunctional ... that is, which might be problem generators rather than problem solvers.

As intimated earlier, I do not believe that philosophy can transport one to destinations such as: truth, wisdom, reality, or justice. However, I do believe that philosophy can, under the proper circumstances, offer an individual something like a tool chest that might just help an individual to maintain certain aspects of one mode of existential transport – namely, rational thinking – in relatively good running order so that a person can continue the quest to journey toward the horizons of truth, wisdom, reality, and justice through other means ... at least to whatever extent such things can be discovered and understood by human beings.

In one sense, *Hermeneutical Dynamics* gives expression to a series of exercises involving different problems and possibilities that are entailed by issues of: fields, chaos, chronobiology, mathematics, quantum mechanics, holography, and so on. Perhaps, what is most important about these exercises is that they provide an individual with opportunities to engage issues, topics, and questions while critically reflecting on not only what is being said by me but, as well, to critically reflect on what is going on within the reader, as she or he works through the material.

Whether one agrees or disagrees with what is being expressed through the following material is, as noted previously, largely irrelevant. The object of the various exercises in these two volumes is to induce a reader to engage, analyze, question, reflect upon, critique, and improve on (where necessary) the process of mapping mental spaces.

There are no definitive answers given in *Hermeneutical Dynamics*. There are, however, a lot of possibilities that are presented for consideration.

At the end of *Hermeneutical Dynamics* is an appendix entitled: "Mapping Mental Spaces", and it gives expression to a distilled version of what is going on -- methodologically speaking -- in the rest of *Hermeneutical Dynamics* In a sense, the various chapters of this book are the appendix writ large in the context of specific topics and problems.

In other words, the chapters of *Hermeneutical Dynamics* – each in its own way – constitute applications or reflections of the principles that are set forth in the appendix. In this sense, each of the chapters of *Hermeneutical Dynamics* represents something of a transform space that is generated when one activates the operational principles that are inherent in the aforementioned appendix.

The format of the appendix: "Mapping Mental Spaces", is, in part, homage to -- or an acknowledgment of – *Tractatus Logico-Philosophicus* by Ludwig Wittgenstein. However, there is no one-to-one mapping correspondence between the numbered premises in the *Mapping Mental Spaces* appendix and Wittgenstein's system of numbering premises in his work.

More than thirty years ago, I encountered the *Tractatus*. Because there were many issues in Wittgenstein's work that I considered problematic, the *Mapping Mental Spaces* appendix is, therefore, something of a response in kind to the *Tractatus*.

Going through Wittgenstein's exercise induced me to begin thinking about a variety of issues that have continued to haunt the corridors of my mind over the more than three decades that have passed since my initial reading of the *Tractatus*. Perhaps, the present work might help prompt this or that reader to become involved in a journey of a similar nature.

I first encountered the *Tractatus* when taking a course with Hillary Putnam at Harvard. Before switching over to Social Relations, I took other courses in philosophy with John Rawls, Robert Nozick, Morton White, and a few others.

In the case of Rawls and Nozick, they were -- at the time I took their courses -- both working through material that would shape their first books – *A Theory of Justice* and *Anarchy, State and Utopia* -- respectively. That material served, in many ways, as the primary content of the courses that I took with them, and, as such, helped introduce me to the point-counterpoint of philosophical exploration.

I did moderately well in some of the courses to which I alluded above, and I did less well in some of the other courses in philosophy that I sampled. In many ways and for a variety of reasons – having more to do with my mental space at the time than with the content of such courses or their instructors -- I struggled with philosophy early on, and this was one of the reasons why I switched majors and began pursuing psychology rather than philosophy.

Yet, I soon found that many of the problems, questions, and issues that I began to discover in psychology were only variations on a theme with respect to the kinds of problems, questions, and issues that earlier I had engaged and by which I had been confronted – however dimly at the time – in philosophy. In fact, many of these same issues re-surfaced when I began to explore, and take an interest in, the realms of mysticism and spirituality.

*Hermeneutical Dynamics* constitutes something of a 'How To' book. In other words, by going through the exercises (i.e., chapters) in *Hermeneutical Dynamics* and engaging, reflecting on, challenging, and questioning what is written, one will be journeying – hopefully -- toward a better understanding of what is involved in the process of mapping conceptual spaces in one's own life – and, this will be true irrespective of whether, or not, one agrees with me on this or that topic or theme.

As stated before, *Hermeneutical Dynamics* is not – strictly speaking -- about truth, reality, or the like. That is, once one travels through the pages of this book, one will not have arrived at a definitive understanding of what the nature of truth or reality is.

Nonetheless, after completing *Hermeneutical Dynamics*, I do believe that an individual will have a much better appreciation of the critical problems, issues, and questions that surround any attempt to work toward grasping the nature of truth and reality than might be the case prior to reading the present work. As such, *Hermeneutical Dynamics* gives expression to a journey rather than a destination, and if one does not like traveling through the conceptual countryside, then one is unlikely to feel any sort of affinity for these two volumes.

Nonetheless, I believe that *Hermeneutical Dynamics* is a very good example of what philosophy has to offer when pursued in what I consider to be an appropriate way ... although you might disagree with me on this. But if you do disagree with the perspective being given expression through this book, then that's okay as well, since these sorts of disagreements are likely to be due to a reader's constructively critical engagement of my book ... something that is quite consistent with the purposes underlying this work.

The topographical landscapes of *Hermeneutical Dynamics* encompass a wide variety of topics. These include: epistemology, ontology, the field concept, morphogenetic systems, chronobiology, quantum physics, chromodynamics, mathematics, mind, and holography.

Consequently, a reader will have an opportunity to learn a fair amount about the themes, problems, and possibilities that populate such landscapes. In addition, the journey that is laid out has considerable heuristic potential with respect to inducing readers to actively engage some of the great questions of life involving: truth, wisdom, reality, knowledge, mind, identity, purpose, and justice.

Naturally, if you or any of your IM team should be apprehended by hostile forces during the course of your mission with respect to *Hermeneutical Dynamics*, I will disavow all knowledge of that undertaking. Good luck!

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Chapter 1: Sheldrake's Theory of Morphogenetic Fields

The mechanistic theory of life holds that all properties of living organisms can be completely accounted for in terms of physical and chemical laws. On the other hand, vitalist approaches propose that one must posit the existence of some non-mechanical causal principle (or set of such principles) -- in addition to the mechanical principles of physics and chemistry -- in order to explicate the various facets of the phenomenon of life. Finally, there are holistic or organic theories of life that attempt to explain the phenomenon of life as a function of emergent properties.

Emergent properties are believed to manifest themselves at certain levels of hierarchical complexity. Their appearance cannot be anticipated on the basis of the principles that are operative on lower levels of complexity.

In effect, emergent properties are said to manifest themselves when certain kinds of hierarchical complexity reach a sort of critical mass and begin to generate phenomena as an expression of the way the whole system interacts together. Consequently, emergent properties are considered to be by-products of the complexity of a given system taken as a whole, rather than the result of some subsystem of mechanistic principles.

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Rupert Sheldrake considers the idea of morphogenetic fields to be an example of the organic approach to theories of life. In general terms, morphogenetic fields are believed to be the agencies that are the source of various kinds of structure, form, shape and organization that are manifested in living systems.

According to Sheldrake, morphogenetic fields transmit their structuring influences across both space and time such that there is a cumulative structuring effect from one point in time to another, as well as from one point in space to another. However, these influences are only passed on to, or affect, systems that are "similar" in some sense.

The hypothesis of formative causation plays an important role in Sheldrake's model. Essentially, this hypothesis says that the degree of repetition that is associated with a given morphogenetic field will affect the intensity of the influence of that field on similar fields with which it comes into contact.

On the basis of the hypothesis of formative causation, Sheldrake says one could expect or predict that something of the following sort will occur. When a given species of animal learns a new form of behavior, then, subsequent members of that species will exhibit, if raised under conditions that are similar to the original group, a tendency to learn such a behavioral form more quickly than when the new behavioral form was first introduced into that species. Furthermore, within certain limits and up to a certain point, the learning curve will accelerate with each successive generation of the species that is taught the behavioral form at issue.

In addition, Sheldrake maintains that the acceleration of the learning curve will be affected by the quantities of species members that are involved in the original, and subsequent, learning experiences. In other words, if one uses only a few members in the original, and subsequent, learning trials, then, the influence of the morphogenetic field that is set in motion will be relatively weak compared to the strength of the morphogenetic field that will be generated if one had used thousands of members in the original, and subsequent, learning trials.

There are a number of questions that arise in relation to the foregoing. For example, if what Sheldrake says is true, then, why don't the subsequent generations of adherents of a given religion learn their religious tradition more quickly, more deeply and more completely than do the early adherents of that tradition? After all, it is almost universally acknowledged that the early adherents of a religious tradition are often the best exemplars of that tradition- best in the sense of having most completely and most deeply mastered the various aspects of the tradition. One might even argue the earlier adherents also pick up the tradition more quickly than subsequent generations of adherents because they have direct access to the individual who is the prophet or avatar or saint who introduced the tradition.

In order for Sheldrake to put forth a tenable position, he is going to have to be able to offer a plausible way of resolving the foregoing problem. For instance, one way of addressing the aforementioned difficulty might be to suppose there are other morphogenetic fields in existence that are antagonistic to the spiritual morphogenetic fields being generated through a prophet and his followers. As a result, the influence of the spiritual morphogenetic field might be dampered, modulated or curtailed by the existence of other kinds of morphogenetic fields that are antagonistic to the first kind of field.

However, if one were to adopt the foregoing position, one would be faced with a further question. Given the presence of antagonistic morphogenetic fields, how does one account for the emergence of a morphogenetic field that runs counter to the already existing fields? One might suppose that the inertial character of the already existing, antagonistic systems would be too much to overcome for the fledgling morphogenetic field.

One also would like to know whether or not the rate or intensity with which a given morphogenetic field is generated will be affected by the truth value, if any, being manifested through that field. In other words, is the character of transmission of a morphogenetic field at all affected by the structural character of the content of what is being transmitted through that field?

If the morphogenetic field is value neutral such that the correctness or incorrectness of what is transmitted is immaterial to the rate or intensity or extent of field generation, then, one will have to keep in mind there might be a lot of morphogenetic fields in existence that could prove to be antagonistic to one another since their truth values conflict with one another. Getting a 'true' morphogenetic field either started or sustained might be difficult because, in a sense, it will be swamped by so many 'false' morphogenetic fields. Such pseudo-fields give expression to structures that have, ultimately, a dissipative effect with respect to the establishing and strengthening of a given field that accurately reflects some aspect of reality. On the other hand, introducing, transmitting and sustaining structures such as rumors, myths, or false theories, might prove to be easier since there not only tend to be so many more of these sorts of positions relative to the number of true fields, but one might wish to argue there is a certain similarity among all these false ideas, myths and so on by 'virtue' of their aspect of falseness.

The answer to the question of whether or not the extent of accuracy characteristic of a given morphogenetic field will have any effect on transmission rates, intensities, range and so on will have a variety of implications for not only educational issues but cultural issues as well. Both cultural processes and educational processes are quite structurally complex.

Consequently, in each case there likely are a wide variety of morphogenetic fields that complement, compete with, supplement, overlap with, reinforce and/or conflict with one another. The stresses, strains, and tensions that are introduced by such a variety of morphogenetic fields will have to be taken into consideration in trying to come up with a coherent, consistent, and constructive, set of educational and/or cultural programs that will be of intellectual, political, moral, economic, legal, emotional and spiritual value for the individual.

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When biological development is described as epigenetic, reference is being made to the manner in which certain biological systems increase in complexity, both with respect to organization, as well as form, over time. Mechanistic, vitalistic and organismic theories of life all acknowledge that many biological systems manifest such epigenetic properties, but these theories differ radically in the way in which they attempt to account for what makes it possible.

The term entelechy comes from a Greek word referring to an entity that carries within itself a goal toward which that entity tends. The term was introduced by Hans Driesch, an embryologist, who believed there were many facets of development, reproduction, regeneration, etc., which could not be explained satisfactorily by mechanistic theories of life.

For Driesch, entelechy represented a non-physical, vitalistic, causal factor that operated on the physical-chemical aspects of biological systems- shaping, regulating, and organizing those aspects into various sorts of organelles, tissues, organs, and bodies. Although the biochemical substances and processes that make up genes, chromosomes, metabolic pathways, and so on, constitute the material medium through which morphogenesis is given expression, the ordering principle responsible for the regulation of the morphogenetic process is, according to Driesch, entelechy.

However, the idea of entelechy was not intended by Driesch to be a metaphysical principle. He believed it was a purely natural, causal phenomenon, capable of acting on material substances. Furthermore, although Driesch did not consider entelechy to be a manifestation of any form of energy, he maintained this principle did not violate either the first or second laws of thermodynamics.

Driesch contended that not all events on the micro level of biological systems are fully determined by mechanical principles. He believed there was indeterminacy in biological systems at the micro level, even though the events that took place on the macro level could be observed to obey various statistical laws.

The principle of entelechy was posited by Driesch to operate within the parameters of indeterminacy existing on the micro level. This principle would impose its ordering process on physical-chemical systems by regulating the phase relationships that determined when a given micro event would be given expression. Through a process of constraining and/or enhancing such events, entelechy organizes biological activities in accordance with its own ends-oriented ordering principle.

Sheldrake does not automatically dismiss the idea of entelechy. However, he is dissatisfied with its vitalistic orientation that requires a non-physical principle to operate on, in some inexplicable way, physical systems.

Holistic or organismic theories arose against the backdrop of the same sorts of problems that had led to various vitalistic theories of life being proposed. These problems were reproduction, regeneration, and development. However, rather than resort to some mysterious vitalistic principle, holistic theories were rooted in ideas like morphogenetic fields and the chreode. The latter term was introduced by C.H. Waddington and referred to the way in which embryological processes seemed to be canalized toward certain structural ends as a result of the manner in which the epigenetic landscape was laid out over time.

Sheldrake considers theories such as Waddington's to be largely descriptive, rather than explanatory. He even points out that Waddington himself treated the idea of a chreode as little more than a descriptive convenience.

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Sheldrake states that those people who attempt to equate entropy with the idea of disorder are mistaken. He points out that according to the third law of thermodynamics, every pure, crystalline solid at absolute zero will have an entropy value of zero. Since there is no thermal agitation at absolute zero to disturb the system's thermodynamical properties, there will be no element of disorder introduced into such a system. Therefore, there will be no entropy present.

However, if one takes two pure, crystalline solids, such as salt and hemoglobin, although their entropy values are equivalent at absolute zero, the two differ vastly in the structural character of their complexity. Consequently, one cannot equate complexity or degree of order with entropy.

Sheldrake also speaks of instances in which order and entropy values will go in opposite directions. In other words, sometimes a series of biological events will occur that result in a increase of entropy. Nevertheless, at the same time, these events also bring about an increase in morphological complexity and order. Again, the indication is that entropy and disorder are not necessarily covariant entities.

The term "formative" is used in Sheldrake's hypothesis of formative causation in order to distinguish the kind of causation that he has in mind from the sorts of causation that are rooted in the physics of energy. Although morphogenetic fields have an association with physical systems of energy, such fields are not themselves a function of, or expression of, energy systems.

On the other hand, Sheldrake contends that the morphogenetic field is a spatial structure akin to other fields such as the electromagnetic and gravitational fields. Like these latter sorts of fields, the morphogenetic field makes its presence known through the spatial forms and structures to which it gives expression.

Sheldrake contends there are a vast range of different kinds of morphogenetic fields. Essentially, there will be a different morphogenetic field for each kind of form which exists.

All the elementary particles will have their individual morphogenetic field, as will different atoms, molecules, cells, organelles, tissues, organs, species, and so on. Furthermore, just as organisms are said to be hierarchically organized at every level, so, too, morphogenetic fields are hierarchically organized. In fact, each morphic unit of a given level of organismic hierarchical organization will be regulated by its own particular morphogenetic field.

According to Sheldrake, the morphogenetic process only can arise when a morphogenetic germ is present. A morphogenetic germ is an existing, organized structure or system.

Morphogenesis occurs when the germ develops into a more complex structure or system through the effect that an associated morphogenetic field has on that structure or system. Although Sheldrake contends that a morphogenetic field becomes associated with a morphogenetic germ as a result of similarity of form between the two, he doesn't explain where the morphogenetic field comes from in the first place.

Moreover, he does not provide an account of how the field and germ become associated at the time of morphogenesis. Or, if the field and germ are always associated, he does not elaborate on what switches the field on and off at different times, or on what coordinates the switching on and off of a variety of different, interacting germ/field systems.

As noted previously, Sheldrake does indicate there is a whole hierarchy of morphogenetic fields. However, this doesn't so much solve the foregoing problems, as much as it merely provides a means of evading them.

Even given such a set of hierarchically arranged morphogenetic fields, one would still like to know: (a) where they come from; (b) how they are generated; (c) how morphogenetic germs and fields become associated; and, (d) how the non-physical morphogenetic fields are able to influence, or act upon, physical morphogenetic germs.

In Sheldrake's words, "the morphogenetic germ is a part of a system-to-be" This means the morphogenetic field that is associated with that germ is partially active and partially potential or virtual. In other words, in so far as the germ exists, it has an associated morphogenetic field surrounding it that is capable of operating on the germ and inducing the process of morphogenesis in it. In this sense, the associated morphogenetic field is active, and the interaction between the field and the germ generates a system that is beginning to manifest itself morphogenetically.

However, there are still aspects of the germ-field interaction that have not, yet, been activated, and, therefore, according to Sheldrake, the germ-field constitutes a kind of form in waiting. Consequently, under the appropriate circumstances and at the opportune time, these currently non-activated aspects of the germ-field system will be given expression and the full structural character of what once was a 'system-to-be' becomes a fully realized, operating germ-field system.

In short, Sheldrake believes the morphogenetic field contains the formal blueprints, so to speak, for the morphogenetic process of unfolding or becoming. By acting on the physical/material medium of a given morphogenetic germ, the field induces that germ to undergo morphogenesis in the directions and ways prescribed by the blueprint or virtual form inherent in the associated morphogenetic field.

Sheldrake speaks of the morphogenetic field as containing a virtual form that, in time, is to be given expression through its influence on the physical/material medium of the germ. However, looked at in another way, the morphogenetic field is already an actual form waiting to operate on the structural character of the morphogenetic germ so that the form of the field can be manifested on, or given expression on, another level of scale- namely, in the physical/material world.

Therefore, one is not so much dealing with a case in which something that is virtual becomes actual. Rather, what Sheldrake is referring to seems to be something that is already actual and, then, subsequently, becomes manifest on a different level of scale.

The germ is not a geometric point without any internal structure that suddenly produces complexity where previously there only had been pure simplicity of the most fundamental sort. The morphogenetic germ has a spectrum of ratios of constraints and degrees of freedom covering a range of differentiated functions, properties or characteristics.

Consequently, morphogenesis is a process that takes already complex structures (even at the level of, relatively speaking, simple morphic units) and by altering certain aspects of the spectrum of the ratios of constraints and degrees of freedom, brings about a transformation of the character of the structural complexity that is being given expression. Thus, what had been, inwardly, a complex structure but, outwardly, appeared to be a relatively simple morphic unit, now, under the influence of the morphogenetic field, becomes, outwardly, manifested as a complex structure. The germ, in other words, had always been structurally complex, but what had been hidden complexity now has become manifest complexity.

According to Sheldrake, there are two broad types of morphogenesis. One type is referred to as aggregative. The other type of morphogenesis is called transformative.'

In aggregative morphogenesis a number of independent morphic units are brought together to form a more complex morphic unit. In the case of transformative morphogenesis, a given morphic unit becomes transformed, under the influence of the morphogenetic field, into a more complex morphic unit.

However, this distinction between aggregative and transformative morphogenesis seems somewhat arbitrary since, on some level of scale, one probably could construe virtually every process of morphogenesis as a bringing together of a variety of previously independent morphic units. Even in the case of transformative morphogenesis, one might well argue that the transformation takes place as a reordering or reorganizing of various morphic units within the morphogenetic germ, and as such, constitutes the bringing together of a variety of independent units to give expression to a more complex form.

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Sheldrake likens morphogenetic fields to the orbital pathways of particles that are described by quantum mechanics as probability distributions. One cannot give specific details about the precise location and velocity of a given particle within its orbital and, therefore, one is required to work out a probability distribution that shows the likelihood of finding the particle in question at any given location in the orbital.

So too, Sheldrake believes there are a variety of indeterminacies associated with the morphogenetic field. As a result, he proposes the morphogenetic field be construed as a probability structure. This probability structure gives expression to a set of distributed values concerning the process of unfolding of structural complexity in association with a given morphogenetic germ.

From the perspective of this essay, probability structures are a function of the way a given kind of methodology engages an aspect of ontology or the phenomenology of the experiential field and, as a result of this engagement, generates an interpretation of that engagement process. Probability structures are the methodological means one uses to keep track of how various ontological structures' spectra of constraints and degrees of freedom express themselves over time.

Morphogenetic fields (assuming, of course, that they actually exist) and wave phenomena both give expression to a latticework of phase relationships that establish a ratio or spectrum of ratios of constraints and degrees of freedom that are capable of giving expression to particular kinds of structural character under a given set of circumstances. Probability structures, of one description or another, are attempts to map various dimensions of such morphogenetic fields.

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The amino acid sequence that constitutes a given protein takes on a tertiary structural form by folding into a three-dimensional configuration. A polypeptide chain of amino acids only becomes a functional protein when it has assumed a certain three dimensional configuration. Moreover, each distinct protein has a characteristic tertiary structure.

Because this folding process occurs more quickly than would be predicted if one assumed it was taking place as the result of a random search through possible energy configurations, Sheldrake suggests the difference between actual and predicted folding time indicates the folding process follows certain preferred paths. He interprets this to mean there is a morphogenetic field present that is placing constraints on the manner in which the folding process will work its way through the energy configurations available to the polypeptide chain. Such a preferred path is referred to by Sheldrake as a chreode (cf. Waddington) or canalized pathway.

Sheldrake also briefly discusses the way in which the processes of symmetry breaking, phase transitions and dissipative structures frequently display a wide diversity in the structural character of the outcomes of these sort of phenomena. In cases such as these, there are a large number of energy configurations that are possible. Although one often can predict the general thermodynamic character of the outcome of these processes, one cannot predict the structural form that will manifest such a thermodynamic character.

In other words, the physical and chemical laws governing a given system present a range of energy or thermodynamic configurations that are possible under the conditions that prevail in the system. The morphogenetic fields select from among those possibilities that are permitted by chemical and physical laws under a given set of circumstances.

He points out, however, that not all of these cases of change in form necessarily involve morphogenetic fields or the process of formative causation. Sometimes transitions in form are the result of purely random events. On other occasions a particular change of form might occur because it represents the structure that gives expression to the condition of minimum-energy or maximum stability.

Moreover, Sheldrake believes morphogenetic fields, when they are present, do not act in opposition to chemical or physical process. He contends they act in concert. Indeed, such physical and chemical processes become the medium through which the morphogenetic field manifests its effect.

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Sheldrake's admission that there are instances of transition in form that are not the result of morphogenetic fields again raises questions about the origin of such fields, as well as about how a morphogenetic field comes to be associated with a given form or morphogenetic germ. In addition, one might wish to ask why there aren't morphogenetic fields associated with such things as minimum-energy states, or whether one can really speak of any process being random.

In the latter case, one might wonder why one couldn't construe the so-called 'random' process as being part of a system-to-be. What Sheldrake refers to as random events might be a system-to-be that is merely idling within certain parameters of constraints and degrees of freedom until an appropriate morphogenetic field imprints a blueprint of formative causation on such a process.

Indeed, one might suppose the entities or elements or objects that are caught up in the 'random' process constitute morphic units that already are operating under morphogenetic fields. As such, they might be passing through an interim phase until some higher hierarchical morphogenetic field comes along and organizes these individual morphic units into a more complex system.

Sheldrake outlines two broad approaches to answering the question of where morphogenetic fields derive their form. One possibility is that morphogenetic fields are expressions of eternal, fixed forms of the sort that either Plato or Aristotle talked about, each from his own perspective. The other possibility that Sheldrake outlines is actually not an answer at all. It leaves, instead, the issue shrouded in the mystery of the unknown.

In this second possibility, Sheldrake says no scientific answer can be offered as to why a morphogenetic field of a given form first arose. Nonetheless, once such a field has arisen, it is capable of transmitting its influence across time and space to bring about the transformative or aggregative morphogenesis of some morphogenetic germ(s).

Furthermore, Sheldrake maintains his hypothesis of formative causation is concerned with the effect that the role that the repeating of forms plays in morphogenesis. Consequently, he believes the origins of forms is a non-issue as far as the idea of causative formation is concerned.

While Sheldrake can chose to whistle past the cemetery if he likes, as long as he refuses to treat the problem of origins as a clear and present issue, his perspective becomes permeated by a large degree of arbitrariness. Not only is he unable to explain the origins of the forms of such fields, he cannot account for how they transmit their influence, or how they come to recognize a given morphogenetic germ as a resonant form with which to become associated.

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Later on he uses the term "resonance" to suggest how a given morphogenetic germ, entity or system "recognizes" similarity in another morphogenetic germ, etc.. Nevertheless, in the context of Sheldrake's discussion of morphogenetic fields, resonance is a term that gives the illusion of an explanation without actually possessing the reality of such an account.

Resonance becomes like a black box in which something takes place that permits non-physical fields to interact with, and influence, physical systems. Yet, one never comes to understand what the nature of the resonance is that is set in motion between non-physical and physical systems.

Resonance is a term used in science to describe situations in which the structural character of the vibration of one system acts upon some other system because the oscillating character of the latter system has a natural frequency that is very similar to the oscillating character of the first system. Resonance is a selective process in as much as it only occurs within fairly specific parameters of oscillating character.

Sheldrake believes the interaction between a morphogenetic field and a morphogenetic germ is a case of morphic resonance. However, unlike the sort of resonance that occurs in purely physical systems, morphic resonance does not involve energy in any way. On the other hand, like instances of energetic resonance, morphic resonance does revolve around the oscillating character of systems, which means that it is a dynamic, rather than a static, process.

Morphic resonance, according to Sheldrake, gives expression to forms of vibration that are spatial-temporal in character. These three-dimensional oscillating forms are capable of being transmitted across space and time, imposing, within certain limits, their morphogenetic imprint onto a given morphogenetic germ or morphic unit.

Although the idea of an order-field has certain 'similarities' to Sheldrake's idea of a morphogenetic field, there are also some obvious differences. One of the most fundamental of these differences concerns our contrasting conceptions of the structural character of the field.

For example, whereas Sheldrake speaks of action at a distance, the dissertation speaks in terms of contiguous transmission of order-field effects. In addition, whereas Sheldrake describes formative causation in terms of a three-dimensional spatial-temporal oscillating resonance, the structural character of the order-field's mode of oscillating transmission is through the dimension of time.

Time is one of the dimensions (but not necessarily the only one) that is held in common by all structures, structuring processes, dialectic interactions, morphogenetic transitions, phase transitions, dissipative structures, symmetry breaking events etc.. This aspect of commonality might make temporality an ideal medium through which to transmit certain kinds of influences, especially those involving phase relationships, sequential events, oscillations, periodicies, aperiodicies, chaotic dynamics, and so on. All of these influences play key, pivotal roles in virtually all - if not all- physical, material, biological, mental, and emotional processes, as well as in many, but not necessarily all spiritual experiences.

Everything in the physical/material/mental world gives expression to some sort of structural character. Structures are manifestations of a spectrum of ratios of constraints and degrees of freedom. These ratios of constraints and degrees of freedom are an expression of certain kinds of dialectical activity that occurs between, or among, various dimensions- space and time being just two of these dimensions.

Phase transitions and morphogenetic transformation constitute a selection from, or alteration in, the spectrum of ratios that constitute a given structure. Such transitions or transformations occur by means of phase relationship states in which phase quanta are exchanged. (For now, one might characterize phase relationships as expressions of the way different aspects of ontology interact with one another while in certain states, conditions, and cycles of manifestation. These states, conditions, and cycles constitute the phases of an object or process during particular modes of being that give expression to various dimensions of possibility inherent in an object's or process' being.)

Phase quanta are the carriers of force that bring about a change in the way a given spectrum of ratios gives expression to itself, or that brings about a change in the very character of the spectrum itself, either by adding ratios, or taking away ratios, or by modifying the existing ratios in some new way. Phase quanta represent oscillating modes of temporality. In other words, they are temporal wave forms whose structural character specifies a ratio of constraints and degrees of freedom but that is coded for in terms of phase relationships.

Ultimately, phase is a matter of a temporal order that codes form(s) or structure(s) in terms of how the constraints and degrees of freedom that constitute that (those) form(s) are temporally related to one another within the context of unfolding or being manifested. Indeed, phase is a point-structure whose ratio of constraints and degrees of freedom is expressed in a temporal waveform.

As such, any form or aspect of form (of whatever medium) can be represented by a temporal wave of a given phase structure. In fact, one might argue that any structure, in whatever medium, is, in part, a manifestation of the presence of a temporal wave that is moving through that medium and helping to shape the character of such a structure.

When phase quanta are exchanged, this might affect the spectrum of ratios of constraints and degrees of freedom that constitute a given structural character. Thus, the order-field acts on structures by, along with other dimensional means, transmitting its effects through the phase quanta that are carriers of temporal force.

As such, temporal force becomes a transmitter of certain aspects of the underlying order-field. Phase quanta are the means through which temporal resonance manifests itself. Morphic resonance is a species of temporal resonance.

Sheldrake believes all past systems that are similar to a given system existing in the present will have a shaping effect on the current system. However, since not all of these systems are precisely the same, he contends there will be an averaging process that takes place.

During this averaging process, those aspects of all the past systems that are held in common with the current system will be enhanced. The degree of enhancement will depend on the degree of similarity. Sheldrake contends that whenever there is variance with respect to some given structural theme, a certain amount of blurring will occur due to the way the variance is distributed over the morphogenetic field rather than localized or concentrated in a well-defined region that is capable of providing sharp resolution.

The above-mentioned variance distribution is why Sheldrake describes the morphogenetic field as a probability structure. It describes the probability that a given morphic unit or morphogenetic germ, with which the field becomes associated, is likely to be affected by the field at different points in that morphic unit or germ.

The foregoing position appears somewhat problematic in several respects. For example, how similar do things have to be in order for there to be an enhancement or reinforcement effect? What is to prevent someone from arguing that since everything shares a certain degree of similarity with everything else, therefore, all structural themes, in every morphic unit or morphogenetic germ, will be reinforced, so some extent, by various morphogenetic fields? Alternatively, given that everything is dissimilar to some degree, what stops the aspects of dissimilarity from acting as a dampening effect on the process of reinforcing various structural themes?

One could argue there is a far greater amount of dissimilarity than similarity, as one goes from situation to situation. If this were the case, one might wonder why the themes of dissimilarity don't just swamp the themes of similarity during the averaging process, thereby preventing structural themes from ever being sufficiently reinforced to have any appreciable morphogenetic influence on subsequent morphic units or germs.

The foregoing theme might be 'reinforced', to some extent, by Sheldrake's contention that the effects of a morphogenetic field are not attenuated by either space or time. In other words, Sheldrake does not believe the morphogenetic field is a function or expression of either mass or energy. Therefore, he feels such fields will not be vulnerable to the same deterioration of quantity and quality to which physical phenomena are subject when propagated across space and time.

In any event, if the effects of a morphogenetic field are not attenuated by space or time, then, this would seem to indicate that the opportunity for dissimilarities to influence morphogenetic events, through the averaging process, becomes that much greater. This is the case since such themes of dissimilarity will not be attenuated in their strength or intensity by factors of space and time.

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Chapter 2: The Methodologies of Field Theories

Up until the time that Michael Faraday introduced his concept of the field into nineteenth century thinking, physicists believed the most fundamental description of physical/material phenomena was a function of the manner in which discrete substances or pieces of matter were arranged. However, Faraday argued that the most fundamental description of the events of physics should be rooted in continuous rather than discrete processes.

H. C. Øersted, a Danish physicist, had made an interesting discovery in 1820. He found that the moving charges of an electrical current were capable of deflecting the needle of a compass that had been placed in a position perpendicular to the direction of motion of the moving electric charge.

This finding was noteworthy for two reasons. (1) It suggested there was a connection of some sort between electrical and magnetic phenomena. (2) Unlike the cases of gravitational and electrostatic forces -- in which forces were transmitted between interacting objects along lines that linked the centers of these objects -- moving electrical charges generated forces that were perpendicular to the usual direction of the transmission of forces.

Faraday believed Øersted observations meant electricity and magnetism were different manifestations of one and the same force. The illusion of the existence of separate forces was more an artifact of the experimental situation in which relative motion was used to induce the underlying, single force to manifest itself in primarily an electrical or magnetic mode of expression.

This linking of electricity with magnetism was the staging area from that Faraday launched his revolutionary concept of the field. He jettisoned the traditional idea of discrete bodies acting on one another in terms of the Newtonian notion of 'action-at-a-distance'.

Faraday replaced that idea with his formulation of a potential field of force. In other words, he believed objects were linked by means of a field of force that continuously manifested itself in the space that permeated and surrounded the objects being linked by the field.

Later on in his career, Faraday proposed that the idea of a potential field of force should be extended to cover the manifestation of all forms of physical force, not just those of electricity and magnetism. By suggesting such an extension or generalization of the field concept, Faraday became the first physicist to advocate using a unified field theory approach to account for all physical or material phenomena.

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Continuity: an integral aspect of the field concept

When Faraday used the term 'continuous field of force', he had something particular in mind. He believed a sphere of influence surrounded every charge.

The properties of this sphere of influence were a function of the character of the charge that generated it. However, irrespective of the particular properties of the sphere of influence that were generated by a given charge, all such spheres of influence manifested themselves in a continuous fashion.

Imagine using a test charge to engage the sphere of influence at some point 'p'. According to Faraday, one should be able to anticipate that the properties of a given sphere of influence have the potential to affect the test charge in a determinate way at the point of engagement.

When considered as a whole, the sphere of influence of a given electrical charge will give expression to a field whose strength of intensity of electrical charge will vary from point to point in that field in a way that reflects the character of the electrical charge that generates the field in question. Thus, if one were to consider some other point, 'x', at some distance, 'd' from the point, 'p', through which one initially had engaged that field by means of a test charge, then according to Faraday, one would find that the sphere of influence of the field generated by the electrical charge would affect the test probe with a strength of electrical field intensity that was characteristic of the field at that point of engagement. In fact, such fields are said to be continuous because one should be able to select any point in the interval-d, between 'p' and 'x' -- or between any other points that might be selected -- and determine the strength of electrical intensity with which the sphere of influence of an electrical charge's field will affect a test probe that is introduced at such intermediate points.

The idea of a continuous field requires that there can be no point within the sphere of influence of a given electrical charge that does not have the potential to affect, with some manifestation of strength of electrical intensity, a test probe that engages the field at that point. In short, the potential capability of a field to exert a force of variable strength of electrical intensity at each and every point of the field renders the field continuous.

One of the up-shots of the foregoing position is as follows. The idea of atomism is rejected since such an idea necessarily carries with it a discrete perspective in which the phenomena of the physical universe are expressions of interacting particles that are distinct and separate from one another in certain ways.

Instead, the atomistic properties that various phenomena seem to possess are only apparent and are not real. Underlying these discrete-appearing surface features is a smooth or continuous distribution of field variables manifesting themselves in ways that are sometimes intense and concentrated or localized.

At other times, these field variables are dispersed and not localized. The combination of these concentrated and dispersed manifestations of a continuously varying set of field variables gives rise to the illusion there are discrete events.

Thus, from Faraday's perspective, there are no fundamental entities such as elementary particles or atoms. Everything is an expression of a single unified field that manifests itself on a continuous basis by means of transitions in the way various field variables are given expression through the field. These field variables are not individual, distinct, discrete features. They are, in a sense, abstractions or samples that have drawn from one of the smooth distributions of values that characterize a given field's manner of manifesting itself.

Although all of the experimental evidence available to physicists in the 1800s supported Faraday's idea of a field, Faraday's position was not unassailable. For example, on some exceedingly small level of scale, there could be one, or more, points that fall within the sphere of influence of an electrical charge and, yet, do not manifest the sort of strength in electrical intensity that is capable of affecting a test probe inserted at that point.

In this case, the variable distribution of the strength of electrical intensity that characterizes the field at such points would fall off to zero. As a result, the field would be manifesting discontinuous properties. However, the level of sophistication of available experimental methodology might not be able to detect the presence of such points of discontinuity and, consequently, such limited methodology would produce experimental results that indicated the field in question was continuous.

One could approach the test charge issue from a perspective that is somewhat similar to Weierstrass' epsilon/delta format. In other words, the neighborhood of these points can be explored on varying levels of scale.

Within the limits of one's instrumentality and methodology one could challenge the assumption of continuity in such neighborhoods as much as one likes. The idea of continuity stands as long as one can meet any test challenges that are made in a neighborhood whose outer boundaries are marked by the two points, 'p' and 'x', and that fall within the parameters of the sphere of influence of an electrical charge.

An alternative to the foregoing is to get entirely away from approaches requiring one to construe continuity in terms of a series of inexhaustible points that occupy the space within a certain set of parameters. For example, continuity might be construed as an expression of the integrity of the phase relationships (For now, one might characterize phase relationships as expressions of the way different aspects of ontology interact with one another while in certain states, conditions, and cycles of manifestation. These states, conditions, and cycles constitute the phases of an object or process during particular modes of being that give expression to various dimensions of possibility inherent in an object's or process' manner of being). Such phase relationships are preserved among the neighborhoods that constitute the 'point-structures' of a field latticework being probed by a test charge or force of some sort.

From the perspective of the foregoing position, a field is not infinite. It is finite.

What makes a such a field continuous is the network of phase relationships that link one neighborhood with another, or that link the different, internal aspects of a neighborhood with one another ... and not a set of infinite points that manifest or give expression to a given sort of force. As long as there is some minimal set of phase relationships that permit a latticework -- or a given neighborhood -- to manifest one or more of the ratios of constraints and degrees of freedom that are encompassed by the spectrum of ratios that constitute the structural character of the latticework, or neighborhood, then continuity has been maintained.

Given the foregoing, if one found 'holes' (that is, non-active areas that were not manifesting field properties) in the vicinity of a neighborhood, or somewhere in a latticework, these 'holes' would not necessarily represent disruptions in the continuous character of the neighborhood or latticework. For example, conceivably, the character of a field could involve a complex structure such that the field is defined as being wherever it manifests itself.

If one finds a 'hole', in the foregoing sense, one has merely located one of the parameters or boundary markers of the field. The more holes of this sort there are, then the more complex the boundary structure of the field becomes. As such, the field becomes a topological object comparable to a very complex torus.

Thus, a field manifests itself continuously, but not necessarily in the sense that every point of a given space is under the sphere of influence of that field. The field is continuous because one, or more, of the ratios of constraint and degrees of freedom that characterize that field is (are) being manifested at any given instance of time.

Continuity is a function of how a certain latticework of order manifests itself and preserves itself across time. This does not necessarily require the latticework to be able to express itself at any given point of space. Moreover, if a given field is capable of withstanding any sort of epsilon/delta-like challenge that might be thrown at it, this is a special case that does not violate the more fundamental property of continuity as characterized in terms of order as opposed to being characterized in terms of spatial points.

A field might have a dialectical relationship with the dimension of space through which it is manifested, but the field is not reducible to space. Other dimensions must interact with space to generate a field, and when the field is generated, it need not occupy all of space to be continuous. The field is continuous by virtue of the set of phase relationships to which the latticework that constitutes the field gives expression.

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Entropy as a ratio of constraints to degrees of freedom

If one characterizes entropy in terms of the ratio of constraints to degrees of freedom in a given context, then one can speak of the entropy spectrum for a structure. Such a spectrum constitutes the envelope of ratio values that are possible for that structure under a variety of circumstances ... whether induced or spontaneously manifested.

In general terms, if there is a change in the ratio of constraints to degrees of freedom for a given structure, then there has been a change in the entropy character of that structure. Or, said slightly differently, another aspect of the structure's entropy spectrum has been manifested.

If the nature of the ratio change is to shift the manifestation of a structure's entropy spectrum in the direction of more constraints, relative to degrees of freedom, then such a change is said to constitute an increase in the entropy of the structure. This is the case since -- relative to the entropy state prior to the change in question -- the structure is less able to give expression to its degrees of freedom.

Neither an increase in entropy nor a decrease in entropy, affects the quality of order in the structure or system undergoing a transition in the way the entropy spectrum is being manifested. ‘Order’ is a reflection of the fact there is some kind of ratio of constraints to degrees of freedom being given expression though a set of phase relationships that are bound together to form a particular point, neighborhood, or latticework.

Very rarely, if ever (at least in the created realm), would one find cases of pure constraint, without degrees of freedom (e.g., even at, or near, Absolute Zero, there are a variety of strange phenomena that have been observed to occur and, therefore, this state does not constitute a realm of pure constraint as once was thought), or pure degrees of freedom without constraint. Usually, constraints and degrees of freedom pair off to form a source of tension of a dialectical nature.

Therefore, as far as the issue of 'order' is concerned, what the character of the associated ratio is doesn't make any difference. As long as a ratio is present, then the degree of order doesn't fluctuate even if the character of that ratio does change.

This is in direct contrast to the way modern thermodynamics and information theory tie order to the idea of entropy. On the other hand, the present position is resonant with certain aspects of Sheldrake's views on these issues that were outlined in the essay on morphogenetic fields and the hypothesis of causative formation in chapter one of this volume of 'Mapping Mental Spaces'.

Approached from the foregoing perspective, the idea of a smooth distribution can be construed in terms of an envelope of values or a set of parameters. This set describes how the entropy spectrum manifests itself through an overlapping sequence of transitions in the ratio of constraints and degrees of freedom governing the dialectic of two or more points, neighborhoods, or latticeworks of coherent phase relationships.

Any individual expression of a given ratio of constraints to degrees of freedom is, in point of fact, a phase state. Consequently, the envelope of values that gives expression to the set of ratios that make up the entropy spectrum governing the dialectical interaction between two or more point-structures, latticeworks, or neighborhoods constitutes the bundle of phase relationships that mark the different facets of the way the neighborhoods, etc., are, or can be, linked with one another.

If there is a disruption in the phase relationships connecting, for example, different neighborhoods, such that the ratio of constraints to degrees of freedom that gives expression to this connectivity drops to zero, then there is no longer any connection between the neighborhoods. Continuity has been broken.

When the ratio is zero, this means, effectively, none of the neighborhoods, latticeworks, and so on which previously had been linked are capable of constraining one another. Furthermore, they are not capable of entering into dialectical engagement with one another in accordance with some range of degrees of freedom.

In short, the phase relationships that had connected the neighborhoods or latticeworks and that had been given expression in the form of shifting ratios of constraints and degrees of freedom of dialectical interaction, no longer exist. The minimal condition for continuity -- namely, that the neighborhoods or latticeworks in question be linked through some on-going manifestation of an entropy spectrum -- is no longer capable of being satisfied.

In the context of hermeneutics, one of the ways shifts in the character of the entropy spectrum manifest themselves is the manner in which such shifts affect the activity of the hermeneutical operator (which, briefly speaking, can be characterized as a set of operations consisting of: (1) identifying reference, (2) reflexive awareness, (3) characterization, (4) the interrogative imperative, (5) inferential mapping, and (6) congruence functions) as it (the hermeneutical operator) engages the various horizonal considerations and work toward a hermeneutical orientation. Any increase or decrease in the constraints that are placed on the activity of the hermeneutical operator that is not congruent with the structural character of that aspect of ontology or experience to which identifying reference is being made is, generally speaking, construed as an increase in the entropy of the hermeneutical system. Similarly, any increase or decrease in the degrees of freedom that occur with respect to the activity of the hermeneutical operator and that are incongruent with the structural character of the aspect of ontology or experience to which identifying reference is being made is, generally speaking, to be construed as an increase in the entropy of the hermeneutical system.

Thus, increases in entropy are a function of what brings distortion, deviation, or error into the activity of any given hermeneutical activity. Consequently, the hermeneutical analog for high entropy concerns those instances of hermeneutical operator activity in which there is either: (a) an insufficient number of constraints or degrees of freedom of the ‘right’ character available, or (b) there is an excess of constraints and/or degrees of freedom of the wrong character. The 'rightness' and 'wrongness' of character alluded to in the foregoing depends on whether or not a given instance of hermeneutical operator activity is capable of being used in a constructive, positive, heuristically valuable fashion so that progress toward establishing full analogical congruence can be achieved (i.e., one approaches the truth of something as a limit).

There appear to be a variety of inferences one might make with respect to educational issues on the basis of the foregoing discussion linking entropy and the activity of the hermeneutical operator. Perhaps, the most fundamental of the points that might be made in this regard, however, concerns the following consideration. The educational process should provide the individual with a means of learning how to go about constructing, generating, acquiring and/or searching for an entropy ratio that will maximize the heuristic value of one's dialectical engagement of experience and/or reality.

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<u>Lines of force</u>

For Faraday, a line of force is inherently characterized by two polarized ends of opposite charge. That is to say, he believed one could not have either kind of polarity in isolation. From the perspective of this essay, a line of force could be characterized as a manifestation of the phase relationship that arises between polar ends.

Faraday demonstrated that if one had a wire of a certain conductivity, then the total current that could be induced in that wire was entirely dependent on the number of lines of force that were cut. This was the basic rule of electromagnetic induction.

Faraday did not commit himself to any particular view as to the specific identity of a line of force. They could be lines of vibration, or they could be lines of ether flow, or they could give expression to some other mode of transmission. However, Faraday did feel that whatever their actual character might be, they stood for the physical means by which, or through which, force was transmitted in nature.

Unfortunately, Faraday was never able to demonstrate that lines of force had a physical reality of their own. Nevertheless, he did believe his notion of lines of force had a heuristic value. More specifically, the idea of 'lines of force' helped lend the sort of concreteness and form to a theory that would help one to develop ways of testing the theory, making deductions with respect to the theory, and so on.

For Faraday, the fundamental -- indeed, the only -- physical substance responsible for natural phenomena is force. Thus, a field is, from Faraday's perspective, an expression of the presence of force. Another way of stating the same thing is to say that forces generate fields that can be described in terms of lines of force.

According to Faraday, force acts exclusively on the contiguous points of force with which it comes into contact as it manifests itself. This concept of force was quite different from the kind of force that was operative in Newton's theories.

For Newton, force was something that any given particle exerted on other particles that were at a distance from the particle exerting the force. As such, forces did not manifest themselves through a field -- whether this was a field of force or some other kind of field. Newtonian forces manifested themselves directly on the other body in an instantaneous fashion.

Within the context of Newtonian theory, one might speak of measuring field intensities in terms of force per unit of mass. Moreover, in such a context, one might speak of the force exerted on a body that encounters a region of given field intensity as being equal to the product of the mass of that body and the level of field intensity that it encounters. However, the role played by the use of field terminology in Newton's theories amounted to little more than a mathematical means for arriving at an answer in relation to questions concerning the amount of force that was being exerted on a particular body in a given set of circumstances.

One of the major stumbling blocks one encounters in attempting to construct a testable theory built around Faraday's concept of a field -- as expressed in terms of lines of force -- is to establish the laws that govern the way forces interact. Without such laws, one is in no position to attempt to account for how material phenomena can be construed as expressions of an underlying set of interacting forces.

Faraday had proposed only one such law: the conservation of force. Essentially, this law indicated there is no change in the total amount of force in the universe. However, this law was not clearly stated.

In other words, Faraday never clearly spelled out how the field of force giving expression to one body exerts its effect on the field of force that gives expression to some other body being acted upon. Consequently, one does not know how the changes in force occurring in one region are to be compensated for by changes in force in contiguous areas, and such knowledge is essential for any proposed law of the conservation of force.

Whatever specific content one decides to introduce into the laws that govern the interaction of forces, that content must retain three features inherent in Faraday's notion of force if such laws are to be consistent with what Faraday might have had in mind. To begin with, forces have a definite location. Secondly, Faraday's idea of force has an element of directionality to it. Finally, the rate at which a force is transmitted through a field is not only finite, but this rate also is dependent on the character of the contiguous forces that it encounters during the process of being transmitted through the field with which the force is associated.

The idea of lines of force might fit in nicely with the idea of a latticework as an expression of the set of constraints and degrees of freedom giving expression to the dynamics of phase relationships that arise as a result of the dialectic of dimensions that have been set in motion by the underlying order-field. On the other hand, in the context of phenomenology and hermeneutics, these lines of force are not linear in character, nor are they limited to three or four dimensions.

These 'lines' are, instead, complex, multi-dimensional manifolds that are shaped by a variety of chaotic attractors. Nonetheless, like their counterparts in the physical world, hermeneutical and phenomenological lines of force have a capacity to affect, alter, shape, orient, transform or operate on 'objects' that come within, and are receptive to, the sphere of influence of the field that makes possible lines of force of such structural character.

For example, one can speak of the lines of force that are established phenomenologically and hermeneutically between focus and horizon. These components can be considered as two polarized ends of opposite 'charge'.

Obviously, however, the nature of a hermeneutical or phenomenological charge is something quite different than an electrical charge. However, the important consideration here is the aspect of polarity that exists between focus and horizon since there is a dynamic tension between them that generates phase relationships or lines of force.

The structural character of any given pair of focal/horizonal phase relationships will be a function of the intensity, orientation, and so on, of the 'charge' character that arises whenever one brings a focus and a horizon of such determinate nature into dialectical engagement of one another. Moreover, as is the case with electrical charge, one cannot treat either focus or horizon in isolation from one another. Where one is, one also will find the other.

One measures the continuous mapping of the lines of force between oppositely charged poles in an electrical field by inserting a test probe into the field, thereby deriving an indication of the electrical potential that has been created at the point of insertion. One also can sample something of the flavor or character of the continuous mapping of the lines of force that have been generated between a given focus and horizon by inserting into the hermeneutical or phenomenological field a test probe. This probe is rooted in one, or the other, of the poles, thereby, permitting one to derive an indication of the hermeneutical or phenomenological potential that has been created at the point of insertion.

In the context of hermeneutics and phenomenology, the character of the test probe will come in the form of questions, emotionally charged issues, beliefs, values, ideas and so on. Anything that is capable of eliciting, evoking or inducing various kinds of phenomenological response is capable of serving as a hermeneutical probe.

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<u>Maxwell's concept of a field</u>

Certain aspects of Faraday's ideas concerning the notion of a field were given a mathematical precision and rigor through the efforts of James Clerk Maxwell. More specifically, the field equations that were developed in Maxwell's work *Treatise on Electricity and Magnetism* provided a means of describing the rate at which electrical and magnetic fields changed in relation to time as well as the three axes of space. The character of the relationship of the rates of change of the electrical and magnetic fields along the temporal and spatial dimensions was captured by Maxwell in the form of partial differential equations.

Partial differential equations were more complex and sophisticated versions of the ordinary differential equations that were employed by Newton to describe the rates of change of distance between objects. The latter kind of equations revolved around just one independent variable -- namely, rates of change with respect, say, to the distance between objects when calculating gravitational effects.

However, when one was trying to determine the rates of change of electrical and magnetic fields, one had to treat each of the spatial coordinates separately from one another. This is required because the orientation or direction of a magnetic field is different from the orientation or direction of the electrical current that is the source of that magnetic field.

In addition, the partial differential equations devised by Maxwell had to take into consideration the fact that a magnetic field was actually equivalent to a moving electrical field, just as an electrical field was equivalent to a moving magnetic field. This meant his equations needed to keep track of the rate at which the position of a body changed in relation to time since this reflected the property of motion that played such an important role in linking magnetic and electrical phenomena.

Maxwell's equations gave expression to certain aspects of the idea of a field that had been introduced by Faraday. More specifically, Maxwell's equations described fields that were manifestations of continuously distributed densities of electrical or magnetic charge that constitute the field of force that is generated by a given material source. The way in which variations in charge density manifest themselves as a continuous function of changes in time and position within a given field is dependent on the character of the source material with which the field is associated.

Maxwell's concept of a field differed from Faraday's idea of a field of force. Although Maxwell based his mathematical formulations on the experimental findings of Faraday, Maxwell did not adopt the theoretical framework in which Faraday had embedded his empirical observations. Whereas Faraday had maintained matter is but a manifestation of a more fundamental field of force and, therefore, believed there was an equivalency between matter and the field with which it was associated, Maxwell treated matter and its associated field as separate entities.

Maxwell did retain something of Faraday's field concept in as much as he believed bodies did not act directly on other bodies. Thus, he agreed with Faraday that the action of bodies on other bodies was mediated through a field.

On the other hand, Maxwell retained a Newtonian flavor in his thinking by treating force as something that was to be distinguished from matter. Moreover, like Newton, he didn't conceive of, say, an electrical field as being a field of force as Faraday had done. Maxwell thought in terms of mathematical formulations that allowed one to calculate the quantity of force per unit charge that was present in a given field.

Yet, Maxwell differed from both Newton and Faraday. He believed a field -- in this case an electrical one -- occupies, in some unspecified sense, the same space as does the charge on which the field acts, despite believing that matter and the field were two different things.

Maxwell chose to reinterpret issues surrounding the field concept in terms of the idea of the ether. More specifically, he believed the electromagnetic field could be construed in terms of a form of ether that conformed to the laws of Newtonian mechanics. Consequently, Maxwell assumed the ether possessed, among other things, mechanical properties such as mass and elasticity.

Because the ether was assumed to have a variety of mechanical properties, Maxwell believed phenomena such as electromagnetism would be propagated through the ether field at a finite velocity. Thus, he agreed with Faraday about the finite character of the propagation in the electromagnetic field, but he differed with Faraday concerning the reasons why this was the case.

Maxwell's theoretical task became a matter of constructing a model of electromagnetic phenomena in terms of a sort of mechanical ether. He had to show how the mechanical ether was able to induce phenomena to not only propagate at a finite velocity, but to propagate in a way that was in agreement with what was already known about electrical and magnetic phenomena.

One of the primary reasons for Maxwell's shift in perspective away from Faraday's field concept is because the idea of the ether lent itself to exploitation by means of mechanical analogs in a way that Faraday's fields of force did not. In other words, the idea of the ether had heuristic value in as much as its somewhat amorphous character allowed Maxwell to build a variety of mechanical properties into it that collectively were capable of reflecting many of the structural characteristics of electrical and magnetic phenomena. Indeed, Maxwell's mechanical model of the ether permitted him to provide a unified means of describing phenomena such as electrical currents, static electricity, magnetism and the inductive effects resulting from the interaction of electrical and magnetic properties.

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<u>The method of analogies</u>

The method of analogies played a fundamental role in helping Maxwell to develop his theory of the electromagnetic field. Maxwell, of course, realized the mechanical analogs he was using to represent electrical and magnetic phenomena were not correct. That is, he did not feel the electromagnetic field possessed the sort of mechanical structures in which his model was rooted. At the same time he believed models that were false in certain ways still could help uncover various aspects of the truth.

Thus, even if, ultimately, his mechanical model did not accurately reflect the structural character of the electromagnetic field as far as showing how certain effects and properties actually (i.e., ontologically) were generated in that field, nonetheless, the model allowed him to develop a clear grasp of the sorts of properties and relationships that existed in the field. As a result, he would be in a position to transform his understanding into a mathematical description that would accurately reflect the properties and relationships that characterized the electromagnetic field.

When all is said and done, Maxwell derived a set of equations that conformed to the laws of Newtonian mechanics and that also permitted one to accurately reflect many aspects of the structural character of electromagnetic fields. However, his model left open, if not entirely unanswered, the identity of the ontological "mechanism" that was responsible for the phenomena of electromagnetic fields.

Among the mechanical analogs that Maxwell developed was the idea of vortices or eddies in the ether medium. These gave representation to magnetic phenomena.

Vortices were conceived of as being like flexible bars with a rough surface. He theorized that in any given locality of the field such vortices revolved in the same direction about axes that were roughly parallel with one another. However, as one moved from one locality in the field to other localities of the field, the properties of the vortices could change such that the rotational velocity of the vortex, or the direction of movement of the vortex about its axis, could vary due to differences in conditions prevailing in different localities of the field.

In addition, Maxwell proposed that the vortices were separated from one another by a medium made up of small electrical balls. These balls revolved about their own axes in a direction opposite to the direction of rotation of the vortices.

Movement of these balls constituted an electrical current. Moreover, by linking the mechanics of vortex behavior with the mechanics of the behavior of the electrical balls, Maxwell was able to bring electrical and magnetic phenomena in contact with one another within the context of the field.

The concept of a displacement current assumed a role of central importance to Maxwell's theory of the electromagnetic field. According to Maxwell, when a displacement current occurred at a particular point in the field, this was due to a change in position of a given electrical charge.

Such a transition in electrical displacement would have, associated with it, a magnetic field that would spread out at right angles from the path of the displacement current. Since the magnetic field would be mirroring changes in the displacement current, the changes in the magnetic field would bring about further electrical displacements as a result of the moving magnetic field's capacity to generate electromotive forces of induction.

This dialectic of electrical displacements, leading, in turn, to the emergence of a magnetic field, that would lead to further electrical displacements, and so on, would go on for an indefinite period of time and would spread throughout the field. However, neither Maxwell, nor anyone since him, has been able to provide a tenable account of why displacement currents should be able to generate the ensuing complex of interacting fields and waves.

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<u>Some field components and their hermeneutical counterparts</u>

The following terms form the basis for many of the components of Maxwell's equations:

(1) 'j' -- stands for the intensity of current at a given point in the field, and, in Maxwell's mechanical model, it is calculated by the number of balls that pass a given point per unit of time;

(2) 'H' -- represents the intensity of the magnetic force, which Maxwell measured by calculating the speed of the vortex (the mechanical analog-image that Maxwell devised to help him think about how magnetic force might manifest itself) at its surface. Maxwell contended that magnetic force arises from the centrifugal force of the vortices:

(3) 'mu'-- gives expression to the magnetic permeability of a given field as measured by the average density of the vortices in that field;

(4) (mu)(H) squared -- the kinetic energy of the rotating vortices is proportional to this; the energy of the magnetic field is expressed in terms of such kinetic energy;

(5) 'E' -- constitutes the part of the electromotive force that is due to induction. In terms of Maxwell's mechanical model, when two adjacent vortices have differences in rotational velocity, there will be a tangential force exerted on whatever electrical particles exist between the vortices. This tangential force is E. Thus, for Maxwell, electromotive force is a function of the field stresses that impinge on the mechanism (whatever its identity turns out to be) which links together various kinds of motion in the field:

(6) 'A' -- refers to the vector potential or electrotonic state that is associated with the momentum of the vortices in a field. Electromotive force is functionally dependent on changes in the momentum of the vortices. Moreover, the electromagnetic induction of currents emerges in contexts In which the changing velocities of various vortices brings into play forces capable of generating such induction activity;

(7) 'D' -- is the label given to the displacement or elastic distortion to which any given electrical ball is subjected. When electrical balls are rooted in a dielectric, the mechanical model does not permit them to move, but the balls can be distorted by the forces that are acting on them. How much distortion will occur will be a function of both the character of the forces acting on the ball, as well as the elastic properties of the ball. Maxwell demonstrated that a change in displacement is capable of generating a magnetic field, just as a conduction current is capable of doing so. The displacement current constitutes the rate at which the displacement component changes over time -- $\delta D / \delta t$. In short, Maxwell held that electric displacement was functionally dependent on the degree to which the mechanism connecting different modes of motion in the field displayed elasticity in the context of forces that were impinging on that connecting mechanism;

(8) 'ε' (Epsilon) -- is the dielectric constant or inductive capacity of a medium;

(9) ψ (Psi)-- concerns the electrical potential or tension that is exerted by the electrical particles on one another. This pressure is the source of charge in Maxwell's model. The differential pressure that is exerted on the sides of an electrical particle generates the part of the electromotive force that is due to static electricity. For Maxwell, a charged body is the result of a net pressure being exerted on the surrounding dielectric by the electrical particles of that body;

(10) 'curl' -- a modern term (i.e., although this term was not used by Maxwell, it does refer to a concept of his) that is used to express the idea of a rotating torque that is exerted on any small electrical ball that might be placed at a given point in a force field. According to Maxwell, one can state the motion of the electrical balls (i.e., the electrical current) as a function of the differentials in vortex speed (known as

magnetic intensity) which occur from place to place in the field. The term 'curl' refers to this function.

(11) ‘div’ -- refers to the divergence of a given current. According to Maxwell, the divergence of the total current of a field is zero, and in this sense, divergence is a mathematical property of the total current of any given field. In the context of field exhibiting displacement currents, Maxwell interpreted the fact that the total current of a field has zero divergence to mean that all of the total currents of the field form complete or closed circuits.

(12) ‘rho’ -- refers to the charge density of a conductor;

(13) ‘r’ -- represents the resistance in a conductor;

(14) ‘v’ -- is the velocity of a moving conductor;

j, E, D, H, A and v are all vector quantities, whereas: ’psi,’ ‘mu’, ‘rho’, and ‘r’ are all scalar quantities.

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The sections (a) -- (j) on the next several pages constitute a few of the possible hermeneutical/phenomenological counterparts to some of the foregoing concepts of Maxwell's electromagnetic field theory. Moreover, like the latter theory, the ensuing concepts can be incorporated into a set of field equations (See Appendix 5)

However, the hermeneutical field equations, unlike their electromagnetic counterparts, are, at the present time, still qualitative. In order to become quantitative, some appropriate means of rendering them into operational terms would need to be discovered.

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(a) The dialectic of focus and horizon (whether in the context of point-structures, neighborhoods, or latticeworks) is given expression through the exchange of phase quanta and the establishment of phase relationship states. This dialectical involves cyclical/oscillating activity that is manifested through different waveforms that are described by a set of constraints and degrees of freedom.

The displacement current is a waveform that alters the ratio of constraints and degrees of freedom at a given point in the dialectic of focus and horizon. By altering the ratio at a given point in the dialectical process, this sets in motion a chain of alterations of ratios in various other point-structures, neighborhoods or latticeworks that are contiguous to (that is, interact with) the ratio or set of ratios that have been altered by the displacement current that gives expression to the effect of a given order-wave.

The effect of the initial displacement current radiates outward from the path of the current, cutting across other lines of force or phase relationships in either focus and/or horizon. This results in switches of focus as well as results in the introduction of a variety of horizonal (e.g., memory) components. The introduction of horizonal material can lead to further switches in focus, just as switches in focus can lead to the further introduction of horizonal vectors, whether in the form of memories, or learning or emotion or beliefs or values or motivations or desires or needs or problems.

(b) Phenomenological waveforms and hermeneutical waveforms are generated by the dialectic of focus and horizon. In the case of phenomenological waveforms, the focal/horizon dialectic gives expression to a framework of reflexive awareness. Awareness is the focus, and the tacit intuiting of the constraints of the range of such awareness forms the horizonal boundaries. In the case of hermeneutical waveforms, the focal/horizonal dialectic is expressed in terms of the activity of the hermeneutical operator (combining the operations of: (1) identifying reference, (2) reflexive awareness, (3) characterization, (4) the interrogative imperative, (5) inferential mapping, and (6) congruence functions) that engages various horizonal considerations and works toward a hermeneutical orientation as this operator cuts across the lines of force existing in both focus and horizon.

The hermeneutical framework that exists at a given time gives equal expression to both focal and horizonal components. The intensity, immediacy and resolution of focus is counterbalanced by the depth, breadth and pervasiveness of horizon.

(c) The hermeneutical/phenomenological counterpart to the idea of magnetic permeability might be construed in terms of the receptivity or sensitivity of a given point-structure, neighborhood, or latticework that is to be induced into dialectic activity by other point-structures, neighborhoods, and latticeworks. There might be differences of active and passive potential that are intrinsic features of a given point-structure, neighborhood or latticework, and such features will affect the direction of dialectical currents that arise.

In this sense, some mediums are more permeable to forces of induction than are other mediums. Moreover, different phenomenological/hermeneutical mediums (e.g., ideas and attitudes) will be preferentially oriented toward (and, therefore, selectively permeable to) different forces of phenomenological/hermeneutical induction.

(d) The hermeneutical counterpart to the notion of charge density concerns the quality of intensity that is associated with a given aspect of phenomenology or hermeneutical activity.

(e) The component of elasticity can be rendered in terms of a ratio of constraints to degrees of freedom in the sense that the more degrees of freedom that are present, then the more elastic or flexible is the point-structure or neighborhood or latticework that displays such a ratio. On the other hand, if a given structure manifests a preponderance of constraints over degrees of freedom, then, it tends to be more rigid, or less elastic and flexible.

Previously, entropy was construed in terms of the ratio of constraints and degrees of freedom. One could conceive of elasticity as a particular facet of entropy. Thus, hermeneutical structures exhibiting a high degree of entropy will manifest a low degree of elasticity or flexibility with respect to their capacity to exhibit congruence properties. Similarly, hermeneutical structures exhibiting a low degree of entropy will display a high degree of elasticity in the way their manifolds 'cover or reflect an issue.

(f) The hermeneutical counterpart to the notion of curl might have to do with the set of tensors that impinge on focus and generate an orientation through which focus is expressed. The idea of orientation has something of the quality of torque about it.

Orientation gives expression to a sort of hermeneutical twisting. This leads to cyclical activity in and about an attractor basin whose shape is a function of the character of the tensor forces that are present and impinging on focus. Furthermore, treating orientation as an expression of a sort of torque force also suggests something of the difficulty that is involved in bringing about changes in orientation (e.g., certain kinds of entrenched attitudes) because of the complexity and strength of the tensor set that is generating such an orientation.

(g) The hermeneutical counterpart for the property of resistance involves the aspects of a spectrum of ratios of constraints and degrees of freedom that actively or passively resist being induced to manifest themselves in a given way under certain circumstances. As such, resistance would seem to be a property of the particular qualities of a given dialectic, rather than some autonomous, independent property that manifests itself in the same way under all circumstances.

(h) The ideas of divergence and free electricity have a hermeneutical counterpart in the ideas of bound and unbound hermeneutical operators. Bound operators function according to the constraints and degrees of freedom that color, shape, orient, direct, and organize the operator's activity as a result of certain values, beliefs, ideas, commitments, assumptions, emotions, and so on.

In this sense, the bound hermeneutical operator represents something akin to the idea of the property of divergence that indicates that the currents of a field are closed circuits. The bound hermeneutical operator also constitutes something of a closed circuit since its character is described by the set of constraints and degrees of freedom to which the hermeneutical operator is bound through a given value, belief, attitude, idea, emotion, and so on.

Unbound hermeneutical operators, on the other hand, engage various aspects of the phenomenology of the experiential field in a way that is -- relative to bound operator activity -- sensitive, if not receptive, to the currents, eddies, vectors and other properties of that phenomenology. However, unbound hermeneutical operators do not impose value structures onto the experiential field as bound hermeneutical operators do. In this sense, unbound hermeneutical operators are a bit like the idea of free electricity and have a certain amount of latitude to be able to generate new circuits whose shape and character will be a function of the dialectic between such unbound hermeneutical operators and whatever aspect of phenomenology or ontology is being engaged.

(i) A dielectric is a nonconductor of direct electrical current. It refers to the aspects of resistance in a given medium to the conducting of an electrical current. Presumably, there are elements in the phenomenology of the experiential field -- or, more particularly, in the hermeneutics of the phenomenology of the experiential field -- which are resistant to the conducting or induction or propagation of a hermeneutical current.

The question, then, becomes whether this resistance is a constant in different hermeneutical and phenomenological contexts, and if this is the case, whether one could identify what it is in such media that is contributing to the resistance of hermeneutical currents. In general terms, it seems intuitively attractive to suppose there are elements in the intellectual, emotional, sensory, and spiritual contexts that might be resistant to the conducting of certain kinds of hermeneutical currents.

Biases, prejudices, attitudes, delusions, and beliefs are obvious examples in the context of intellectual issues. The absolute refractory period of neuronal functioning is an example on the level of biological activity. In addition, negative emotional forces such as envy, pride, anger, and jealousy might serve as examples on the level of emotion that would pose an inherent resistance to the propagating of hermeneutical currents involving, say, love, compassion, generosity, humility, and so on.

(j) Reflexive awareness, identifying reference, characterization, the interrogative imperative, inferential mapping, congruence functions and emotions are all vector quantities. Experiential intensity might be -- depending on circumstances -- either a scalar or vector quantity.

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<u>The special theory of relativity</u>

Around the turn of the twentieth century, scientists could make predictions about the character of the relationship between the temperature of a given body and the kind of wavelength of light it gives off when radiating at that temperature. The means used to make such predictions involved marrying the principles of statistical mechanics to Maxwell's electromagnetic equations. Unfortunately, the theoretical predictions that were made on the basis of such a methodological union frequently did not agree with empirical measurements.

Max Planck had suggested in 1900 that one might be able to resolve the problem of black-body radiation (e.g., what wavelength of light will be radiated by a given object or body that is heated to a certain temperature) if one were to suppose light were emitted from such bodies only at certain levels of energy. These energy packets would be multiples of a value 'h', derived by Planck, and known, henceforth, as the Planck constant.

Einstein made use of Planck's proposal in the former's 1905 paper on the photoelectric effect, the phenomenon in which electrons were observe to be emitted from various solid, liquid, or gaseous materials when exposed to radiation of certain wavelengths. Essentially, Einstein argued the photoelectric effect could be understood as a function of the absorption and emission of discrete bundles of energy.

While the work of Planck and Einstein helped resolve some of the issues surrounding the problem of black-body radiation, it also helped give rise to a further problem that had far-reaching implications. For example, the idea of a discrete, particle-like, bundle of energy was difficult, to say the least, to reconcile with Maxwell's theory of electromagnetic fields in which light, as one form of electromagnetic radiation, supposedly was propagated in the form of a wave.

Einstein began to look for principles he hoped would be capable of withstanding whatever theoretical and methodological reconstruction might have to take place with respect to the "classical" mechanics of Newton and Maxwell that were under assault by the changes taking place in physics around the turn of the century. Thus, in another of his famous three revolutionary papers written early in the twentieth century, he advanced his theory of special relativity as a way of helping to bridge the transformations taking place.

In 1905 Albert Einstein put forth his ideas on special relativity. The "special" aspect of his first paper on relativity reflects his focus on the relation of different frames of reference that were traveling with a constant, rectilinear (either in straight lines or at right angles) motion relative to one another.

One might think of a frame of reference as the vantage point from which one methodologically engages or measures a given phenomenon of physics. Frames of reference that traveled with a constant, rectilinear relative to one another were known as "inertial frames of reference". Consequently, because there were many other kinds of non-linear motion possible for a given frame of reference, Einstein was initially interested only in the special case of rectilinear relative motion.

According to Einstein, the principle of special relativity was intimately connected with all physical phenomena. In effect, this principle stipulates that irrespective of the motion of a given observer relative to any other observer, the laws of nature will be the same for all observers. Another way of stating the same idea is to say that the laws of nature are independent of the kinds of motion that different observers have with respect to one another.

In other words, the special theory of relativity is, at heart, about the invariance of physical laws and, therefore, about that which transcends the relative motion of observers within different frames of reference. Unfortunately, many people have remembered the "relative" part of the theory but entirely have forgotten (or never, actually, knew) the real significance underlying Einstein's seminal 1905 paper.

Ironically, the popular misconception of the theory of relativity as being mainly about how reality tends to appear, or look, differently, relative to one's point of view was aided and abetted by Einstein himself. More specifically, apparently, Einstein was once reported to have glibly explained the theory of relativity as somewhat akin to how sitting on a hot stove for a minute seems like an hour and sitting next to a beautiful girl for a minute seems like an hour.

He might have had his tongue firmly in his cheek when he said this. However, many people have been misled by the imagery ever since that time.

In any event, earlier, in the late 1500s, Galileo also had put forth a principle of relativity. He maintained that various laws of motion he had been exploring retained their invariant form as laws even if the coordinate framework of an observer was subjected to different transformations such as rotation, translation (motion in which all the parts of an object move in the same direction), and so on. In other words, physical laws of motion were independent of the sorts of geometric transformations that might be performed on any given coordinate system being used by an observer to represent the motion in question.

Nevertheless, there is a major difference between Galileo's principle of relativity and the principle of relativity advocated by Einstein. This difference concerned the role that time played in the two theoretical frameworks.

Galileo believed the laws of motion were the same independent of the frame of reference being considered. However, the transformations in Galileo's theory (which showed how one frame of reference was the equivalent of other frames of reference vis–à–vis, say, a particular law of motion) only were performed on the "spatial" coordinates of the frames of reference being considered.

Galileo considered the time coordinate to be absolute. That is, the time coordinate was the same for all observers in all inertial frames of reference. Consequently, according to Galileo, there was no need to translate the time component from one frame of reference to another as had been done in relation to the spatial component.

For Galileo, spatial coordinates could be moved, rotated and twisted. Time, however, was inviolate and not subject to changes.

One of the revolutionary facets of Einstein's special theory of relativity was the manner in which it departed from the classical treatment of, or approach to, time as an absolute. Indeed, Einstein argued there was, at least, one law of nature -- namely, the Maxwell equations for electromagnetic phenomena -- in which time could not be treated as an absolute.

Einstein contended that if one treated time as an absolute, then Maxwell's equations altered their character in certain ways as one moved from one frame of reference to another. Therefore, when time was treated as an absolute, the laws of physics that were given expression through Maxwell's equations became dependent on, and were a function of, the character of the state of motion of a given observational frame of reference.

As indicated previously, Einstein believed the laws of nature were invariant and independent of any given observational frame of reference. Consequently, in order to maintain this view, Einstein argued that as one moved from one inertial framework to another, there was a need not only for the spatial coordinates of one framework to be translated into their equivalent counterpart in the new frame of reference, but there also was a need for one to translate the temporal coordinates of one frame of reference into their temporal "equivalents" in a new frame of reference that had rectilinear motion relative to the first framework.

In short, Einstein agreed with Galileo concerning the invariance of the "laws" of nature and that such laws were independent of the frames of reference through which these laws were experienced or engaged. At the same time, he disagreed with Galileo concerning the role that time played -- for Einstein, time was part of the fabric of a frame of reference and not part of the fabric of the invariant laws of nature.

However, Einstein did not believe that a principle of relativity that emphasized the invariance of physical laws was sufficient, in and of itself, to withstand the challenges to classical mechanics (in the form of Newtonian and Maxwellian theories) which were in the air at the turn of the century. Some additional factor was necessary.

This extra factor turned out to be the constancy of the speed of light. More specifically, Einstein assumed that, in ‘empty’ space, light would always be propagated at a constant velocity "c". Furthermore, he maintained the velocity of light is independent of the motion of the body that is emitting light, and, therefore, the speed of light would have the same value for all frameworks that were in uniform, rectilinear motion relative to one another.

The foregoing position gave rise to the problem of how to account for the constancy of the speed of light. After all, one might expect that the velocity of light should be subject to the same variability as were other spatial and temporal features of inertial frameworks.

Lorentz, prior to Einstein, had suggested that one would have to assign different times and distances to different frameworks that were in uniform, constant motion relative to one another. Then, one would have to use a set of transformation equations to show how the measured values in one framework could be related to the comparable variables being measured in other frameworks moving in constant, uniform motion relative to the first framework.

Lorentz believed one would have different values for the observables -- such as length, time, and so on -- being measured in inertial frameworks as a result of the effect that the ether imparted to systems traveling through it. 'The ether' was a hypothetical idea adopted by many physicists of the 19th and early twentieth century and was believed to be the spatial medium through which all bodies were assumed to move.

This facet of Lorentz' perspective was unacceptable to Einstein. Einstein was interested in developing a position that would be independent of considerations of 'the ether' -- a problematic theoretical entity.

Although the relativistic transformation equations derived by Einstein -- in order to preserve the constancy of the speed of light in all frameworks -- had precisely the same form as Lorentz's transformations equations (which had been constructed with the idea of taking into account the effect that movement through the ether was assumed to have on physical/material objects), Einstein understood the same equations in a very different way than did Lorentz. Einstein had been led to the Lorentz transformation equations by rethinking the ideas of length, time, and simultaneity and not through the causal effects of the ether.

In Einstein's relativistic theory, measurements involving time, length, and so on, could have different values in different inertial frameworks despite being tied to one-and-the-same observed event. Variability of such measurements relative to a given event was permitted in order to be able to preserve the velocity of light as a constant, and the constancy of the velocity of light is a fundamental building block in the invariant character of the laws of classical physics involving the basic equations of Maxwell and Newton.

By reworking the mathematics of the Lorentz equations (which are still known as Lorentz transformations despite the differences in the manner in which they were generated and understood), Einstein showed that the inverse of a Lorentz transformation is itself a Lorentz transformation. This meant that in systems that were in uniform relative motion with respect to one another, differences in measurements for length, time, and mass taken for a given event within one inertial framework would be reflected reciprocally --

through the Lorentz transformation equations -- in other inertial frameworks conducting their own set of measurements involving the same event.

Thus, despite differences in the values for length, time, mass, and so on, that might be obtained in inertial frameworks linked to one and-the-same event, each of the inertial frameworks observed the same laws of physics in operation. In other words, when one looked at an event through Einstein-filtered glasses involving the Lorentz transformations, then one could "see" that the cement that bound together the different measurement values of various inertial frameworks linked to a common event was the fact that the general character of physical laws remained intact when one translated the results of measurement in one inertial framework with the results of measurement in other inertial frameworks observing the same event. In short, measurement across inertial frameworks could be shown to be relative, but the laws of physics manifested in these same inertial frameworks remained invariant.

For Einstein, the fact that the inverse of a Lorentz transformation could be shown to be a Lorentz transformation, as well, had another significant meaning. It meant there was no inertial framework that could be demonstrated to have a preferred stationary position relative to the ether, and, therefore, there was no framework that could be used as a sort of ontological ground zero through which one could calibrate the relationship of all other frameworks vis–à–vis some given physical event.

Another way of saying the same thing is to maintain that the ether -- if it existed at all -- could not be shown to have any causal effect on variables such as length, time, or mass within inertial frameworks that were in uniform, constant motion relative to one another. For, in order to be able to demonstrate that the ether did have such a causal impact, one would have to be able to identify some framework as being stationary relative to the ether and, therefore, capable of being used to establish a baseline against which the impact of the ether on non-stationary frameworks could be measured.

Absolute motion could not be detected. Only relative motion was measurable, and it was only the relative motion of inertial frameworks that were tied to a given event that would affect the measurements made in such linked systems. Yet, irrespective of whatever differences in measurement might arise from one inertial framework to another relative to some given event, each of the frameworks would be able to show, via the Lorentz transformation equations, that the same laws of physics governed the event being observed irrespective of the framework of measurement and relative motion that one selected.

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Methodology, fields and uncertainty

Einstein's special theory of relativity is largely a theory about methodological issues. There are, to be sure, certain ontological overtones that exist in Einstein's special theory of relativity.

For example, one such overtone is his assumption that the speed of light is independent of the state of motion of the body from which it is emitted. This sort of overtone aside, however, most of his paper on the electrodynamics of moving bodies involves a methodological reworking of concepts such as time, length, mass, synchronization, and so on.

More specifically, the reworking is done, on the one hand, in terms of the manner in which the process of measurement shapes one's understanding with respect to the character of various aspects of experience. In other words, the way one makes an idea (which is a form of the process of characterization) operational shapes the way one engages and understands ontology.

For instance, when Einstein says time is what a clock measures[1], he colors his understanding of the ontology of time. The coloring comes from the character of the means he uses to operationalize -- for purposes of quantifying and measuring -- the ontology of time.

There also is another aspect to Einstein's methodological reworking of the meaning of some of the basic concepts of physics. This aspect concerns the manner in which one goes about translating the measured values obtained in another framework that has relative uniform motion with respect to one's own framework. In short, this aspect revolves around the methodology of translation between or among different frameworks.

Each of the foregoing aspects of the methodological reworking of basic ideas of physics doesn't really say much about the structural character of ontology ... except indirectly. In effect, Einstein is exploring some of the constraints and degrees of freedom of ontology as far as how one can methodologically interact with that ontology in the context of doing comparative studies with observers in other frameworks who have relative uniform motion with respect to one.

The principle that: the inverse of a Lorentz transformation is, itself, a Lorentz transformation, says absolutely nothing about the structural character of ontology. What it does say is: (a) the methodologies of systems involved in relative uniform motion are tied together in certain ways; (b) our perceptions and interpretations of how such methodologies are employed in other observational frameworks is rooted in, and shaped by, methodological considerations; and, (c) our understanding of what goes on in our own observational framework is rooted in, and shaped by the manner in which we operationalize terms in that framework in order to be able to quantify and measure events that occur in that framework.

The idea of relativistic effects is often given an ontological flavor such that, for example, time paradoxes are permitted to have ontological implications. Thus, supposedly, one and the same clock can, in an ontological sense, run both faster and slower at the same time, just as a Lorentz transformation and its inverse -- which are mathematical structures -- can exist simultaneously.

Herbert Dingle, in his book 'Science at the Crossroads', seems to be taking issue with just this aspect of the special theory of relativity. He is commenting on, and criticizing, the tendency of people to interpret the special theory as an ontological theory that provides an accurate description of certain aspects of reality. Indeed, if one does suppose that the special theory of relativity is primarily about ontology, then one does end up with a number of paradoxes, some of which are pointed out by Dingle.

On the other hand, if one likens the special theory of relativity to the invention of a better calibrated ruler or measuring device, then although the new measuring device does not, in and of itself, say anything about ontology, it does alter the structural character of one's engagement of ontology. As a result, the measuring device might improve certain aspects of one's understanding of ontology because it provides a means of compensating for certain factors that are capable of distorting the way in which one's mode of methodology engages ontology during the measurement process.

The special theory of relativity leaves the laws of nature unchanged. The special theory of relativity is intended to show that the laws of nature are invariant despite the fact that the measurements for different variables such as time, mass, length, and so on, might vary from one framework to another in relation to the observation of one-and-the-same event.

Apparently, the best way Einstein could think of to demonstrate invariance among a variety of frameworks that have uniform relative motion with respect to one another, was to re-calibrate the methodology. He did this by using the constancy of the speed of light as the value that is to guide the re-calibration process as one goes from one locality to another. This re-calibration is accomplished through the transformation equations that are themselves rooted in a reworking of the meaning of such basic concepts as time, simultaneity, length and so on.

In a sense, what Einstein has done in the special theory of relativity is somewhat analogous to what Maxwell has done in arriving at his electromagnetic field theory. Maxwell used a method (namely, the method of analogies) which generated implausible mechanisms in order to make certain relationships visible and certain calculations possible.

Despite such implausibilities, Maxwell's method yielded results that not only were in agreement with empirical results, but also tied together, in a unified way, a wide variety of electrical and magnetic phenomena. So, even though the mechanisms utilized by Maxwell did not appear to be likely candidates to accurately reflect how (in an ontological sense) things happened in the context of electromagnetic field, nonetheless, use of such mechanisms (analogies) led to results that were able to accurately reflect, to some extent, the invariant character of the effects that ensued from the unknown how's of such fields.

Einstein, too, has employed a method (namely, the special theory of relativity) which generated implausible mechanisms (e.g., time should simultaneously run both faster and slower) in order to make certain relationships visible and certain calculations possible. Despite such implausibilities, Einstein's method, yielded results that were not only in closer agreement to empirical findings than were the results derived from the methods of Newtonian mechanics, but that also tied together, in a unified way, a wide variety of physical phenomena. Therefore, even though the relativity methodology did not appear to be a likely candidate to accurately reflect how (in an ontological sense) things actually happened in the context of, say, the electromagnetic field, it led to results that were able to accurately reflect, to a degree, the invariant character that was inherent in the unknown how's of such fields.

In short, Einstein's special theory of relativity didn't get one any closer to understanding the 'how' of things, but it did bring one closer to a more accurate representation of what that unknown 'how' made possible. His method accomplished this by sensitizing one to the way methodological engagement affected processes of observation, measurement, interpretation and translation. This leaves open the possibility that just as Einstein found his way to a methodological improvement concerning Newtonian mechanics, someone also might be able to discover a means of improving on the methodology of Einstein's special theory of relativity in a way that would not entail problems such as the twin paradox, or having one and the same clock running both faster and slower at the same time, and so on.

What is essential in all of this is not so much Einstein's methodology in particular, but the effect of that methodology in allowing one to generate a more accurate description of certain aspects of our engagement of ontology, while preserving the invariance of the laws of nature as one moves from one observational framework to another. If one could come up with an alternative means of accomplishing what Einstein's methodology accomplishes, yet, that is free from some of the problem's of Einstein's special theory of relativity, then this new approach to things would constitute an improvement, once again, in the manner in which we methodologically engage certain aspects of reality.

However, one might not be able to eliminate, or by-pass, the problems inherent in Einstein's methodology, for such problems might give expression to certain limits in the character of rational methodology itself. More specifically, there is a sense in which the problems that occur in Einstein's special theory of relativity might serve as something akin to Heisenberg's uncertainty principle.

Heisenberg indicated that the very process we use to observe phenomena can disturb, if not distort, the character of what is observed and, thereby, place limits on the extent to which reality can be known. So too, one of the effects of Einstein's special theory of relativity might be to indicate that the very methodology that is used to preserve the invariance of the physical laws of the universe interferes with our ability to establish certain facts about the universe. For example, one might not be able to determine the actual structural identity of a given event independent of its being embedded in a network of assumptions and methodological considerations concerning measurement and relative motion.

Einstein's methodology permits one to see that a given event is law-governed. His methodology also permits one to see how the structural forms of the laws that are operative, manifest themselves according to the manner in which different observational systems engage a given event.

However, Einstein's methodology obscures one's vision of the actual ontological character of that which underlies the event. One sees relative mass, velocity, length, and time, but one does not see the actual mass, velocity, length or time of an event.

One sees only what one's methodology permits one to see. In a sense, the methodology becomes like a modern heir to the Kantian categories.

Consequently, Einstein's methodology introduces an element of uncertainty concerning the nature of reality. As is the case with quantum phenomena, one can approach the actual structural character of reality only up to a point. Beyond that, the methodology itself prevents one from getting any closer. Indeed, the attempt to get closer only leads to problems, paradoxes and distortions.

In other words, within certain limits, the methodologies of both quantum physics as well as relativistic physics help one to grasp the structural character of certain aspects of ontology. However, if the boundaries of these methodological limits are ruptured or exceeded, an increasing element of indeterminacy and/or uncertainty is introduced into the proceedings. As a result, one's vision of certain aspects of ontology becomes obscured.

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Measuring the temporal

Maxwell's equations were accepted by scientists as reflections or embodiments of certain aspects of the invariance inherent in the character of the laws governing natural phenomena. If one treated time as an absolute, Maxwell's equations produced variable results as one moved from one frame of reference to another.

Thus, if one wanted to retain these equations, then one had to make adjustments in the manner in which one methodologically approached the issue of time. Einstein did this by requiring the temporal component of a coordinate system to be subject to the same translation process as the three spatial components of that same coordinate system.

One of the mistakes that might have been made in classical mechanics is that the measurement of time was considered to be absolute in the same way that time itself was considered an absolute. Measurement is affected by a variety of forces operative in a given framework (and time is but one such dimensional force), whereas time's ontology is not necessarily affected by such things at all.

In other words, the structural character of the ontology of time might be such that it permits a range of possible dialectics between itself and various modes of measurement that might engage it. While the mode of measurement will be sensitive to a variety of forces that will affect its capacity to get an accurate reading of the character of time, the dimension of time is not affected by any of these forces.

As such, although time acts upon, and shapes, whatever engages it, time might not, in turn, be affected by the activity or character of any of the entities or forces that it engages. In this sense, ontological time (as opposed to measured time) could be said to have perfect elasticity, since no matter how it is engaged or by what it is engaged, ontological time retains its original structure without displacement affects ensuing from such engagement.

In any event, part of Einstein's revolution was to draw our attention to the extent to which the measurement of time is extremely sensitive, under certain circumstances, to the effects of motion, gravitational fields, and so on. Nonetheless, as indicated earlier, nothing that Einstein said could be considered to carry any necessary entailments with respect to the ontology of time itself. (1)

The scientists from Galileo onward -- up to the time of Einstein -- made a mistake when they assumed that because the ontology of time is everywhere the same, therefore, the measurement of time must everywhere be the same. They failed to properly understand the complex nature of the relationship between methodology and ontology.

For instance, they failed to understand that the hermeneutical engagement of time, as expressed in terms of some mode of measurement, constitutes a process of making operational the temporal dimension and comes to be used as an index for such hermeneutical engagement. This index of measurement is dependent on the state of motion, or on the state of the conditions of gravitation, in which the measurement index is embedded. In other words, the scientists from Galileo up to the time of Einstein failed to understand that the measurement of time is relative to the frame of reference in which the measurement takes place since the latter is affected by the conditions and forces that prevail locally within that frame of reference.

Since the time of Einstein, there also has been an erroneous assumption that has been made. This faulty assumption is the reverse of the mistake by Galileo, Newton and others.

Whereas Galileo, et al, had mistakenly assumed that because the ontology of time is everywhere the same, then therefore, the measurement of time must everywhere be the same, Einstein, and subsequent generations, have mistakenly assumed that because the measurement of time will vary from framework to framework, therefore, the structural character or the ontology of time also will vary from framework to framework. This need not be the case.

The ontology of time might be independent of one's mode of measurement. However, the mode of measurement is not independent of the structural character of the ontology of time since the latter establishes the parameters within which any given mode of temporal measurement must operate.

The confusion between the measurement of time and the ontology of time carries over into another issue of some importance to the theory of relativity -- namely, the problem of simultaneity. In a sense, this problem is really only a variation on the measurement issue discussed previously. As a result, there is a failure to keep a clear distinction between the measurement of simultaneity and the idea of absolute simultaneity as an expression of the actual nature of ontology.

When one says the word "now", the instant required to say that word exists simultaneously everywhere in the universe. This is an intuitive example of absolute simultaneity. However, once one undertakes to measure the instant in question and to attempt to compare the measurements taken, then one encounters all the problems of simultaneity about which Einstein talked and wrote.

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The idea of an order-field

If one treats changes in the ratio of constraints and degrees of freedom as evidence of the presence of one or more forces, then several questions that need to be asked are these: first, how does a force bring about a change in the ratio of constraints and degrees of freedom? Secondly, what is the relationship between a force and a field?

These questions will not be answered in their entirety within the context of the present chapter. What is being offered here is more like pointing in a certain direction and identifying a few of the components. It is an unfinished sketch to which an increasing amount of detail can be added over time as new data and understanding become available.

Part of the answer to the foregoing questions concerns the idea of an order-field. An order-field is generated through the dialectic of a set of dimensions. The structural character of these dimensions is an expression of a spectrum of various ratios of constraints and degrees of freedom that have been established by the underlying order-field. This underlying order-field induces and/or permits different aspects of the spectrum of ratios to engage one another.

The ensuing engagement generates a further spectrum of ratios that give expression to the character of the dialectic between, or among, different dimensions. This dialectic of dimensions generates, in turn, a further spectrum of ratios of constraints and degrees of freedom that give expression to point-structures, in neighborhoods, and latticeworks on different levels of scale.

At the heart of any field theory -- whether it be rooted in Faraday's idea of a force, or in Maxwell's model of a mechanical ether, or in the geometry of Einstein's general theory of relativity -- is an antagonism to the concept of Newton's idea of action-at-a distance. Field theories are all predicated on the principle that the dynamics of the field, the dialectical activity of the field, is a function of contiguous events. Field theories differ from one another in the manner in which they attempt to account for the structural character of the contiguous relationship among various aspects of the field and how effects are propagated through the field by means of such contiguity.

Consequently, an order-field constitutes a field due to the way that the underlying order has contact, in some sense, with, or is contiguous with, each aspect of the fundamental dimensions that have been established. The order-field also gives expression to field properties in the way it has contact with the dialectic that it induces these basic dimensions, and from that emerge various point-structures, neighborhoods, and latticeworks. All of this contact is accomplished through the spectrum of ratios of constraints and degrees of freedom out of which dimensionality and dialectical activity initially arise.

Thus, the order-field is present at each and every point of these spectrums, on whatever level of scale one cares to consider ... from the microcosmic to the macrocosmic. This presence manifests itself as a field that organizes, arranges, shapes, directs, orients and generates all structures and structuring activity.

These structures and structuring activities are waveform manifestations of the way the order-field gives expression to itself as a result of operating on itself. So, the order-field is more akin to the contiguous character of Faraday's notion of a force field, than it is to either the action-at-a-distance field concept of Newton or the bifurcated matter/field concept of Maxwell.

Nevertheless, the order-field being proposed here is different from Faraday's notion of a force field. From the perspective of the theory being put forth in this essay, the idea of a force is itself an index of the presence of an order-field, manifesting itself in a form that results in a change in a given ration of constraints and degrees of freedom.

Consequently, as such, force is not the basic constituent of the universe as it is for Faraday. Force is, instead, itself a manifestation of something more fundamental -- namely, order. The structural character of any given force is a function of the ratio, or set of ratios, of constraints and degrees of freedom that have been arranged through the presence of ontological and metaphysical order.

The range of a force is described by the series of point-structures, neighborhoods, or latticeworks whose altered character can be traced to the presence of a capability for bringing about a transformation in the ratio(s) of constraints and degrees of freedom of the observed kind. The path of a force is described by the vectored or tensored series of point-structures, neighborhoods, or latticeworks whose alteration in ratio character can be traced to the primary epicenter(s) of intensity of the force's presence, as opposed to secondary, aftershock effects that occur away from the primary points of field intensity. The structural character of either the range of a force or the path of a force need not be simple or linear in nature.

The notion of an order-field provides a potential means for any given point of time/space to be in "contact" with any other point of time/space by means of the dialectic of phase relationships through which the ratios of constraints and degrees of freedom are given expression. However, these junctions of contact are not necessarily physical in character ... after all, there might be other dimensions than those that pertain to the physical/material world.

Furthermore, the dialectic connecting various neighborhoods does not need to be construed in terms that require the transmission of physical signals between points that are spatially separated. The points of contact are manifestations of the dialectic of dimensions that have been set in motion by the underlying order-field. Thus, 'points' might be in non-physical contact on the level of the order-field, and this contact might manifest itself on the level of scale of physical events as simultaneous events between, or among, physical points separated by spatial distances.

Methodologically, one might not be able to demonstrate the simultaneity of such events because of the sorts of problems pointed out by Einstein concerning the measurement of simultaneity in relation to points that are physically separated. Nonetheless, ontologically, the events might be simultaneous expressions of certain facets of an underlying ontological and/or metaphysical order-field. Consequently, viewed from such a perspective, the ontological character of an order-field underwrites the simultaneity of events, not the mode of measurement.

On a given level of scale, a particular ratio of constraints and degrees of freedom expresses itself as a point-structure. A group of related ratios manifest themselves as a structural neighborhood.

In the hermeneutical context, neighborhoods tend to build-up (e.g. through learning and memory) around points of phenomenological engagement to which attention is directed and identifying reference is made. Indeed, attention and identifying reference mark the beachhead landing of the hermeneutical operator with respect to various aspects of the phenomenology of the experiential field. Whether -- and, if so, to what extent -- a neighborhood will bind the hermeneutical operator or whether the hermeneutical operator will remain relatively unbound will be a function of the dialectical engagement between (or among) the hermeneutical operator and a given neighborhood or neighborhoods.

Hermeneutical point-structures are not geometric points. In other words, they are not necessarily 'spatial' or simple in character. Consequently, unlike geometric points, hermeneutical point-structures cannot necessarily be construed as lacking an internal structure.

A point-structure is a ratio of constraints and degrees of freedom that give expression, when taken all together, to a form that can have multiple facets and themes. This suggests a potential for complexity of structural character.

A further flavor of complexity comes from the fact that what is a point-structure on one level of scale, might, on another level of scale, give rise to a neighborhood of point-structures or even a variety of latticeworks. As such, point-structures have the capacity to manifest fractal-like properties when engaged on different levels of scale.

Latticeworks are the result of a collection of neighborhoods that are held together by a set of phase relationships. These phase relationships establish identifiable patterns of focal activity, as well as identifiable patterns of horizonal boundaries, within which the collection of neighborhoods interact with one another.

Ratios of constraints and degrees of freedom are related to one another by means of phase relationships. More precisely, ratios are linked to one another by a spectrum of constraints and degrees of freedom that establish parameters within which phase quanta are exchanged between interacting ratios. Phase quanta are discrete arrangements of constraints and degrees of freedom that are drawn from the spectrum of arrangements that are possible in a given context of interacting point-structures, neighborhoods, and/or latticeworks established through a given order-field.

At any given time, if two point-structures or neighborhoods or latticeworks are linked to one another, the structural character of the link is an expression of one aspect of the spectrum of ratios that is generated by the underlying dialectic of dimensions. When such a link manifests itself, this is known as a phase quanta exchange, and this exchange gives expression to a state known as a phase relationship.

Thus, the phase relationship state encompasses the following sequence of activity. (a) It begins with first engagement of specific ratios; (b) proceeds through phase quanta exchanges (which are not necessarily physical in nature – quanta in this case being the smallest 'packet' of structural character that can be manifested without altering the nature of what is being expressed); (c) includes the alteration of the ratio character of the point structures, neighborhoods and/or latticeworks involved in the engagement process; and, (d) ends with the disengagement of previously interacting ratios.

Both the process of phase quanta exchange, as well as the state of phase relationship in which that exchange is embedded, are subject to the influence of differential, vectored pressure components. Sometimes the structural character of the way these vectored pressure components interact is complex and multi-dimensional.

When this is the case, the dialectic of components gives expression to tensor components that constitute a source of stresses capable of simultaneously pushing, pulling, twisting and stretching any given phase quanta exchange or phase relationship state. This is comparable to the manner in which Faraday's lines of force could be subjected to a variety of stresses and pressures within the electromagnetic field.

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Continuity in the context of the order-field

The order-field is continuous in the sense that a relay race is continuous. In other words, despite the presence of discrete elements (i.e., the runners for the different teams competing in the race), these elements are organized or arranged in such a way that one or more of the runners is always running throughout the race, although not all the runners will be running at any given instant during the course of the race.

The integrity of the continuity of the race is preserved because of the way the runners, taken as discrete elements, are ordered within the context of the rules that govern the running of the race. The primary characteristic of this ordering is that there should be an overlapping of one discrete element with another discrete element at different points of the race. This is the region within which the baton is passed on from one runner to the next.

Similarly, an order-field is continuous because the spectrum of ratios on any given level of scale will always be giving expression to one or more particular instances of the ratios that form that spectrum. Moreover, there is an overlapping of events that occurs between the expression of one ratio and a subsequent expression of another ratio drawn from the same spectrum.

This region of overlap is contained either in the phase relationship that links the two ratios that are being expressed, or it is contained in the mere contiguity of the events. In either case, as one ratio -- for whatever reason -- ceases manifesting itself, other ratios spontaneously will manifest themselves, or be induced to do so, even though there might be no causal link between or among such contiguous events, and all of this is traceable to the modes of manifestation being expressed through the order-field.

From the perspective of field theory, the laws describing the fundamental character of physical phenomena will be expressed in terms of a set of field variables, $f_v$. Each observer will map these field variables in a continuous fashion by means of a coordinate system that gives representational expression to three spatial components and one temporal component. However, each observer might use a different set of words or hermeneutical functions (of which mathematics is but one modality) to describe such space-time coordinate systems.

Irrespective of what labels might be assigned to the coordinate system in each frame of reference, the principle of relativity requires that the physical laws that are derived by various observers in relative motion with respect to one another must, nonetheless, be in one-to-one correspondence with each other. However, until one has devised a means of translating from the coordinate language of one frame of reference to the coordinate language of another frame of reference, one is in no position to establish whether or not the physical laws deduced in the different frameworks which are in relative motion to one another are capable of being placed in one-to-one correspondence.

On the other hand, if one is successful in generating a set of translations that: (a) allow one to move from one framework to another in a way that conforms to the invariant structural character of the physical laws of nature, and (b) is independent of the state of motion of any given observer relative to the state of motion of any other observer, then such a set of translations is known as a continuous transformation group. If one has a set of homeomorphic analog mapping latticeworks that preserve the invariance or symmetry of the laws of understanding independently of the state of dialectical engagement of any given hermeneutical observer with respect to some given event or phenomenon, such a set constitutes a continuous hermeneutical group. The methodology of special relativity theory might, in fact, be a special limiting case of the more general principle of hermeneutical relativity that is directed toward establishing invariance of structural character in the context of dialectical engagement of ontology by a number of different observational frameworks and their concomitant systems of measurement.

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Intersubjective hermeneutical activity

One encounters the social community of alleged 'knowers' and interpreters in the context of the continuous hermeneutical transformation group. This occurs in the following way.

In order for the invariance or symmetry of a given law of understanding to be preserved, one must establish congruence with that which makes phenomena of such structural character possible. The fact that various hermeneutical latticeworks of different observers are analogs of one another is not sufficient.

They must all preserve symmetry through generating congruence functions in relation to the structural character of the phenomenon to which all observers are making identifying reference. Only in this context of each hermeneutical framework having established defensible congruence functions with respect to some aspect of the structural character of reality would there be significance in being able to demonstrate that these different frameworks are analogs for one another.

At the same time, through the dialectic between, or among, different hermeneutical frameworks, members of the community can work toward uncovering facets of invariance in different aspects of the structural character of reality or ontology. In this sense, the hermeneutical activity of the community considered as a whole takes on the form of a hermeneutical operator that engages the point-structure products that are generated by individuals through the activity of their own hermeneutical operator.

In other words, the hermeneutical activity of the community as a whole forms a latticework in which the hermeneutical activity of individuals forms complex point-structures or neighborhoods (in the case of a number of people whose hermeneutical positions are similar but not entirely the same) within that community latticework. Thus, the hermeneutical activity of the community is an expression of the hermeneutical operator considered from a different level of scale than that of the individual.

Consequently, all of the basic components that are inherent in the individual's hermeneutical operator also are inherent in the community run hermeneutical operator. Furthermore, just as one finds different kinds of attractors on the individual level of scale, one also finds various kinds of attractors on the community level of scale.

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Substance, events and invariance

When one speaks of the invariance or symmetry of a law of understanding, it is important to understand that one is not talking about an abstract structure that is divorced from a concrete context. While invariant laws must be independent of the idiosyncrasies that might characterize the hermeneutical framework of any particular observer, such laws are not independent from the structural character of the aspect of ontology that is giving expression to this sort of invariance. Indeed, only when the hermeneutical framework of a given observer merges horizons with a certain aspect of ontology by means of congruence functions, could one say that the individual has grasped something -- on a given level of scale -- of the invariant structural character of that to which identifying reference is being made.

In the classical tradition of physics, the idea of a physical material or substance was something that could be assigned a determinate -- usually unique -- location in space and time. Moreover, this idea usually included an array of properties -- the array varying with different substances -- which gave expression to various facets of the character of the substance in question.

In addition, whatever array of properties might be associated with a given substance, the traditional view held that, in general (although there were exceptions to this) such properties would be conserved as the substance is exposed to, or moves through, a variety of changes across time and space. Finally, by following the transitions undergone by a given substance or set of substances, classical scientists believed the character of causal relationships could be detected from which one could deduce universal laws, such as the laws of motion governing physical substances or materials.

Einstein rejected an essential portion of the classical idea of substance that has been outlined above. For example, Einstein argued that one cannot make any unique assignment of properties -- such as mass, length, velocity, time, causality or simultaneity -- to any aspect of a field.

Instead, in accordance with the transformation equations that Einstein had derived, not only will one be required to assign different values to such properties in different frameworks, one also will not be able to identify any of these assignments as being the 'true' or 'real' one. Indeed, according to Einstein, one's methodology does not permit one to do anything but treat all of the values as being equally real or true.

While Einstein did not accept the idea of substance in the traditional sense, neither did he believe that the assignment of values could be made arbitrarily. In fact, once one makes an assignment of a value in some given frame of reference, all of the other values for that frame of reference can be determined by means of the transformation equations.

Because, as indicated previously, none of these assignments or determinations really can be said to be rooted in some substance in the field, what was being described was an event. This event could be observed to be characterized by a different set of property values in different frames of reference.

Consequently, Einstein had substituted the idea of events with variable properties -- which, nonetheless, conformed to invariant laws of nature -- for the classical idea of: a substance whose properties were conserved across time and space and that was subject to laws of causality. In short, with Einstein's special theory of relativity, physics became an exploration into the realm of invariance, which had no room for the notion of a physics rooted in the fixed identity of some conserved substance.

There is a difference, however, between: our methodological incapacity to establish the uniqueness of the properties of matter and the field, and saying that there is no uniqueness of the ontological properties of matter and the field. In a sense, the relativity principle sacrificed the issue of uniqueness of property value on the altar of invariance.

In other words, apparently, Einstein had to pay a price for having a methodological means of establishing invariance in the laws of nature amongst a group of referential frames exhibiting differential values of time, mass, length, simultaneity, and so on, with respect to one-and-the-same event. That price was to lose any chance of determining an ontologically unique set of property values in relation to that event.

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Methodological field properties

As far as Einstein's special theory of relativity is concerned, it's field aspects seem to be more a reflection of the field properties of the methodology that is central to the special theory than they are a reflection of any field properties of ontology. Said in another way, the special theory of relativity is a field theory only in the sense that it provides an account of how the measured properties of time, length, mass, velocity, and simultaneity can be shown to be a function of the conditions that prevail at a given locality of space, and, as a result, the descriptions given at those localities are not dependent on any notion of action-at-a-distance. As the general idea of a field concept requires, any given description of phenomena that is made with respect to bodies that are in uniform motion relative to one another will be entirely dependent on local conditions only.

More specifically, local conditions include the way one's methodology engages the universal laws that are given expression through the manner in which physical phenomena unfold under a particular set of circumstances in a given locality of space time. Thus, such issues as causality, force, energy distribution, substance, and so on, will manifest themselves as a function of the manner in which the field properties of the methodology of special relativity theory engage localized aspects of ontology.

The field properties of the methodology of special relativity theory also are given expression in the so-called Lorentz transformations that permit one to take the values that have been measured in the context of a given inertial framework and translate those values into the context of some other inertial frame of reference. In essence, the transformation equations represent nothing more than a transfer of the field properties of the methodology of the special theory of relativity from one inertial framework to another. In fact, such transformation equations ensure that the special theory of relativity remains a field theory in as much as the values that are to be assigned to the various physical properties of a given inertial framework will always be a continuous reflection of the local conditions that prevail with respect to that inertial framework.

In a sense, the methodological flavor that characterizes Einstein's special theory of relativity serves to lay the groundwork for the kind of field theory that is encompassed by Einstein's later, general theory of relativity. In other words, the field concept of the general theory of relativity also is rooted in methodological considerations -- namely, the geometry of space-time. This means the phenomenon of gravitation is reduced to being a function of the methodological means (i.e., geometry) which Einstein chose to use in order to give operational expression to certain universal laws of relationship among different bodies of the physical universe.

Moreover, as required by the general idea of the field concept, one can measure the gravitational effect on any given point of space by taking into consideration the geometric properties that manifest themselves in the local region of the point. Consequently, gravitation, when expressed as a function of the geometric properties that prevail with respect to a given set of conditions in a given region of space-time, transmits its 'influence' in accordance with the characteristics of field theory -- namely, on a localized, point-by-point basis.

Although there are obvious differences between the methodological character of the field properties of Einstein's special theory of relativity and the field properties of his general theory of relativity, there is an underlying, thematic sameness to them. Essentially, this commonality or unity lies in the fact that Einstein's idea of a field in each case is solidly embedded in the properties of the methodology used to operationalize and give representational expression to certain aspects of ontology. Said in another way, the underlying thematic sameness of the two theories of relativity lies in the way Einstein makes field properties in each theory a function of methodology rather than ontology.

One is able to describe what occurs from one point to the next of space-time in the special theory of relativity, by taking into account the effects of relative motion on measurement and/or using an appropriate set of transformation equations that permit one to translate the values generated by the measurement process in one framework into the values that will be generated by the measurement process in another framework. In the general theory of relativity, one is able to describe what occurs from one point to another in space-time by taking into account the effects of the structural character of the geometry that manifests itself in the context of a methodological engagement of gravitational phenomena in a given locality.

In the special theory of relativity, one is not able to establish, or know, the nature of reality in and of itself. One only can interact with reality through the frames of the methodological glasses one uses to engage that reality.

Therefore, although the character of the relativistic lenses of the special theory permits one to see the universality of physical laws in all frameworks, they prevent one from seeing just what it is that is being governed in such a law-like way. From Einstein's perspective, all that one sees are the values generated by the methodology of special relativity.

Similarly, in the general theory of relativity, one is not able to make contact with reality in and of itself. Again, one's vision is limited to the structural character of the frames of the methodological glasses one uses to engage reality. Therefore, although the character of the relativistic lenses of the general theory of relativity permits one to see that the law of gravitation is universally applicable in all frameworks, one does not know why space-time has the geometry it does, or what it is that is capable of warping space to generate geometric characteristics of the kind that are observed in various cases.

One sees there is a correlation among geometry, mass and gravitational phenomena, but one does not know what it is that sustains this correlation. To say that gravitation is geometry, does not account for how space comes to have the geometry it does, nor does it account for why mass should be proportional to geometric properties.

Consequently, the methodological strategy that Einstein used in the special theory of relativity to develop his notion of a field had laid the groundwork for his doing the same sort of thing when it came to the development of the field concept in the context of the general theory of relativity. Moreover, by rooting the field concept in methodology, each theory of relativity was able to permit one to describe certain universal properties and behaviors that are manifested in the context of localized frameworks, while, simultaneously, limiting one’s understanding of the underlying reality that made universal properties and behaviors of such structural character possible.

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<u>Footnote</u>

1.) There are several experimental findings that often are cited to justify an ontological interpretation of Einstein's special theory of relativity. One such finding concerns the manner in which two atomic clocks that were synchronized initially, subsequently yielded differences of measurement in the passage of time relative to one another after one of the clocks had been transported by jet while the other remained stationary on the ground. Supposedly, this experiment showed that as one approached (even in a modest fashion) the speed of light, time slowed down, since the clock on the moving jet plane indicated that less time had passed than did the stationary clock on the ground.

Another experimental finding involves the manner in which the decay-rate of certain accelerated particles is slowed down relative to the decay rate of these same sorts of particles at lesser velocities. Again, the tendency has been to suppose this demonstrates that the structural character of the ontology of time is capable of being affected as velocities approach the speed of light.

Neither of these experimental findings, however, undermines the position being raised in this essay. For example, although an atomic clock is a highly precise mode of measurement, it is, nonetheless, a measuring device.

As such, it is susceptible to being affected by the conditions of gravitation, velocity, and so on that surround it and to which it is subjected. The atomic clock experiment proves only that the mode of measurement was affected by conditions of jet transport and says absolutely nothing about the ontology of time being affected.

Thus, on the one hand, the experiment is perfectly consistent with what Einstein's special theory of relativity would predict. On the other hand, it offers no evidence to contradict what is being advocated in the present chapter concerning the problematic and limiting character of the possible relationships between methodology and ontology in relation to the temporal dimension.

The same sort of result follows from the particle decay experiment. The rate of decay of a particle constitutes a special kind of measuring device. The fact this decay rate can be speeded up or slowed down merely means that it shares a property in common with other clock devices -- namely, that its mode of measurement is affected by the physical conditions to which it is exposed.

Gravitational fields and velocity affect the rate at which the internal structure of the particle unfolds across time. Gravitational fields and velocity affect the manner in which the phase relationships governing the rate of decay phenomenon manifest themselves.

However, neither gravitational fields nor velocity has any effect whatsoever on the structural character of the ontology of time. What is affected is the methodological engagement of time.

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Chapter 3: Chaotic Methods

In the traditional or classical approach to science, as exemplified in the post-Newtonian world, one assumes that if one begins with an approximate knowledge of the initial conditions of a given system, then one will be able to produce an approximate picture of how the system will behave in the future. This presupposes, of course, one has possession of formulae capable of capturing the laws governing such a system.

In the traditional approach to science, a further assumption is made. This assumption states one can ignore fluctuations of small magnitude involving initial conditions. These sorts of fluctuations are considered to be incapable of affecting the general properties and behavior of the system to any appreciable degree. In other words, such minor fluctuations are assumed to fall below a level of intensity or strength capable of interfering with one's ability to predict how the system will manifest itself in the future if one starts from a given set of initial conditions.

In the case of chaotic systems, however, the so-called minor fluctuations occurring in a given system are part of a complex dialectic. This dialectic magnifies the character of these fluctuations over time.

When such fluctuations are magnified beyond certain critical values, they become the source of turbulence. As a result, the traditional linear approach, with its underlying assumptions, becomes an ineffective means of describing or accounting for the long term behavior of a chaotic system.

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Lorenz, aperiodic phenomena and the Butterfly effect

In the early 1960's, Edward Lorenz was trying to develop models capable of reflecting the behavior of weather systems. Unfortunately, the system of equations he was using to model that behavior was problematic. When small errors of measurement -- which inevitably occur -- were introduced into the equations, these errors soon became magnified to catastrophic levels as they were processed through the various functions and operations inherent in the equations.

For example, suppose one had obtained a measurement value extending to 6 decimal points, but for whatever reason (e.g., to save space on a printout, for ease of calculations, etc.), the measurement was shortened to just three decimal points. When this value was plugged into the equations being used to model the behavior of weather, the missing decimal values had a sort of multiplier effect as one processed the equations. As a result, the answers produced by the equations were at considerable variance with the observed values in the actual behavior of weather.

However, the essential problem of model building with respect to systems such as the weather was not just a matter of the lack of precision inherent in the process of measurement. Furthermore, the essential problem surrounding nonlinear systems was not due to the distorting effect ensuing from the over-simplifications of the underlying assumptions of classical physics. The crucial issue at the heart of model building in relation to nonlinear systems concerned the aperiodic character of such systems.

Aperiodicity refers to systems that do not gravitate toward a uniform, steady state in which certain structural themes repeat themselves, more or less exactly, from one cycle to the next on a regular or periodic basis. Aperiodic systems seem to fluctuate in an unpredictable fashion about certain values. Sometimes, such systems generate a spectrum of fluctuating values similar to, but not replicas of, one another.

On the surface, aperiodic phenomena appear to be a manifestation of random elements and local 'noise'. This local noise prevents such systems from reaching a steady, uniform state of regular periodicity.

Lorenz sensed, however, there was an underlying structure to the apparent "randomness". He felt an essential structure was being camouflaged by the spectrum of variable fluctuations characteristic of aperiodic systems.

According to Lorenz, one manifestation of the relationship between structure and variability is the Butterfly effect. This refers to the tendency of aperiodic or chaotic systems to be very sensitive to and dependent on the character of initial conditions. Small magnitudes of fluctuation inherent in initial conditions of aperiodic systems come to have a vectored multiplier effect on the way the system behaves over time.

Linear and nonlinear systems

Linear equations can be described by a straight line on a graph. The straightness of the line indicates that the relationship between x and y, that is being plotted, is a proportional one. Therefore, determinate changes undergone by one of the two variables will be reflected in the proportionate character of the determinate changes undergone by the other variable under the same functional conditions.

Another characteristic of linear systems is their amenability to being broken down analytically. The components generated by such analysis can be reassembled to produce the original linear system, complete in all its properties and aspects.

None of the foregoing characteristics of linear systems, however, are true of nonlinear systems. Thus, the variables being linked in a nonlinear system are not proportionate to one another.

Moreover, one cannot analytically break down a nonlinear system -- as one can with linear systems -- due to the way nonlinear values are constantly changing instead of remaining uniform. Finally, nonlinear systems always have proven resistant to yielding solutions to the equations being used in nonlinear contexts.

For example, suppose one wanted to calculate the manner in which a hockey puck accelerates when it is the beneficiary of an input of energy transmitted through a hockey stick. As long as one disregards friction, one can come up with a linear equation capable of describing the acceleration of such a system. However, as soon as one introduces friction into the calculations, the linear character of the system disappears.

The reason for the disappearance of linear character is because of the intimate nature of the relationship among velocity, friction and energy. More specifically, the amount of friction generated by a hockey puck moving across a surface depends on the velocity of the puck. Yet, at the same time, the velocity of the puck will be affected by the friction being generated by the puck's movement.

Therefore, the effect a given input of energy will have on acceleration (i.e., when the puck is struck by a hockey stick) will both affect, as well as be affected by, the existing values of velocity and energy. In short, one cannot assign a uniform, single value to any of the basic variables of the system because they are all mutually reactive and affect one another through a complex dialectic that cannot be captured by a set of stable, constant linear relationships.

One runs into the same kinds of problems in the case of fluid dynamics. The basic method for solving problems in fluid dynamics is the Navier-Stokes equation.

This equation links together variables of pressure, viscosity, velocity and density in one set of functional relationships. However, since the contexts described by the Navier-Stokes equation are nonlinear, the character of the relationships among the variables is constantly subject to change and transition. Consequently, one is, once again, confronted with a complex dialectic of variables that cannot be easily grasped, if at all, by linear techniques.

A time series has traditionally been used to depict the changing values of a given variable as a function of time. The usual way of displaying this is to plot time along the horizontal axis, while using the vertical axis to plot fluctuations in the character of a given variable. When plotted against time, these fluctuations appear as a series of amplitude-like values falling above or below the horizontal axis.

A time series, however, cannot capture the manner in which the relationships among a set of variables change with respect to one another over time. To be able to show this aspect of transition in the relationship among a set of variables, one needs to think of each point that is to be plotted as the product of the vectored interaction of a set of variables. The interaction of this set of variables establishes or fixes the location of the point in three-dimensional space.

As the relationships among the set of variables changes with time, this element of change will be reflected by the way a point moves about in the three-dimensional space. The plotting of the movement of the point in three-dimensional space gives expression to the continuous character of change of relationship among the set of variables over time.

If one is plotting such a complex point in a nonlinear system, the trajectory described by the movement of that point never intersects itself since the character of the vectored interaction of the variables never quite repeats itself. The trajectory of the movement of the point in a nonlinear system loops around one or more central tendencies indefinitely.

A chaotic system always stays within a set of parameters or envelope of values, but it never precisely repeats itself. The order that is manifested is always showing a new 'look' or new mode of trajectory within a set of constraints. The trajectories constitute the degrees of freedom of the structural character of the chaotic system in question, whereas, the envelope of values within which the trajectories express themselves constitutes the constraints of the structural character of the chaotic system.

In a Lorenz attractor the graph of the kind of moving point described above is expressed as a pair of concentric-like set of ellipsoids that each revolve around a central space. These sets of ellipsoids have a cross-over region intermediate between them.

The point being plotted moves from the sphere of influence of one set of concentric ellipsoids to the sphere of influence of the other set of ellipsoids. When fully graphed, the whole thing looks sort of like a pair of owl's eyes.

Although the microscopic character of chaotic systems often was understood quite well, this understanding could not be translated into an ability to grasp how and why the macroscopic behavior of these chaotic systems had the complex character it did. In short, the problem facing researchers was that the global behavior of a system was different from the local behavior of that same system. As a result, knowledge of the micro-structure of a nonlinear system was not very helpful in permitting one to derive knowledge of the macro-structure of that nonlinear system.

Traditionally, a great deal of a would-be physicist's education is devoted to the study of how to go about solving differential equations. When one uses differential equations to model some aspect of reality, reality is assumed to have a continuous nature in which all transitions manifested in that kind of a system will be smooth and not discrete. The problem with this approach, however -- and leaving aside the difficulties surrounding the idea of what is meant by 'being continuous' -- is that the majority of differential equations are not solvable.

One of the reasons for the lack of success with respect to differential equations is the following. If one is to hope to have a chance of solving a differential equation, one must be able to find some minimal number (which varies from context to context) of regular invariants that can be fed into a given system of differential equations. Only those phenomena manifesting properties that can be fit into this mold of regular invariance are somewhat amenable to treatment by differential equations.

Although differential equations can handle certain kinds of situations exhibiting change over time, many of the contexts displaying various degrees and instances of change do so in an irregular, erratic, variable manner. Such erratic, irregular modes of change tend to fall beyond the capacity of present differential techniques.

Consequently, often times, the most one can hope to accomplish if one continues to rely on differential equations to solve problems concerning nonlinear systems is to try to come up with linear approximations for nonlinear change. These sorts of technique, however, tend to yield results that are far from satisfying.

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Chaos: a special case of nonlinearity

James Yorke, a mathematician who gave the study of the dynamics of nonlinear systems its name (i.e., chaos) saw the need to discover better ways of uncovering regularities in the midst of apparent disorder and erratic behavior. He addressed this issue in a paper entitled: "Period Three Implies Chaos" that he wrote with Tien-Yien Li.

The main thesis of the aforementioned paper is as follows. In any one-dimensional system, cycles of period three will display regular cycles interspersed by chaotic cycles. In other words, the two authors claimed that the idea of a period-three oscillatory system that regularly repeats itself but does not give expression to chaotic behavior is not possible in a one-dimensional system.

If one has a period-three oscillatory system (even one as simple as a one-dimensional system), and if some parameter is changing at a rate and in a direction that pushes the system deeper and deeper into nonlinearity, then this affects the structural character of the system's equilibrium, causing it to bifurcate. The system will proceed to oscillate between the points of bifurcated equilibrium. As the system is pushed deeper into nonlinearity due to the continued changing character of one of the system's parameters, the rate of the bifurcation process will increase, and the system will oscillate among the different junctures of equilibrium.

Eventually, the accelerating bifurcation process will reach what is referred to as the point of accumulation. At this point, the previously regular periodic character of the system will be replaced with chaotic behavior. However, if the system is further driven into nonlinearity by the changing character of the same parameter, one will observe pockets or envelopes of regularity re-emerging in the midst of the chaotic behavior.

If one vectors parameters other than the one with which one started and, thereby, subjects the system to increasingly nonlinear forces of a different sort, this will lead to the same system displaying a new set of bifurcation/point of accumulation characteristics. Therefore, the dialectic between chaotic behavior and the emergence of pockets of regular periodicity that occurs in the context of the vectoring of different parameters will generate unique arrangements of order and chaos.

Chaos refers to the way in which systems manifesting perturbations or fluctuations never settle down to a single, stable point of equilibrium. Nonetheless, chaotic systems also exhibit envelopes of stability and regular periodicity that suddenly and unpredictably emerge, from time to time, in the midst of such fluctuations.

One further feature of chaotic systems concerns the way in which the structure of these systems seems to run indefinitely deep. If one examines any given region of a chaotic system closely enough, that region will display the same structural character as the entire system as a whole does.

In other words, the micro-structure of any given region of a chaotic system is a reflection of the macro-structure of the system. Moreover, if one were to examine the micro-structure of a given region of the chaotic system, one would discover an underlying mini-micro structure that, again, was a reflection of the structural character of the macro level of the chaotic system. This aspect of chaotic systems is an expression of a fractal-like property.

This quality of fractal-like structure in chaotic systems is very crucial and central. Essentially, what it means is this. Even very simple deterministic systems are, under the right circumstances, capable of producing behavior that, on the one hand, appears to manifest random properties yet that is, on the other hand, highly structured on a multiplicity of levels.

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The development of fractal methodology

In statistics and probability, the bell-shaped curve is the usual means of plotting variation as an expression of the changing relationship between two variables. The bell-shaped curve represents the normal distribution or standard Gaussian distribution of variation in a given statistical context.

Basically, this means that there is a tendency for variance to distribute itself around a set of central values. Among other things this indicates that as one becomes further removed from those central values, one will also encounter an increasingly diminishing number of instances of the set of values that comprise that variance. However, the character of this decrease as one moves further away from the central tendencies of a Gaussian distribution is said to be smooth (i.e., continuous) and regular.

Benoit Mandelbrot had had an intuition for some time that non-statistical laws governed the characteristics of so-called random, stochastic processes. This intuition began to take concrete form in the early 1960s.

Mandelbrot believed there is an intimate connection between micro-events and macro-events. In fact, he felt there is a pattern to the manner in which a given phenomenon manifests itself on different scales. Mandelbrot held there was symmetry of scale in which the same structural pattern would manifest itself across whatever range of scales one cared to examine in relation to that phenomenon. Thus, he believed certain structural invariants were preserved from one scale to the next, despite the apparent random character of the phenomenon under consideration.

For instance, when he analyzed fluctuations in cotton prices, he discovered that the sequence of price changes were preserved independent of what scale was used as a basis for studying the changes. One could chart the sequence of price changes for cotton in a day, or a month, or over a number of years, and the structural character of the sequence of changes would reassert itself with each change of scale.

Although the precise value for any single instance of change was unpredictable, a set of changes over time would manifest the same structural sequence, irrespective of the period one chose as the basis for a temporal scaling factor. In short, there seemed to be a structural signature that was being imposed on, or preserved across, scaling factors.

Shortly after coming to the Yorktown, New York, IBM research center, Mandelbrot became interested in the problems associated with transmitting computer data over phone lines. Computer data is transmitted over such lines by means of an electric current.

This current carries information in the form of discrete packages. However, no matter how strong one made the current carrying this information, there was always an irreducible amount of noise arising during the process of transmission. Sometimes this noise would result in the loss of a portion of the data being transmitted.

There was no way to predict when and where the noise would arise. Nonetheless, there did seem to be something of a sequential structure to the appearance of the noise. More specifically, there seemed to be periods of transmission that were free of errors interspersed with periods of transmission in which errors were manifested in clusters. Yet, when engineers tried to grasp the character of these noise-clusters more closely, it seemed to dissolve into a complex maze that defied analysis.

Mandelbrot devised a means of characterizing, in a precise fashion, the distribution of the error-clusters. His methodology produced solutions that reflected what had been observed empirically. Essentially, Mandelbrot's position maintained that errors were not distributed continuously throughout the transmission.

If one examines any given error-cluster, one would find within that cluster regions that were free from error. Indeed, Mandelbrot contended that irrespective of the temporal scale one used as a basis for examining a given error-cluster, one would find an invariant relationship in the ratio of error-free portions of a given cluster to the error-plagued portions of that cluster.

The phenomenon of transmitting information through telephone lines, like all phenomena, has a characteristic structural character or spectrum of ratios of constraints and degrees of freedom. This spectrum of ratios has an internal dialectic that gives expression to the sorts of phase relationships and transitions in phase relationships that establish the envelope of possibilities or parameters of values within which the phenomenon manifests its structural character.

However, the ratio (or ratios) governing the relationship of information and noise in the transmission of a message over telephone lines is nonlinear in character. This means, essentially, that for any given instant of transmission one cannot predict whether one will encounter noise or information.

The best one can do is to capture the general structural character of the ratio between noise and information for a given interval of time. Moreover, one can show that the ratio will be independent of the temporal level of scale one uses to demonstrate the ratio.

The reason one cannot predict whether one will encounter information or noise at any given instant of transmission is because one has no way of determining the phase state of the system for any given instant. In other words, for any given instant, one has no way of calculating, with any precision: (a) which ratios of constraints and degrees of freedom will be given expression by the electrons making up the transmitted message, nor (b) the extent to which the spectra of ratios or structural character of the interacting electrons will be affected by interference phenomena, either from within the transmission process itself or from outside sources.

On the other hand, Mandelbrot was able to come up with a description for the general structure of the ratio of noise to information for a given interval of time. He was able to do this because the dialectic of electrons, under conditions of telephone transmission, generates a characteristic range of possibilities. One of these characteristic features is the way in which the ratio of noise to information persists across all levels of scale of measurement involving intervals of time.

In effect, Mandelbrot's ratio is a macro representation (in the sense that it involves an interval rather than an instant) of the complexities of the dialectic of electrons occurring on a micro level (i.e., from instant to instant or phase state to phase state). No matter how small one makes the interval, it will always be an interval and not an instant.

Nonetheless, his ratio is a macro reflection of what one would find if one had the mathematical and technological sophistication to see or capture the structural character of the complex dialectic of the phase states of interacting electrons as it manifests itself at a given instant of time. In short, the macro reflects the micro because one is dealing with the same spectrum of ratios of constraints and degrees of freedom irrespective of what level of scale one is engaging the phenomenon in question.

Although Mandelbrot had arrived at his position through his geometric intuition, he was providing an analog for an abstractly derived construction already known to mathematicians: namely, the Cantor set. To construct a Cantor set, one uses a line segment to represent the numbers between 0 and 1.

One, then, proceeds to remove the middle third of that line segment. This leaves two portions of line segment.

One also removes the middle third from these two remaining line segment portions. One continues to remove the middle third from each subsequent series of remaining line segment portions that is generated from each preceding removal operation.

Theoretically, this process can be carried on indefinitely. Ultimately, it yields an infinite set of clusters of increasingly refined nature as one proceeds from one level of the removal operation to the next level of the removal operation. Moreover, according to mathematicians, the total length of this infinite residue is supposedly zero.

In effect, Mandelbrot was characterizing the ratio of error-free transmission to error-plagued transmission as a Cantor set plotted against time. Although errors would become increasingly sparse as one selected smaller and smaller temporal scales through which to examine the character of the transmission, there would always be a certain irreducible error component in any transmission. Moreover, this error component was inextricably linked to error free portions of transmission in the form of a ratio.

Therefore, in any given temporal period, the ratio of error-free to error-plagued transmission was invariant. However, this was as close as one could come to pinning down the error component of transmission. One simply had no means of determining where in that temporal period one would find error-free transmission as opposed to error-plagued transmission.

Once again, Mandelbrot had uncovered an invariance that is preserved across differences of temporal scale. Once again, this invariance was found in the midst of seemingly random fluctuations.

Mandelbrot coined a couple of terms to describe certain aspects of the phenomenon he was investigating. These are referred to as the Noah Effect and the Joseph Effect.

The Noah Effect referred to the discontinuous character of the way in which many things changed. Rather than assume, as had been the case traditionally, that a change from point 'A' to point 'B' necessarily involved a smooth traversing of all intermediate points, Mandelbrot contended the transition from 'A' to 'B' could occur despite the fact that one or more of the intermediate points had been by-passed altogether. The movement from 'A' to 'B', in other words, was in the form of a single discrete jump or in the form of a series of discrete jumps, depending on the forces that were vectoring the situation in question.

The Joseph Effect refers to the tendency of the structural properties of a complex, nonlinear system to persist over time. Although such systems seem to exhibit random-like characteristics, nonetheless, these characteristics exist side-by-side with certain stable features. These stable features might disappear from visible sight for a period of time, but they would reappear at other junctures in time. These features formed a persistent set of themes in the life of many, complex, nonlinear systems.

In the terminology of the present essay, Mandelbrot's Joseph Effect gives expression to the spectrum of ratios of constraints and degrees of freedom that constitute the structural identity of any given object, event, process, state, condition and so on. The dialectic of dimensions establishes complex manifolds out of which emerge point-structures, neighborhoods and latticeworks that permit various structural properties of nonlinear systems to persist over time and across different levels of scale.

This dialectic of dimensions is capable, in turn, of maintaining such stability in the midst of variability because of the way the underlying order-field has invested the spectra of ratios of constraints and degrees of freedom of each of the dimensions with their own structural identity. The phase relationships and phase transitions permitted by a given dimension's spectrum of ratios serves as the coupling constant through which different phase state variations of the dimension's structural character are able to maintain an essential structural integrity.

When different dimensions come into 'contact' with one another through, for example, phase relationships, they will generate point-structures, neighborhoods and latticeworks that will manifest various aspects of the structural character of the dimensions involved in the dialectic.

In this way, an order-field distributes some of its properties across a variety of levels of scale. This distributive quality extends all the way from dimensions, to the sorts of point-structures, neighborhoods, and latticeworks that emerge as a result of the dialectic of dimensions that has been set in motion by the order-field.

Mandelbrot's fractal geometry is an attempt to reflect the structural character of certain aspects of reality more accurately than traditional Euclidean geometry is able to do. As Mandelbrot says: "clouds are not spheres, mountains are not cones ...." In other words, one cannot use the methods and theorems of Euclidean geometry to gain insight into the complex, irregular structural character of clouds, even though such geometry might be well suited for describing the structural character of, among other things, regular spheres.

The face of nature tends to be more akin to nonlinear dynamics than to regular, linear dynamics. As a result, one needs a methodological approach that will equip one to handle the complexities, irregularities and erratic properties manifested in natural phenomena. Fractal geometry was intended to serve as a means of investigating the discontinuous, irregular, nonlinear, and erratic character displayed by many aspects of experience.

Similarly, hermeneutical field theory is intended as a methodological approach that will assist an individual to grapple with some of the complexities, irregularities and nonlinear properties that are manifested in many issues concerning understanding, interpretation, methodology, and knowledge. In other words, hermeneutical field theory is rooted in the realization that not everything in the phenomenology of the experiential field is capable of being reduced down to linear configurations.

A milestone in the development of Mandelbrot's perspective came with the publication of a paper entitled: "How Long Is the Coast of Britain?" In essence, Mandelbrot contended one could have a variety of answers to this question.

On the one hand, he argued there is a sense in which the coastline is infinitely long since with each succeeding change of scale, one is opened up to a new set of contour irregularities that were not apparent on the previous level of scale. Conceivably, there might be no end to the levels of scale one encountered as one's measuring efforts get lost in the mists of the sub-quantum world beyond the horizon of the Planck length.

On the other hand, Mandelbrot also maintained the answer to the question being asked in his article would depend on the length of the ruler one used to measure the coast of Britain. If, for example, one used a ruler that was one meter in length, one would get a different answer than if one used a ruler that was one foot in length. The reason for this is that the smaller, foot ruler is able to have access to more of the irregularities of the coastline than is the meter ruler.

In other words, the larger ruler could not be used to measure all those irregularities that were less than one meter in length. Therefore, measurements based on the one meter ruler would exclude such irregularities.

The one meter ruler only could be used to measure those portions of the coastline against which the entire length of the ruler could be laid. Similarly, although the smaller, foot ruler could be used to measure many of the irregularities not capable of being measured by the meter ruler, the foot ruler could not be used to measure the irregularities of the coastline that were less than one foot.

With each reduction in the length of the ruler used to measure the coastline, one makes the transition to another level of scale. As one goes to smaller and smaller modes of measurement, the length of the coastline is increased because these smaller measuring units are able to capture all the irregularities that had to be excluded from the measuring process used on the previous level of scale.

Inherent in the foregoing analysis concerning the length of the British coastline is a danger that one might confuse ontology and methodology. In order to better grasp the sense of this concern, consider the following.

Intuitively, one might wish to argue that the value of length generated by a measurement process is an abbreviated index for the way in which a given process of methodology (i.e., measurement) engages a given aspect of reality or ontology. Part and parcel of this intuition is a feeling that irrespective of what values are generated by the measurement process, the object, structure, process, or event being methodologically engaged has a structural character that is independent of the measurement process. In other words, the structural character of the object, event, and so on, does not depend on measurement for its existence as a structure of one kind rather than another.

To be sure, different aspects of the spectrum of ratios of constraints and degrees of freedom that constitute an object’s or an event's structural character might be tapped by a given methodological engagement. As a result, different modes of measurement might induce different facets of a structure's spectral character to manifest themselves. Consequently, in each case one might come up with different indices for the character of the interaction between methodology and ontology.

However, the changing character of the dialectic through which the measurement process engages, and is engaged by, a given structure does not alter the basic spectrum of ratios of constraints and degrees of freedom that constitutes the character of the structure being measured. All that is affected is one's methodological orientation toward that structure's spectrum of ratios.

All that is affected is the ratio or ratios that are selected or sampled for examination by the measurement process. In short, the structure will manifest itself differently according to the way in which a measurement process engages that structure, but the structure remains the same as far as its characteristic spectrum of ratios is concerned.

The changing nature of the answer concerning the length of the British coastline is not a reflection of the variable character of the coastline's ontology. The changing nature of the answer concerning length is a reflection of the changing character of the manner in which methodology or the measurement process engages that coastline.

Traditionally, Euclidean geometry operated from a perspective that allowed for as many as three dimensions. These dimensions were conceived of as running at right angles to one another.

A point is considered to have zero dimensionality. A line is said to be one-dimensional, whereas a surface consists of two-dimensions and a solid occupies three-dimensions.

However, if one were to ask: what is the dimensionality of, say, a ball of twine? Mandelbrot maintained the answer that one gave would depend on one's point of view.

If one were far enough away from the ball of twine, it could take on the appearance of a point of zero dimensionality. As one got closer, it would appear three-dimensional, but if one went into the inner recesses of the ball of twine and examined the twine from different levels of scale, the twine could appear to be one-dimensional, two-dimensional, or three-dimensional.

Mandelbrot also raised the possibility that there might be dimensions in between the normal one-, two-, or three-dimensions. He referred to these in-between levels of scale as fractal dimensions.

Fractal dimensions were intended to serve as a means of describing, through measurement, various sorts of qualities falling beyond, or outside of, the traditional, Euclidean conceptions of dimensionality. In other words, Mandelbrot intended fractal dimensions to be an index for characteristics such as the degree of irregularity that are displayed by whatever is being measured. Furthermore, Mandelbrot claimed this index of fractal dimensionality remained invariant across all levels of scale that might be used to measure or describe the phenomenon or object or structure being examined.

However, in line with the previous comments concerning the possible dangers of confusing methodology and ontology in relation to determining the length of the coastline of Britain, one must exhibit a certain amount of caution with respect to interpreting the significance of Mandelbrot's idea of a fractal dimension. The sense of dimensionality that is being given to fractional values in the foregoing cases is not necessarily an ontological dimension.

Mandelbrot's sense of fractional dimensionality is a reflection of the manner in which a given methodology is engaging a particular aspect of ontology. In other words, fractional dimensions are an artifact of methodology, not ontology.

One should not construe the above caution to mean that fractional dimensions cannot have great heuristic value. If nothing else, the idea of fractional dimensionality might permit one to methodologically tap (e.g., measure) different facets of the spectrum of ratios of constraints and degrees of freedom that constitute a given structure.

As a result, one might be able to develop a better understanding of the structural character of various aspects of ontology. However, one should remember that fractional dimensionality is an expression of methodology, together with the way it engages different aspects of ontology, rather than an expression of ontology per se.

Keeping in mind the foregoing, consider the following. A Koch curve (this figure is named after Helge von Koch who was the first person to describe it -- around 1904) supposedly, represents an infinitely long line surrounding a finite area. To construct a Koch curve, one takes a triangle that has sides one unit in length. Next, one places a triangle, which has been reduced by two-thirds, in the middle of each side of the initial triangle.

One, then, repeats this second step an indefinite number of times, making the appropriate reductions in size for each new level of scale relative to the preceding level of scale. The perimeter or boundary length of the final figure will be 3 x 4/3 x 4/3 x 4/3 x ... 4/3n, with 'n' being the number of times the second step is repeated.

Of course, mathematicians argue that, in principle, this process can be repeated an infinite number of times, thereby generating a curve of infinite length that never intersects itself. Yet, if one circumscribes the initial triangle with a circle, the infinite Koch curve will never reach to any point beyond the circle that surrounds the initial triangle.

Consequently, although the curve itself takes on an infinite complexity, it is enfolded into a finite space. This space will be larger than the area covered by the original unit triangle but less than the circle circumscribing that triangle.

In general, if one has a structure consisting of n-dimensions that is, subsequently, divided into p-equal parts, then the ratio of similarity, r, between any given part of this structure and the structure as a whole, will be given by the formula:

r = nth root of 'p'

In the case of structures like the Koch curve, one is uncertain about the dimensionality of such a curve. On the other hand, one can determine values for both 'r' and 'p'.

Thus, when constructing the Koch curve, one takes any given side of the original equilateral triangle, and replaces, in the prescribed fashion, one line (which constitutes the side of the triangle) with four lines: the two lines on either side of the section that has been removed, together with the two sides of the reduced equilateral triangle that are added on (projecting outwardly from, but affixed) to the side with which one started originally. If one substitutes these values into the above formula, one gets:

3 = nth root of 4

To solve for 'n', one must use logarithms.

First, one takes the logarithm for each side of the equation, resulting in the following: log 3 = n log 4. After one has completed the appropriate calculations or looked up the values in a set of log tables, one finds that n = 1.2618.62

Consequently, the dimension of a Koch curve is not a whole number, but fractional. Moreover, this property of fractional dimensionality also is capable of manifesting itself in the context of surfaces and solids.

Thus, the Sierpiński sponge begins life as a cube. Subsequently, an infinite reiterative process is applied to it. The end-result of this reiterative process is a structure, supposedly, consisting of zero volume enclosed within an infinite surface. This structure is said to have a fractional dimensionality of 2.7268.

Furthermore, each face of the Sierpiński sponge manifests self-similar properties in relation to the structure as a whole. In other words, each face has zero area surrounded by a perimeter of infinite length as well as a fractional dimensionality. These faces are referred to as Sierpiński carpets, and they each have the same fractional dimensionality as a Koch curve, namely: 1.2618.

As indicated previously, structures that possess this property of having a fractional dimensionality are known, collectively, as fractals. The investigation of fractal properties is known as fractal geometry.

The Koch curve, the Sierpiński sponge, and Sierpiński carpets are all the result of a conceptual construction process. The construction processes underlying these structures is an expression of the way in which methodology -- especially in its mode of generating measurement values -- has been applied to an initial seed structure. By recursively altering such seed structures an infinite number of times one is alleged to end up with rather paradoxical figures.

For example, such construction process permit non-intersecting curves of infinite length to be circumscribed within a finite area (i.e., the Koch curve). Another paradoxical example involves 'solid' structures of zero volume and infinite surface (i.e., the Sierpiński sponge).

Once again, however, these examples of paradoxical, fractional dimensionality are an artifact of methodology. In this respect they illustrate precisely the same phenomenon that surfaced in trying to come up with an answer to the length of the coastline of Britain. As such, they are heuristic structures that might or might not help one to better understand either: the character of methodology; the measurement process; or the character of the dialectic between methodology and ontology.

While hermeneutical field theory shares fractal geometry's commitment to, and emphasis on, the property of invariance across levels of scale as an extremely fundamental theme, the former differs from the latter in the significance that is attributed to the idea of fractional dimensionality. Fractional geometry tends to treat the notion of fractional dimensions as a reflection of the ontological character of spatial dimensionality. Hermeneutical field theory, on the other hand, considers fractional dimensionality to be an artifact of the way that methodology engages, and is engaged by, different aspects of ontology.

Fractal dimensionality can be a useful tool for probing the spectrum of constraints and degrees of freedom that constitute the structural character of the dimension of space. However, fractal dimensionality does not demonstrate that there exists, in any ontological sense, physical spatial dimensions that are in between the usual, three spatial dimensions. Fractal dimensionality represents a particular methodological means of orienting oneself with respect to the structural character of one's engagement by, and exploration of, different facets of the spectrum of ratios of constraints and degrees of freedom that give expression to the dimension of space.

In this respect, fractional dimensions are not really dimensions at all. They are examples of the way different ratios of constraints and degrees of freedom inherent in the structural character of the dimension of space are induced to manifest themselves under different circumstances of methodological engagement -- measurement is our way of attempting to establish a variety of base lines through which to gauge what the structural character of that ratio is and might entail.

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<u>Attractors in the complex plane</u>

A major difference between, on the one hand, geometric structures like the Sierpiński sponge or the Koch curve and, on the other hand, natural structures like the coastline of Britain, is that the former are highly regular or predictable, whereas the latter tend to be more irregular and less predictable. The primary reason for the regularity of constructed structures such as the Koch curve or the Sierpiński sponge is that they are invariant under the sorts of simple scaling, linear transformations applied to them during the generative process that leads from simple geometric figures to their fractal counterparts.

However, naturally occurring figures, such as a coastline, might not remain invariant -- at least in any linear fashion -- under the scaling transformations that are applied to them. Even if such figures do remain invariant, then one has the problem of determining whether the invariance is an artifact of a methodology's manner of engaging some facet of ontology, or a reflection of some aspect of ontology that is being engaged through a given methodology.

Around the mid-1970s, Mandelbrot began to investigate a more complex form of fractal-generating processes involving invariant properties under conditions of transformations. Eventually, toward the close of the 1970s, Mandelbrot settled on the complex function, $x^2 + c$, to serve as a main vehicle for his computer researches. In the foregoing function, both the constant, c, as well as the variable, x, represent complex numbers.

A feedback loop involves a process of change for some given structure, q, in which the changing character of that structure in the present is dependent on the way that structure manifested itself just prior to the present instant. The nature of this dependency is usually in the form of a mathematical function, f(x). This function establishes how one will take some seed value, $x_0$ and, then, proceed to generate successive values: $x_0 + 1$, $x_0 + 2$, $x_0 + 3$ and so on.

Feedback loops that map an initial seed value into a series of successive values are usually referred to as dynamical systems. The set of successive values into which the seed value is mapped is known as a path or orbit.

If this orbit or path is ordered, then the associated dynamical system is said to be ordered. If, on the other hand, the mapping path is not ordered, then the dynamical system is called chaotic.

Using the formula $f(x) = x^2 + c$ -- and priming this formula with a complex number seed value -- Mandelbrot iterated the function by means of the rule: $x_n + 1 = f(x_n)$. He found that the character of the constant 'c' had considerable capacity to shape the kind of results one would obtain from iterating the initial function.

If one considers the case when c is 0, then depending on the character of the seed value with which one begins, there will be three possible results. If the seed value is less than one unit of distance from the origin, the path generated by mapping this seed value into a set of successive points will approach the origin as a limit, becoming, as a result, increasingly smaller with each new iteration of the underlying function. Under such circumstances, the origin, or 0, becomes an attractor for this sort of an iterated function.

On the other hand, if the seed value used to prime the function is greater than one unit of distance from the origin, then the path generated will become increasingly further removed from the origin ... tending toward infinity. As a result, infinity is said to be the attractor for such a feedback loop in the sense that successive values generated through the iterated function will be become increasingly large, as if drawn toward infinity that is beyond the horizons of the complex plane.

The final possibility to consider when c = 0, is when the seed value that is fed into the function is one unit of distance from the origin. Another way of stating this is to say that the seed value falls somewhere on the unit circle whose center is the origin of the complex coordinate system. If this is the case, then the generated path or orbit will never go beyond the perimeter of the unit circle.

Consequently, when $c = 0$ and $x_0 = 1$, the unit circle becomes the boundary between instances in which $x_0$ is less than 1 unit of distance from the origin, and instances in which $x_0$ is more than one unit of distance from the origin. In other words, the unit circle becomes the boundary between the attractors governed by 0 and infinity.

However, when the value of the constant c becomes non-zero, rather than 0 as in the foregoing, Mandelbrot discovered that not only could attractors give expression to more than one point of attraction, but the boundary structure between such points could become quite complex. This complexity often manifested itself in the form of structures that were self-similar, but on a reduced scale, to the object undergoing successive transformations.

This result already had been anticipated by Julia and Fatou many years earlier when they demonstrated that any portion or segment of a boundary, irrespective of its size, could be used as a source of information from which the entire curve or structure of which it was part could be constructed. All one had to do was use the same iterative function that generated the system originally.

In the present case, that function is $f(x) = x^2 + c$. The sequence of numbers generated in this fashion is referred to as a Julia set.

The Mandelbrot set is a subset of the complex plane. It has proven to be of considerable interest due to its apparently inherent rootedness in dynamical processes in general or vice versa. More specifically, depending on the character of the value c [cf. $f(x) = x^2 + c$] in relation to the Mandelbrot set, a number of outcomes are possible when the foregoing complex function is subjected to a process of iterative feedback.

For example, when given a particular value of c relative to the Mandelbrot set, a complex dynamical process can lead to the degeneration of the Julia set into a set that does not border any interior sector. Given another value of c relative to the Mandelbrot set, a complex dynamical process can bring about the division of the complex plane into either one or more interior sectors, together with an exterior region that extends to infinity.

In short, if one chooses c from within the main body of the Mandelbrot set, or if one selects a value of c that is drawn from one of the buds that is connected to the main body of the Mandelbrot set, or if one focuses on a value of c that falls outside the Mandelbrot set altogether, then the structural character of the fractal object(s) one generates during the iterative process will be differentially affected as a result of the selection one makes for c relative to the Mandelbrot set.

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<u>Hermeneutical mapping algorithms</u>

If one wants to: establish, dialectically engage, preserve, question and/or, eventually, improve upon any given set of ideas or values, one must generate hermeneutical mapping algorithms. Such algorithms are capable of arranging or combining the six basic hermeneutical operations (identifying reference, characterization, reflexive consciousness, interrogative imperative, inferential mappings, congruency functions), into a methodological latticework that can be applied to the phenomenology of the experiential field.

The hermeneutical operator is an analog for Mandelbrot's function: $f(x) = x^2 + c$. As such, it is capable of generating attractors whose boundary properties will depend on: (a) the experiential seed values fed into the operator, together with (b) the hermeneutical orientation and character of the algorithm that has been constructed by the individual. The latticework generated by applying the hermeneutical mapping algorithm to the phenomenology of the experiential field is the hermeneutical counterpart to the notion of a path or orbit in dynamical systems.

Hermeneutical mapping algorithms also are recursive. In other words, the products that are generated by applying hermeneutical operations to different point-structures or seed values drawn from the phenomenology of the experiential field can be fed back into the hermeneutical algorithm, thereby altering the character of the way the algorithm operates on future point-structures in the phenomenology of the experiential field.

Hermeneutical orientation, together with that to which a given orientation is making identifying reference, constitute the two ends of the mapping process that is being constructed through, in part, the operational activity of the algorithm. The mapping itself is an expression of the dialectic between, or among, the phase relationships of the latticeworks involved in the dialectical engagement process.

In the hermeneutical algorithm each of the operational components contributes to the overall structural character of the algorithm by giving expression to envelopes of constraints and degrees of freedom. These envelopes establish a latticework of phase relationships that will engage the 'object', event or condition in a way that is characteristic of that operational component.

Thus, the character of the interrogative latticework is to induce questions about phase relationships and structural themes. On the other hand, the character of the inferential function latticework is to lay down tentative links between, or among, different aspects of one or more point-structures. Each of the other components of the hermeneutical operator has its own characteristic properties.

However, one must not forget that these operational latticework components cannot really be separated from one another. They are dialectically entangled such that each forms part of the horizon of the other. Therefore, they modulate, vector and tensor one another on a constant basis.

In this sense, all of these operational components constitute complex point-structures in the larger, whole, integrated latticework of the hermeneutical mapping algorithm. Thus, one has latticeworks within latticeworks, and, indeed, one could discover new point-structures and latticeworks as one went either up or down across various levels of scale.

Each component operation of the algorithm is "potentially" able to spontaneously engage an 'object' independently of any considerations except those that pertain to helping the individual to grasp, with some degree of undistorted reflectivity, the structural character of the 'object' in question. However, as the word "potentially" suggests, the hermeneutical mapping algorithm is vulnerable to a wide variety of influences capable of disrupting its capacity to establish a merging of horizons.

Said in a slightly different way, the hermeneutical mapping algorithm is extremely sensitive to initial conditions. Therefore, the hermeneutical algorithm is susceptible to being pushed into intense turbulence and/or chaotic behavior that might have little, or no, heuristic value.

The basic function of the hermeneutical mapping algorithm is to generate phenomenological models (ideas, theories, etc) capable of reflecting, in analog fashion, the structural character of various aspects of ontology being engaged on whatever level of scale that algorithm is employed. The hermeneutical mapping algorithm is a methodological means of working toward the unraveling of certain ontological structural themes that are given expression through the phenomenology of the experiential field. A hermeneutical algorithm is successful to the extent it terminates in a merging of structural horizons between understanding and that to which the understanding is making identifying reference in the phenomenology of the experiential field, as well as that which makes possible a phenomenology of such structural character.

One of the central tasks of education is to help an individual discover the structural character of the hermeneutical mapping algorithm. A further central task of education is to help nourish that algorithm and permit it to flourish, develop and become refined. Alternatively, one of the biggest problems of educational theory and practice is to try to determine exactly when the educational process is interfering with, and/or distorting, and/or placing unnecessary limitations on the development of the hermeneutical algorithm that is intrinsic to human beings.

Everything that is done or attempted in education will be substantially affected by what occurs with respect to the nurturing or inhibiting of the intrinsic hermeneutical mapping algorithm. If this algorithm is permitted to be developed properly, the prospect of distortion and error entering into other aspects of the educational process is far less likely to occur. Among other things, if the integrity of the hermeneutical mapping algorithm is intact, one has – within certain limits -- a self-correcting means of methodologically protecting oneself against such distortion and error.

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The property of self-similarity in relation to fractal structures

According to Mandelbrot, there is a link between a system being able to manifest infinitely complex variations on some given shape/theme and the same system being able to exhibit persistent characteristics of irregularity. This link is rooted in the property of symmetry to which fractal structures gave expression.

In other words, fractal figures have the capacity to preserve the quality of self-similarity from one level of scale to another. This property of symmetry joins together the aspects of complexity and irregularity in a dialectic of unified structural character.

The fractal property that preserves the quality of self-similarity across different levels of scale is a nonlinear form of recursion theory. Figures such as a Koch curve, or Peano curves, or Sierpiński carpets, and so on, are recursive structures because the self-similarity aspect is inherent in the repetitive character of the construction process.

The complex structural character of the surfaces of materials often prevents different materials that are brought together from being able to make contact at every point of their respective surfaces. However, the extent to which interacting surfaces will make contact turns out to be independent of the materials involved in the interaction. In fact, the dialectic that establishes the structural character of the contact between (or among) two (or more) surfaces is a function of the fractal properties of the surfaces involved in the interaction.

The Humpty-Dumpty effect is a direct reflection of the way in which contact between surfaces depends on the fractal properties of the surfaces involved. This effect refers to the fact that once an object (such as a bowl, cup or glass) is broken, then even if one can reconstruct the object so that it appears to fit together on some gross level of scale, nonetheless, on less gross levels of scale, there will be incongruencies.

This is because the surfaces have been irreparably altered in various ways by the process of breaking. As a result, stress bumps are formed where portions of the surface have been crushed, squeezed and subjected to shearing forces.

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Hermeneutics and the Humpty-Dumpty Effect

One might suppose there will be something like a Humpty Dumpty Effect in the context of hermeneutics. In other words, as a result of the impact of ontology on methodology, as well as a result of the impact of methodology on ontology, fracture zones or zones of stress will emerge in the realm of understanding.

More specifically, where the manifold of methodology comes into contact with the manifold of 'reality', the stresses, forces, frictions, limitations, and so on, occurring as a result of the dialectic of these manifolds, will prevent perfect congruencies from being established. Consequently, on one or more levels of scale, there will be lacunae and/or stress bumps that act as obstacles to a total merging of horizons.

In fact, the limitations that, inevitably, are inherent in any given methodology, have a distorting, squeezing, pinching, and/or shearing effect on the congruency process. This is because of the tendency of such methodologies to try to impose a structural character onto an aspect of reality that does not really fit the latter.

This attempt to force-fit reality into preconceived categories of whatever description causes the hermeneutic of the phenomenology of the experiential field to develop wrinkles, bumps, lacunae, and so on. These get in the way of achieving a complete congruency relationship or merging of horizons.

One might suppose that when various dimensional manifolds are brought into contact with one another, the complex structural character of these dimensions might often prevent them from making contact at every 'point' of their respective manifolds. In this respect, dimensional manifolds are somewhat like material surfaces.

Moreover, like material surfaces, the character of the interaction between dimensional manifolds might be shaped by the character of the fractal properties of the interacting dimensions. Such fractal properties are, in turn, an expression of the spectrum of constraints and degrees of freedom through which the order-field establishes the structural character of the various dimensions involved in the interaction.

In line with the foregoing, one might treat the horizon as a manifold of complex structural character that is formed by the interaction of a number of different dimensions. One, then, could construe the notion of a merging of horizons as a fractal like problem involving the interaction or dialectic of manifold latticeworks in n-dimensions. Thus, the fact that hermeneutical structures might not coincide with the ontological structures to which the former are making identifying reference could be conceived of as a function of certain incongruencies that occur along the horizon linking ontological events with the fractal character of a person’s mode of hermeneutical activity.

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<u>The problem of turbulence</u>

The fractal perspective is rooted in the assumption that beneath all the discontinuity, irregularity and fragmentation lies a symmetry or invariance governing how such phenomena organize themselves around self-similar themes across various levels of scale. Fractal geometry represents a means of trying to establish a link between chaotic behavior and ordered behavior. It is a means of trying to show or suggest why one could find order in the midst of chaos, as well as chaos in the middle of order.

Furthermore, fractal geometry is an attempt to account for how these pockets of chaos and order are linked by a set of symmetry themes that would lead to the emergence of the same juxtaposition of chaos and order on any and every level of scale one cared to examine.

However, as Mandelbrot, himself, has admitted, although fractal geometry provided a useful descriptive tool, it often fell short of being able to answer a number of fundamental questions.

For example, his theory could not answer why, or how, the juxtaposition of order and chaos is possible. He also could not account for why, or how, symmetry was able to be preserved across various levels of scale, despite the presence of destabilizing forces and fluctuations and perturbations in the system.

Turbulence has been described as a sort of a breakdown of laminar or smooth flow across all levels of scale in a given system. Under normal circumstances, when fluctuations arise in a laminar system, these fluctuations tend to disappear or die out.

However, when some critical point of intensity and/or number of fluctuations has been crossed, the system tends to destabilize in a catastrophic manner. In other words, turbulence occurs.

Turbulence disrupts the flow of energy in a system. Therefore, turbulence impedes the character of the dynamics or motion normally governing a system. Pockets of turbulence both divert energy away from the rest of the system, as well as constitute sources of drag for the normal paths of motion within the system.

Trying to discover how the transition from a laminar flow to a turbulent flow occurs has long been a problem in a variety of sciences.

Unfortunately, whatever success scientists have had in coming to grips with this problem has been limited to descriptive approximations about particular situations. Scientists have not had much success in providing an account that incorporates a set of universal principles capable of explaining (and not just predicting or describing), in precise mathematical formulation, why turbulence occurs in systems previously characterized by laminar flow.

One of the assumptions traditionally made about turbulence is that the disturbances are distributed uniformly throughout a system. Thus, some scientists approached turbulence in terms of a model that described the perturbations arising in a given system as a sort of homogeneous phenomenon.

However, subsequent work has shown that the set of vortices making up turbulence tend to be unevenly and intermittently distributed in a system. In fact, scientists have discovered that when one examines any given vortex of perturbation in finer detail, the vortex itself breaks down into an intermittent pattern of laminar and turbulent motion.

The standard account of the transition problem usually is expressed in terms of some variation on the account originally provided by the Russian scientist, Lev D. Landau. Landau believed any given system of fluid motion consisted of a coupling of frequency components that were a function of the energy in the system. As new energy was fed into the system, new frequencies emerged in the system one at a time.

Yet, these frequencies were not independent of one another. They were tied to the character of neighboring frequency patterns.

Consequently, there were only a limited number of degrees of freedom that could be realized in such a coupled system. In other words, the potential for complex, autonomous frequency components arising in a system of fluid motion is curtailed by the dampening effect that the vectoring of neighboring frequencies has upon new energy components being introduced into the system.

On some occasions, for unknown reasons, an influx of energy introduced, into the system leads to a series of unstable motions that are not dampened by neighboring frequency patterns. According to Landau, these unstable motions tend to accumulate or hang together.

As a result, the amalgamation of unstable motions creates complex frequency structures comprised of a set of overlapping frequency patterns of different rhythms, speeds and sizes.

While this model appeared to fit the overall characteristics of turbulent phenomena, it was virtually useless in helping one to understand how turbulence actually arose. Moreover, Landau's model did not provide one with a means of precisely determining either: (a) when an influx of energy would lead to the appearance of a new frequency in the system, or (b) what the value of that frequency would be if it were to arise.

In short, the increase of one or more vectors leads to a catastrophic and discontinuous change in the macroscopic properties of the system. Significantly, there is only a slight difference in the average energy displayed by a system between a point just prior to the critical transition juncture and the actual point of transition itself.

However, suddenly, the macroscopic characteristics of the system are being regulated by laws. Such laws could not have been anticipated on the basis of knowledge of the microscopic properties of the system prior to reaching the critical phase transition point.

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Catastrophic transitions and education

The foregoing sort of subtle shift in average energy past some critical level that is subsequently followed by a sudden, discontinuous alteration in system properties seems like the abrupt transition that occurs in relation to the Necker cube illusion, when a slight change in focal/horizonal interaction takes place. This focal/horizonal dialectic can be altered in marginal ways until it reaches some critical juncture, beyond which the perspective goes through a catastrophic and discontinuous change.

In fact, any latticework or set of interacting latticeworks will have one or more critical values inherent in the structure's spectrum of ratios of constraints and degrees of freedom. When these values are exceeded, Necker-like transitions occur.

These transitions, however, are not continuous in any traditional mathematical sense, but are more akin to the way the discrete runners in a relay race keep the process continuous by handing off the baton to one another. As such, the Necker-like alteration does not necessarily go through every intermediate point between the pre-critical structural character and the post-critical structural character -- but, rather, at different junctures, one process leaves off and another one begins.

There are a number of intriguing questions, issues and problems that arise when one reflects on the issue of sudden shifts in hermeneutical phase transitions in the context of education. For example, one needs to determine whether certain kinds of vectoring (in the form of teaching, curriculum, textbooks and so on) consistently will lead to certain sorts of catastrophic changes of understanding, behavior and so on.

There is also the problem of determining whether educational changes can be brought about in a non-catastrophic manner. Must one suppose that sudden, discontinuous changes are an intrinsic feature of all learning situations? Or, looked at from another perspective, one might ask: Does learning that is rooted in catastrophic or sudden phase transitions have greater heuristic value than does learning that is rooted in non-catastrophic phase transitions?

An additional issue revolves about the question of whether or not one must individualize education because different people will have different kinds of critical points of catastrophic phase transition. Alternatively, despite differences from one individual to the next, could one suppose there is sufficient self-similarity to be observed across a group of individuals that one does not need to individualize education in the foregoing sense?

Finally, one might seek to determine if there are links between indoctrination and chaos theory. For instance, one might treat indoctrination as the active, or even passive, attempt -- whether intended or not -- to prevent an individual from reaching certain kinds of critical points of phase transition during the course of that person's life-cycle. These critical points might cover a whole host of developmental issues, ranging from emotional themes, to political, social, economic, intellectual, creative, and spiritual issues.

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<u>Fixed point limit cycle and chaotic attractors</u>

Traditionally, there have been two kinds of attractors used to describe the dynamics of phase space. These are: (a) the fixed point attractor and (b) the limit cycle. The fixed point attractor tends toward a single form of steady state. The limit cycle attractor gravitates toward a continuously repeating, oscillating structural form. The character of this oscillating structural form will depend on the vectored forces at work in the system under consideration.

Phase space is a means of giving visual representation to central themes of complicated systems. Essentially, one uses the movement of a point to describe the dynamics of certain thematic aspects of a given system over time. The point constitutes the intersection of two or more co-ordinates, with the number of co-ordinates depending on the number of variables on which one is trying to keep tabs. Each independent variable constitutes a degree of freedom and is represented as another dimension in phase space.

When a new point is plotted, this represents the changing relationship between, or among, the variables being studied. The curve or geometric figure described by a series of plotted points gives expression to the dynamics of the system over time.

For example, consider a phase space describing the relationship of two variables, velocity and position, of a moving pendulum. The curve described by plotting the relationship between velocity and position over time is a loop.

Adding energy to the system, by permitting the pendulum to cover a greater arc and at a faster rate, or withdrawing energy from the system (as would be the case with a pendulum that covers less distance in its moment and does so at a slower rate), will not change the fact that the dynamics of either kind of system will still be described by a loop. The only difference will be in the size of the loop.

In general, the more energy associated with the movement of the pendulum, the larger will be the size of the loop that is plotted. On the other hand, the less energy contained in a pendulum's movement, the smaller will be the size of the loop being plotted to describe the dynamics of such a system.

If one introduces friction as a third variable into the above system, this will be a source of drag. The effect of the drag will be to dissipate the energy contained in the pendulum's movement. As more and more energy is drained from the pendulum's movement, due to the effect of friction, the loop describing the dynamics of the system will become smaller and smaller.

Friction acts as a fixed point attractor. The loop describing the dynamics of the pendulum system shrinks, reflecting the presence of friction. Eventually, the loop is drawn toward equilibrium where position is fixed and velocity is zero.

Therefore, in the phase space describing a pendulum system, dissipation of energy is shown by the way the loop representing the dynamics of that space gravitates toward some central, fixed point. The contraction of a figure in phase space represents the dissipation of energy in a system as the variables of that system are drawn toward an attractor of some sort that is constraining the way the degrees of freedom are manifesting themselves.

When turbulence occurs, energy is both flowing into as well as being dissipated out of the system. As a result, the dynamics of a system beset by turbulence do not tend toward any point of equilibrium. Therefore, one cannot use the idea of fixed point attractor to describe what goes on in the midst of such turbulence.

The only other kind of attractor traditionally used to describe the dynamics of phase space is the limit cycle. In the limit cycle attractor one has a rather special orbital loop giving expression to the movement of a point that describes the changing relationship between, or among, a set of variables.

This orbital loop tends to attract all other orbital loops that might appear in the system. Thus, there is one orbital loop that constitutes a limit toward which other loops in the system will gravitate.

Unlike a fixed-point attractor, however, although the limit cycle displays equilibrium or stability, it does not tend toward a fixed, zero, energy point. A limit cycle describes a periodic dynamic and, therefore, repeats itself in a regular way.

Sometimes a given phase space might be characterized by several attractors. For example, a given system might have both a fixed point attractor component as well as a limit cycle attractor component. Under such circumstances, each attractor component has its own basin, and each basin has a shaping influence on the structural character of the system in which it exists.

Although any given point in phase space represents a possible dynamical state of that space, in point of fact, the long term structural character of a phase space is completely described by the kind of attractor to which such a phase space is drawn. Any kind of motion deviating from the long term structural tendencies of a given system that is governed by a fixed-point or limit cycle will be nothing more than a fleeting fluctuation.

These fluctuations will die out in time. In short, attractors embody the property of stability in the sense that the dynamics of a given phase space tend to gravitate toward the form of the attractor that is governing that phase space.

Turbulent systems, however, present a problem for traditional modes of phase space analysis. The very nature of turbulence is that it doesn't give expression to any single rhythm. It embraces a whole spectrum or range of rhythms that dialectically interact to produce the complex structural character of turbulence.

In 1971, David Ruelle, a mathematical physicist, and Floris Takens, a Dutch mathematician, claimed that turbulence must be described in terms of a special kind of attractor. Like fixed point and limit cycle attractors, this new kind of attractor would show stability.

However, unlike either of the two traditional forms of attractor, the new form of attractor would be nonperiodic. Thus, it would not repeat any given rhythmic sequence. A further feature of the new sort of attractor being proposed was that despite not repeating any cyclical pattern, the differences between one cycle and another would manifest variations of but a few degrees of freedom.

According to Ruelle and Takens, the dynamics of turbulence could be described in phase space by the interaction of only a small number of vector variables. The interaction of such variables could be described by plotting a series of points that constitute the intersection of a small set of co-ordinate axes or dimensions. Thus, low-dimensionality was a further property of the new kind of attractor being introduced.

In effect, the strange attractor (also known as a chaotic attractor) being proposed by Ruelle and Takens already existed in the form of the Lorenz attractor. The Lorenz attractor possessed the necessary properties of being stable and nonperiodic, yet showing low-dimensionality.

Furthermore, the loops of the Lorenz attractor never repeated themselves, nor did they intersect themselves. Nevertheless, the Lorenz loops gave expression to this variety within a finite envelope of space.

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The structural character of hermeneutical attractors

Any ratio of constraints and degrees of freedom gives expression to an attractor. The dialectical character of such a ratio determines the properties of the attractor basin or sphere of influence arising as a manifestation of the attractor.

Therefore, hermeneutical structures (which can be construed in terms of a complex dialectic of various spectrums of ratios of constraints and degrees of freedom to which a given kind of understanding gives expression) manifest attractors and, therefore, attractor basins. Some hermeneutical structures form fixed-point structures. Other hermeneutical structures establish limit cycle attractors, while still other such structures form chaotic attractors.

In general terms, there is a dynamic dialectic occurring along the boundaries linking two or more hermeneutical attractor systems. Each attractor has a basin that serves to shape and orient the forces characteristic of that attractor. The basin gives expression to the hermeneutical counterparts to vectored and tensored components that establish the parameters marking the outer limits of the hermeneutical attractor's sphere of influence.

As indicated earlier, not all dynamical systems are governed by just one state of equilibrium. Some systems have two equilibrium states, and others might have more than two states of equilibrium. This is especially true in the case of hermeneutical systems.

Each equilibrium state constitutes an attractor, and each attractor gives expression to a set of boundary properties. Where two or more attractors come together, the boundary separating them can be both complicated and turbulent ... although this might not always be the case.

Moreover, even though the long-term character of such dialectical interaction might not be chaotic, chaotic properties might surface along the boundary regions separating one hermeneutical attractor basin from another. As a result, predicting in which direction a system will go can become extremely difficult.

The study of hermeneutical, attractor, fractal, basin boundaries is, like its counterpart in nonlinear dynamics, concerned with the phase transitions occurring at certain threshold values along the boundaries of interacting hermeneutical basin attractors. This occurs as one goes from laminar flow to catastrophic behavior, to a, final, non-chaotic equilibrium state within such systems.

In a sense, constraints and degrees of freedom have a sort of yin and yang relationship. In other words, there are degrees of freedom within any given set of constraints, just as there are constraints within any given set of degrees of freedom.

In light of the foregoing comments, one cannot really separate the ratio of constraints and degrees of freedom. The integrity of a latticework's structural character requires both.

Indeed, the yin/yang relationship of constraints and degrees of freedom is somewhat reminiscent of the relationship between information and noise that Mandelbrot discovered in relation to messages communicated over telephone lines. As a result, irrespective of the level of scale through which one engages a given structure, there will be a ratio of constraints and degrees of freedom that gives expression to the character of that structure. This ratio serves as a signature for a given structure – irrespective of whether such a signature is described in mathematical terms or through alternative hermeneutical modalities of understanding.

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<u>Boundary conditions recursion scaling and convergence</u>

In contrast to the Newtonian position in which a given color is reduced to a precise wave length, colors that arise in the context of perception are more difficult to contain in any such precise fashion. The horizonal boundaries of perceptual color seem more diffuse and spread out over a broader phenomenological expanse than are the Newtonian representations of a color's wave length. Nonetheless, despite the incredible complexities and intricacies surrounding the problems of boundary conditions in relation to color perception, human beings are capable of intersubjectively agreeing, on a consistent basis, concerning the character of the color generated during perceptual engagements of such boundary conditions.

Mitchell Feigenbaum, a physicist, considered the foregoing case involving color perception to be a crucial example of how order and universality could emerge from apparent chaos and turbulence. Moreover, this example would serve as a concrete source of inspiration for his subsequent, more abstract probing of the relationship between order and chaos in the context of changing boundary conditions.

Feigenbaum's starting point for his more abstract studies was the equation for a parabola. However, he wanted to employ the parabolic function in a recursive fashion.

That is, he wanted to take the results from having run one set of values for the variables through the function and feed those results back into the function. This process of feed-back would, then be repeated again and again.

He often found that recursion yielded a stable state in which x and y would be equal or in equilibrium. As a result, the character of the graph would not change with further rounds of feed-back.

On other occasions, however, the recursion process did not lead to one final, steady, equilibrium state. On these occasions, Feigenbaum observed that the system fluctuated between several values.

In general, Feigenbaum found the behavior of the system was extremely sensitive to the value of 'r' that determined the steepness of the arc of the parabola. If the value of ‘r’ produced an arch with too little steepness, the end result would be the extinction of whatever system was being represented. This extinction occurred because the recursion process would eventually require the equation to produce a value of 0 for y.

On the other hand, if Feigenbaum permitted the value of 'r' to increase past some minimal, critical level, the recursion process led to the production of a steady state equilibrium shaped by a point attractor. Finally, if the value of 'r' were increased further, Feigenbaum encountered a system that first underwent bifurcation and period doublings. If the value of 'r' was increased still further, he ended up with a totally chaotic system that was not attracted toward any points of equilibrium.

In the hermeneutical context, the hermeneutical operator plays the role that 'r' plays in the parabola equation cited above. Under different experiential circumstances, the phase state of the hermeneutical operator -- as it is manifested through the focal/horizon dialectic -- constitutes a critical variable. This variable determines whether a given perspective, orientation or understanding will: (a) become extinct (i.e., produce static or zero values when plugged into the hermeneutical field equations in recursive fashion); (b) lead to some sort of equilibrium state defined by a fixed-point or limit cycle attractor; or, (c) generate a chaotic process that will never settle down to any set of self-same values.

Previously, Lorenz had discovered that other kinds of possibilities could arise in systems that were somewhat more complicated than the ones generated from recursion of Feigenbaum's starting equation. For example, in some cases, one could encounter systems that harbored more than one stable state.

Under some circumstances, one of the possible stable states establishes itself and persists for a long time. However, under other circumstances, an entirely different sort of equilibrium might establish itself. This sort of system is known as an intransitive system.

In an intransitive system, one state of equilibrium or another would establish itself, but the system did not oscillate between the two. Moreover, on any given occasion, which of the possible states of equilibrium will establish itself depends on the sorts of external vectoring or shaping factors impinging on the system. Consequently, an intransitive system only can change the character of the kind of equilibrium it manifests if forces external to the internal dynamics of the system are capable of bringing about or inducing such a transition in behavior.

In some circumstances, a hermeneutical system seems to reflect some of the properties of an intransitive system. More specifically, in order for a given hermeneutical orientation, attitude, perspective or understanding, which has achieved a certain degree of equilibrium, to give rise to a different kind of hermeneutical orientation, attitude, perspective, etc., one must subject that hermeneutical state to a set of extrinsic forces. These extrinsic forces must be sufficiently strong, or appropriately structured, to induce a phase transition toward one of the other hermeneutical states of equilibrium that are open to a given hermeneutical system.

Furthermore, in intransitive hermeneutical systems, an individual would be in one, or another, of the hermeneutical phase states that are possible in such a system. However, one does not oscillate between them. Which hermeneutical phase state one would be in depends on the nature of the forces impinging on the individual, together with the manner in which the individual was hermeneutically oriented toward those forces.

On the other hand, there might be other hermeneutical contexts in which an individual might oscillate between several phase states or orientations. For example, if the individual were vacillating between several possibilities, such as in cases of approach/approach or avoidance/approach, or something similar, then an individual's hermeneutical stance might not display intransitive characteristics.

In addition to intransitive systems, Lorenz also spoke of systems displaying the property of almost-intransitivity. This kind of system would display one sort of average behavior for an extended period. Thus, the behavior would never go beyond a certain envelope of values. It would fluctuate within this set of values, never settling down to any specific value.

Inexplicably, at a certain point, the system suddenly would begin to manifest a different kind of average behavior as a new envelope of boundary limit values was established due to a new set of fluctuations within the system. Such systems were highly unpredictable.

In 1975, Feigenbaum began to explore the problems surrounding the transition from periodicity to chaos in systems involving a quadratic map. The transition from periodicity to chaos in such systems seemed to share certain features in common with the way in which laminar flow gave way to turbulence in fluid systems. More specifically, as one encountered the boundary region of transition marking the change from periodicity to chaos, one encountered the tell-tale sign of bifurcation, with its cascade of cycle splitting and doublings.

By calculating the values of the parameters that led to the bifurcations, Feigenbaum discovered that the cycle splitting was not just taking place at a faster and faster rate, but they were doing so in a constant manner. In short, the parameters were converging geometrically. This suggested that some aspect of the system was repeating itself across scales.

In short, his findings indicated that scaling was somehow involved in the process of generating the pattern of bifurcations being observed in the context of quadratic mapping. The presence of the property of scaling meant that in the midst of all manner of transitions and changes, something was being preserved from one level of scale to the next.

Feigenbaum calculated the ratio of convergence for the recursion of quadratic mapping. He obtained a value of 4.669.

He, then, began to look at other functions as grist for the recursion mill. One function that he explored concerned the sine of a number, for which he used the equation: $x (t+1) = r (\sin) (\pi) xt$

Once again, Feigenbaum found that the numbers being generated by the equation during the recursion process were converging in a geometric manner. In fact, the convergence ratio was precisely the same as he had discovered in relation to the quadratic map -- namely: 4.669.

With each new function he tried, he observed the same property of geometric convergence emerging when the function was subjected to the recursion process. Even more amazingly, with each new function he tried, he found the same convergence ratio of 4.669 waiting for him at the end of the process. Apparently, the order underlying the recursion phenomenon was somehow independent of the equations being used as a source for number generation.

Prior to Feigenbaum's discovery, the methodological techniques scientists had used to try to get a handle on the global or long-term behavior of a physical system depended on a knowledge and understanding of the mathematical functions being used to represent or model a given system. However, the rule rather than the exception proved to be that, in the case of nonlinear systems, use of the aforementioned functions did not help one achieve the sort of global understanding that had been sought.

In the light of Feigenbaum's work, there seemed to be universals at work that did not depend on the specific character of such functions since, irrespective of the function selected, the recursion process led to precisely the same convergence ratio. Whether one used a trigonometric function or a quadratic function or some other kind of function, the means seemed to be irrelevant to the end result.

On the basis of his discoverer of the scaling universal that was at the heart of the recursion process, Feigenbaum began to look for a different approach to solving nonlinear problems. He was looking for an approach rooted in the new universal convergence ratio rather than any particular kind of mathematical function. One of the first places his explorations took him was to the study of attractors.

The points of equilibrium to which his mappings gave expression were attractors. These attractors shaped or constrained the fluctuations of a system regardless of the starting point from which the system began. However, when a system undergoes bifurcation as a result of continued recursion, the attractor splits in two.

As the system is subjected to further rounds of recursion, the split attractor points would begin to grow more distant from one another until a further bifurcation would occur. This resulted in each of the attractor points splitting yet again and at precisely the same time.

Feigenbaum's universal convergence value enabled him to predict when the various bifurcations would occur. In addition, he found that he also was able to predict the precise value of the point where these values would occur on the attractor as it became increasingly more structurally complex with each new round of recursion.

The phenomenon Feigenbaum had stumbled upon showed strong indications of being self-referential and recursive, as well as exhibiting multiple-scaling properties. However, largely because of its scaling features, Feigenbaum decided to apply re-normalization group theory that had provided physicists with a means of canceling out the embarrassing infinities that kept surfacing in quantum mechanics. Apparently, he felt that if re-normalization group theory could use scaling techniques to resolve one set of problems in physics, perhaps, one could make use of these same scaling techniques to provide insight into the universal principles underlying the multiple-scaling characteristics of the nonlinear systems he had been exploring.

Even though Feigenbaum was dealing only with simple mathematical functions, he believed his numerical recursion experiments revealed a law of nature inherent in any system, mathematical or physical, which was at the boundary between turbulence and order. In other words, when conditions in a system began to generate the bifurcations and period doublings characteristic of turbulence, a spectrum of frequencies would emerge.

The etiology of this spectrum had always baffled investigators. Feigenbaum's universal convergence ratio, however, seemed to provide a window through which to observe the coming into being of the spectrum of frequencies that heralded the transition from orderly to nonlinear behavior in a given system.

In essence, Feigenbaum was drawing attention to the existence of structural features in nonlinear systems that were preserved across all levels of scale in such systems. He was talking about a symmetry property in the midst of seeming chaos. All one had to do to observe the presence of this property was look at the system in the right methodological way.

Feigenbaum's conclusion can be translated into the perspective of the present essay. An order-field gives expression to the constraints, degrees of freedom and transitions in the spectrum of ratios of constraints and degrees of freedom that are manifested on all levels of scale.

The mutual penetration of chaos in symmetry and symmetry in chaos is a function of the dialectic of dimensionality. What we experience as material, physical, mental, emotional, or spiritual latticeworks on the macro level are really scale independent, fractal expressions of the dialectic of the constraints and degrees of freedom of the basic "stuff" of the everyday world of experience: namely, dimensionality.

The universal convergence ratio observed by Feigenbaum is given expression, to some extent, through the manner in which the hermeneutical process proceeds toward a merging of horizons with some aspect of ontology and/or the phenomenology of the experiential field. In other words, the hermeneutics of experience involves applying an algorithm (i.e., the hermeneutical operator) in a recursive fashion in order to produce hermeneutical maps, just as Feigenbaum needed to generate a recursive function to produce his quadratic maps.

Because the hermeneutical mapping algorithm is a far more complex function (i.e., a tensor-matrix) than any of the mathematical functions studied by Feigenbaum, it will not yield the numerical convergence ratio that emerged again and again in the different recursive, mathematical mappings undertaken by Feigenbaum. The numerical convergence ratio is a reflection of the invariant principles that are inherent in the structural character of mathematics as a methodology.

On the other hand, the hermeneutical mapping algorithm does give expression to methodological structures that all exhibit invariant principles inherent in the character of the hermeneutical operator as manifested in the form of a spectrum of ratios of constraints and degrees of freedom. These principles are independent of any particular application of the hermeneutical operator, just as Feigenbaum's numerical convergence ratio is independent of the particular identity of the mathematical function being recursively mapped.

Moreover, just as the numerical convergence ratio is the structural signature of certain principles that are operative at the heart of mathematics, so too, the hermeneutical operator is the structural signature of the principles that are operative at the heart of understanding. In fact, Feigenbaum's numerical convergence ratio is but a specialized exemplar of the hermeneutical operator in action since the former is the product of a particular set of hermeneutical mapping algorithms that have been recursively applied to a particular issue -- namely, the relation of turbulence to laminar flow within the context of the physical world.

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Contiguity in complex boundaries

Michael Barnsley, an English mathematician, was interested in trying to discover the reasons underlying the period doublings of Feigenbaum's convergence sequences. He believed such sequences must be linked to a fractal phenomenon in some way that had not, yet, been fully grasped by investigators.

Moreover, he felt exploration of this issue could best be conducted through the complex plane encompassing both the real numbers as well as the imaginary numbers. In fact, real numbers are a special kind of complex number in which the value of the imaginary component is zero and, therefore, can be ignored.

When Barnsley introduced Feigenbaum's convergence sequences into the complex plane, an intriguing set of structures were generated. As it turned out, however, the structures Barnsley uncovered already had been discovered some 50 years prior to his work. They were known as Julia sets.

According to Barnsley, if one slices a round cake into a number of pieces, all of the pieces converge at a common point in the center. Furthermore, provided one idealizes conditions somewhat (such as assuming that the side faces of each slice are perfectly smooth), the boundary between any two of these slices is relatively uncomplicated.

However, Barnsley continues, if one were to perform a comparable sort of operation in the complex plane, one would get a much different result. In fact, the boundary between any two given slices of a complex plane cake would become incredibly convoluted. Every point on a boundary separating slices would be in contact with other slices of the cake as well.

Apparently, a solid boundary never forms in the realm of complex numbers as occurs in the three-dimensional world. When one inspects the complex boundary in closer detail, it seems to dissolve into complex remnants of the other regions that have been sliced up. Thus, this mysterious property of -- for lack of a better word -- 'convolution' or 'permeation' or 'convoluted permeation', would hold across all levels of scale, thereby, displaying fractal characteristics.

One might well suppose that the dialectic between focus and horizon, is capable of giving expression to boundaries with this same sort of convoluted complexity as the complex plane. If this is the case, then any given point of a hermeneutical horizon is capable of bordering on all the aspects of a given focus and vice versa. Which aspects of horizon and focus will be given expression will depend on how the hermeneutical operator links horizon and focus together through the exchange of hermeneutical phase quanta.

Furthermore, one might suppose that hermeneutical systems manifest periodic or aperiodic bifurcations as such a system is pushed into turbulence. The turbulence is the result of the problems, questions, enigmas, and so on that arise during the course of an individual's attempt to come to terms with the hermeneutics of various aspects of experience.

The phenomenon of aperiodic bifurcations also emerges on a social/historical level of scale. For example, Thomas Kuhn's account of the breakdown of 'normal' science and the emergence of revolutionary science seems to reflect a great deal of the flavor of the multiplicity of interpretive frameworks that arise during periods of crisis.

Eventually, however, one of the candidates gets selected to assume the throne in order to direct the reign of a new expression of normal science. Therefore, the transition from normal science to revolutionary science appears to exhibit many of the characteristics of a system undergoing turbulence, bifurcations, chaos and, finally, a new kind of order that emerges out of the chaos.

Thus, the period doublings of physical systems seem to have their hermeneutical counterparts in the way possible solutions (whether from an individual or from a scientific community) tend to multiply as the focal/horizonal dialectic seeks to discover a viable solution to some outstanding anomaly, problem, question, issue or challenge. A solution or resolution emerges if one can establish a function of the appropriate sort of convergent character.

In the context of hermeneutical field theory, this appropriate sort of function would assume the form of a tensor-matrix generated by the recursive activity of the hermeneutical operator as it produces structures capable of merging horizons, at least on some levels of scale, with various aspects of ontology or phenomenology. Under such circumstances, order emerges out of turbulence.

Chaos: a science of being and becoming

Chaotic dynamics is considered by some physicists to be a science of process rather than a science of state, or a science of becoming rather than a science of being. However, there really is no reason why one couldn't consider it to be a science of both 'process and state' or 'becoming and being'.

Chaos gives expression to the properties of dynamics and dialectics through its aspects of process and becoming. Simultaneously chaos gives expression to the properties of structure and latticework (as an envelope of a set of constraints and degrees of freedom) through its aspects of state and being.

Moreover, whether being expressed as process or state -- becoming or being -- all of these are manifestations of the underlying order-field. This order-field establishes and regulates the dialectic of dimensions that generate the dynamics of a given latticework or set of latticeworks.

Therefore, the order-field determines the structural character of the spectrum of constraints and degrees of freedom that are capable of giving expression to chaotic dynamics under the right set of circumstances. This is the case in both physical as well as hermeneutical systems.

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Chapter 4: Mathematical Musings

Relation and functions

Suppose one has two sets of objects and, then, joins them through the operation of intersection. Suppose, further, one establishes some sort of correspondence between the objects of these two sets. Such a correspondence can be described in terms of a relation F between the elements of the intersection of the two sets. One of the two sets is stipulated to be the domain of definition or D(F), and the remaining set is said to be the range or R(F).

The essential feature of a function concerns the nature of the correspondence through which one set of objects is assigned to objects of another set. Thus, the character of the assignment or correspondence is at the heart of the concept of a function.

A function is a special kind of relation F that assigns or maps elements from the domain into elements of the range. More specifically, if there is one and only one element (b) of the range, R(F), which corresponds to each element (a) of the domain, D(F), then the relation (F) is termed single-valued and the relation is called a function. Moreover, the range element (b) which is assigned to the domain element (a) is referred to as the image of (a).

The foregoing can be summed up in the following way. A function is a set of ordered pairs (a, b) whose first element is a member of the domain of definition D(F) and whose second element is a member of the range R(F).

A mapping of A into B requires that every element of A be an original element. A mapping of A onto B requires that every element of B be an image of an element of A. The element (b) which is assigned to an element (a) by the function f is symbolized as: 'f(a)'. This correspondence relation is written either as: ab = f(a), or as b f(a). The element (a) is referred to as the argument, and the element (b) is called the function value f(a) at the point a.

Virtually all operations in mathematics can be construed in terms of a correspondence that gives expression to a rule of linkage that specifies how to map each and every object or element of some abstract space S to a corresponding image object or element in some other abstract space O. Although O might be distinct from S, this is not necessarily the case.

The foregoing sort of correspondence is known as a mapping of S into O, and the rule of linkage or correspondence is referred to as an operator. One can write the correspondence in the following form: y = A(x), where A stands for a given operator, and x stands for the element of a given space that is being operated on and linked to y by means of A.

In short, in order to be able to characterize a function, one must be able to give: (i) the domain of definition; (ii) the range, and, finally, (iii) the assignment or mapping procedure that relates the elements of the domain to the elements of the range.

In the hermeneutical context, the domain of definition consists of the various products of the hermeneutical operator. The range is expressed in terms of the spectrum of phenomenological structures that arise in the experiential field. The mapping between domain and range is the latticework of understanding that attempts to account for why the components of the range have the structural character or 'image' that they do.

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Vector spaces: mathematical and hermeneutical

The idea of a vector space can be described in terms of a set of elements that can be combined through different operations (usually addition and multiplication) in such a way that the results of these operations will not be an element falling outside the structural parameters of the set in question. Linear algebra is considered to be concerned with the theory of vector spaces.

'Vector' is the term given to any element of a vector space. Scalars refer to the numbers that are used to multiply vectors. A set of scalars can consist of rational, real, or complex numbers, as well as such structures as fields.

There are eight basic rules that define the general properties of a vector space:

(1) associative law of addition -- (a + b) + c = a + (b + c);

(2) commutative law of addition -- a + b = b + a;

(3) existence of zero -- there exists an element '0' such that a + 0 = a for all values of 'a' in the vector space;

(4) existence of inverses -- for each value of 'a', there is an element, -a, such that a + (-a) = 0;

(5) associative law of multiplication -- n(ma) = (nm)a, where n and m are scalar in character;

(6) unital law -- 1 a = a;

(7) first distributive law -- n(a + b) = na + nb, where n is a scalar quantity;

(8) second distributive law -- (n + m)a = na + ma, where n and m are scalars.

Whenever the elements of a set can be combined through the operations of addition, as well as can be multiplied by scalars, without either: (a) exceeding the structural boundaries of that set of elements, or (b) violating any of the above eight rules, then that set is said to constitute a vector space. The set of real numbers, the set of complex numbers, as well as the sets of all integrated and differentiable functions form vector spaces.

In the hermeneutical context, rules (as well as principles that are more complex than rules) stipulate realms of constraints and degrees of freedom. The interaction of these various sets of constraints and degrees of freedom leads to a dialectic that spins the woof and warp of the latticework that gives expression to the structural character of the sort of 'space' or context being described.

A hermeneutical or phenomenological space might be held together by a set of "rules", principles, or themes in a way that is comparable -- in the sense of an analog -- to the way in which a vector space is held together by the aforementioned eight rules. Part of the task of hermeneutics is to try to specify, to whatever extent is possible in a given set of circumstances, what these analog rules and/or principles are.

A shift in vector space occurs whenever there is a point E (known as the 'end-point') which can be associated with each original point O (known as the 'initial point' such that: (1) a directed or oriented line segments connecting any given point O with its image E (a directed line segment of this sort is called a 'representative of the vector') will be parallel with a new directed line segment that connects a point Onto its image En; and, (2) the new directed line segment is of the same length as the original directed line segment. The distance between the initial point 'O' and the end-point E is called the norm or modulus.

A transition of directed line segments satisfying these two conditions is referred to as a 'translation' or 'vector'. As such, a vector can be considered to be a shift in 3-dimensional space.

The hermeneutical/phenomenological counterpart for the aspect of parallelism among vectors might be rooted in the structural character of the analog relationship between, or among, different latticework's. More specifically, as indicated above, a directed line segment must be parallel with, and the same length as, another directed line segment in order for both line segments to be considered to be representatives of the same vector. Similarly, in order for an oriented or directed hermeneutical latticework to be considered to be an analog for some other oriented or directed latticework, there must be some degree of constancy to the structural character of the "distance" between the latticeworks, together with some mode of constancy to the structural character of the "length" of the respective latticeworks.

When translated into the hermeneutical or the phenomenological context, the ideas of 'distance' and 'length' become qualitative in character rather than quantitative. As such, 'distance' and 'length' both will be construed in terms of the hermeneutical operator's dialectical interaction with a given set of structures and concomitant phase relationships. Therefore, the hermeneutical counter-part for 'length' might be construed in terms of congruence, and the hermeneutical counterpart for 'distance' might be construed in terms of inferential functions.

In order for two latticeworks to be analogs for one another, the two must be:

(a) expressed through different mediums;

(b) capable of preserving a set of phase relationships within a latticework that is congruent with the phase relationships of its counterpart image latticework in the character of their respective inferential structures and dialectical interactions;

(c) the phase relationships that are preserved will be continuous, rather than discrete, (or vice versa) by virtue of the manner in which they are linked together through the order of the dialectic of dimensionality that makes a latticework of such structural character possible.

All representatives of the same vector will be parallel as well as have the same length. Similarly, all representatives of the same oriented analog structure will display the hermeneutical counterparts to being 'parallel' as well as having the same 'length'. Thus, they will show congruence through preserving the inferential structure of phase relationships in such a way as to be reflective of their analog images.

Two or more vectors can be added together by taking the sequence of representatives that are to be combined and, then, proceeding so that the end-point of the first representative in the sequence serves as the initial point of the next representative in the sequence to be added. One should continue on in this fashion until all the representatives in the sequence have been exhausted. The sum of this combination of representatives is given expression by the line segment extending from the initial point of the first representation to the end-point of the final representative in the sequence.

The zero vector (also known as the null vector) refers to that vector or translation that leaves unchanged any given point 'O' to which it is applied. In effect, the zero vector is a translation that "shifts" a point 'O' onto itself. This vector has zero length and has no direction or orientation.

One might want to treat reflexive consciousness as a sort of operation that, when added to a given aspect of the experiential field, is capable of (but might not always realize its capability) leaving everything as it was or is. It is something like a dynamic zero or null vector that allows one to examine a given aspect of the experiential field from a variety of different viewpoints without altering the structural character of the latticework being examined. The idea of reflexive consciousness as a sort of dynamic null vector is somewhat reminiscent of the way Paul Pietsch talks about Riemann's idea of zero curvature being an active rather than a passive zero (see the chapter on "Holographic Images" in this volume).

The inverse of a vector is obtained by interchanging the initial point and the end-point of a vector. This is done in such a way that although the length remains the same, the direction or orientation of the vector has been reversed.

Suppose, in the hermeneutical context, one takes some point in the spectrum of a given focus as the initial point. Suppose, further, that one takes some point in the spectrum of horizon as the end-point. If the starting orientation of the 'line segment' joining these two points goes from focus to horizon, then one could say that the inverse of this representative or vector is a line connecting the same two points but with an orientation extending from horizon to focus.

For example, the hermeneutical vector extending from horizon to focus could be considered as an expression of the dialectic that occurs when memory comes to bear on some on-going focal point of the experiential field or the phenomenology of the experiential field. On the other hand, the vector extending from focus to horizon could be construed as an expression of the dialectic that occurs during the process of learning, when focus is engaged by some aspect of, for example, the sensory horizon in order to place a new piece of data in an appropriate hermeneutical neighborhood or latticework category.

In both cases a shaping or modulation process is involved. However, the difference concerns the direction or orientation of the shaping process and whether it is focus or horizon (memory or learning respectively) which is the primary instigator and/or influence during the shaping process. This would make learning and memory inverses of one another in the context of hermeneutical/phenomenological "vector spaces".

In an orthogonal or Cartesian system, the unit vectors that have a positive direction in the x-, y-, and z-axis are referred to as basis vectors of the coordinate system. Moreover, if one considers any given vector 'v' along any of the three axes x-, y or z-, and if 'r', 's' and 't' are the positive unit vectors for, respectively, the x-, y- and z-axes, then: $v_x = v_x$ times r, $v_y = v_y$ x s, and $v_z = v_z$ x t, where $v_x$, $v_y$ and $v_z$ are all real numbers and are known as the coordinates of 'v' for the coordinate system of which they are a part.

A system of vectors -- $v_1$, $v_2$, ..., $v_n$, is said to be linearly independent, if and only if, each and every vector of this system can be expressed either: (a) as a unique (i.e., it can be expressed in just one way) linear combination of $v_1$, $v_2$, ..., $v_n$; or, (b) not at all. The basis vectors of a coordinate system are considered to be linearly independent. Furthermore, every vector in that coordinate system is dependent on them, since any given vector $v = v_x\, r + v_y\, s + v_z\, t$.

Therefore, "a basis of a vector space V is a system B of vectors of V such that every vector in V can be represented in exactly one way as a linear combination of vectors of B." Not only is the basis of a vector space a linearly independent system of vectors of V, but every vector in that vector space is linearly dependent on that basis.

If the basis for a vector space is finite, then the vector space is referred to as finite-dimensional. On the other hand, if the basis for a vector space is infinite, then the vector space is called infinite-dimensional.

In the case of a finite-dimensional vector space, any two bases in that vector space will have the same number of elements, and this number of elements constitutes the dimension of the vector space V. Thus, in the case of $V_3$, the dimension is 3 since there are three elements: 'r', 's' and 't' that form the basis of this vector space. Therefore, irrespective of the actual structural character of a given basis is in $V_3$, there will always be three elements which make up that basis.

No matter how one constructs the structural character of the unit vector of a given vector space, the dimension of that vector space always will tell one how many elements go into making up the basis of that particular vector space. In other words, if the basis of a vector space is changed (i.e., if the character of what constitutes a unit vector is re-defined), then the coordinates of a vector v will change as a result of the change in the character of the basis (after all, vectors are linearly dependent on the basis), but the number of coordinates will still be the same as the dimension of the vector space. Consequently, for any given basis in an n-dimensional vector space, one will be able to associate a unique n-tuple with each vector of that vector space.

In view of the foregoing, if one has two vectors 'm' and 'n' that are given by their coordinates in terms of the same basis, then these vectors can be added together by means of their coordinates. Furthermore, any given vector that is given by its coordinates can be multiplied by a scalar.

One might want to think in terms of treating experiential intensity as a hermeneutical/phenomenological counterpart to the notion of a scalar. As such, it would serve as a quantitative structure that does not add a new orientation or direction to an already existing vector.

Intensity emphasizes the themes of constraints and degrees of freedom that already exist in a given vectored latticework. It accomplishes this process of emphasis through a sort of density distribution function in which different ratios of constraints and degrees of freedom of a given structure are highlighted in different circumstances.

However, beyond certain boundary limits, intensity might take on vectored properties and transcend the purely quantitative properties of a scalar structure. For example, this might be the case in relation to extremes of pain or pleasure.

In the context of hermeneutics and phenomenology, the idea of a basis is like a complex point-structure that serves as the fundamental building block out of which vectors are constructed in a given hermeneutical vector space. This might be where characterization becomes so important since it often tends to set the tone (in the form of values, attitudes, beliefs, impressions, biases and so on) for what the structural character of the basis will be for a given hermeneutical or phenomenological space. In other words, characterization often establishes the initial set of constraints and degrees of freedom that constitute the hermeneutical unit vectors that will be used in generating the phase relationships that give expression to latticeworks in a given hermeneutical or phenomenological space.

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<u>Three types of tensors and their hermeneutical counterparts</u>

If one generalizes the concept of a vector space in linear algebra, one arrives at the idea of tensor space. Just as the elements of vector space are referred to as vectors, the elements of tensor space are known as tensors.

Tensor algebra is a means of, among other things, describing the curvature of surfaces (and even the curvature of space itself) which is manifested in some region of consideration. The curvature tensor is a term that refers to the operations used to generate these sorts of description.

The energy-impulse tensor is an idea, often used in the theory of relativity, which relates how the energy of a particle and the impulse of a particle cannot be separated from one another. Indeed, this tensor combines these two components (i.e., the energy and impulse of a particle) together into one inextricable structure whose overall character is shaped by the dialectic of these two components.

Finally, there is another kind of tensor known as the tension or deformation tensor. This tensor describes the deformation or tension occurring in an elastic medium.

All three of the foregoing terms (curvature tensor, energy-impulse tensor, and the tension or deformation tensor) appear to be very pregnant with possibility in relation to hermeneutics and phenomenology. For example, the hermeneutical operator might, in fact, have a structural character somewhat akin to the energy-impulse tensor in the sense that the former consists of six components that cannot be separated.

Thus, (a) the process of making identifying reference; (b) the turning of reflexive consciousness to the aspect of the experiential field to which identifying reference has directed our attention; (c) the characterization of that aspect now being attended to; (d) the application of the interrogative imperative; (e) the use of mapping/inferential operations; and, (f) the establishing of congruence relationships, all dialectically interact together. As a result, they cannot be isolated from one another.

These components come together and shape how one another proceed. These components also contribute -- each its own way -- to the shaping, organizing and orienting of the latticework of understanding that emerges through the collective efforts of these components or facets of the hermeneutical operator.

In addition, the ideas of a curvature tensor and a deformation tensor also lend themselves well to the notion of a phenomenological manifold that gives expression to waveform structures that are functions of a number of interacting and, often times, inseparable components. Sometimes the hermeneutical operator is a means of exploring the character of curvature or deformation of a given aspect of the experiential field created by the presence of sensory, emotional, conceptual or spiritual waveform latticeworks. On the other hand, sometimes the hermeneutical operator is itself the cause of the curvature or deformation/tension in the phenomenological manifold as a result of the waveform latticeworks that it generates.

One further idea occurs in relation to vectors and the hermeneutical context. Hermeneutical vectors and tensors can be added together. Indeed, one can conceive of the link between the focal/horizonal structure now being operated on through reflexive consciousness and the focal/horizonal structure that preceded it (in the form of, say, a memory), or the focal/horizonal structure that will follow it (in the form of learning or insight) as the hermeneutical transformations that are necessary in order to generate and link different structures. In other words, the latticework of focal/horizonal structures constituting a given understanding and that is given expression over time, or comes into being over time, is linked by a set of phase relationships that are a series of hermeneutical operations. This series of operations permits one to travel or map a functional link between one focal/horizonal structure and other such structures occurring prior to, or subsequent to, any given point of reference.

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<u>Lattices, phase relationships, and latticeworks</u>

In the 1930s, Garrett Birkhoff, along with John von Neumann, introduced the concept of a lattice. This concept was originally developed with the intention of generalizing and organizing some of the relationships existing between, and among, the subsets of a given set. Subsequently, the lattice concept was extended to encompass various relationships existing between certain mathematical structures (such as groups and topological spaces) and their substructures.

Formally speaking, if a set S has two operations known as intersection and union, then that set is a lattice provided that the structural character of the set is able to preserve three axioms for any elements of the set that might be selected:

(a) associativity -- (a 'intersection' b) 'intersection' c = a 'intersection' (b 'intersection' c); (a 'union' b) 'union' c = a 'union' (b 'union' c).

(b) commutativity -- a 'union' b = b 'union' a; a 'intersection' b = b 'intersection' a.

(c) absorption -- a 'union' (a 'intersection' b) = a 'intersection' (a 'union' b) = a.

The subsets of a set constitute a lattice under the operations of union and intersection.

One of the things that is appealing with respect to the idea of a lattice is the way it focuses on the relationships between, or among, different subset components of a given set, or the relationships between, or among, the various sub-structure components of a given structure. However, in the context of hermeneutics, the operations describing such relationships need to be provided with a far greater dialectical and dynamic character than is possible with the operations of intersection and union.

This is where the notion of a phase relationship will be, potentially, much more powerful than the rather static or fixed ideas of intersection and union that key in or the theme of membership or inclusion/exclusion. At the same time, the dialectic among phase relationships is much more difficult to try to grasp hold of since the very nature of a dialectic is that it often tends to be multifaceted, nuanced, and complex in character.

In any event, use of the term latticework in this article, is intended to retain the emphasis on relationships in Birkhoff and von Neumann's original idea of a lattice. Simultaneously, the notion of a latticework directs attention toward the dynamic/dialectical complexities of phase relationships and away from the rather static character of the inclusion/exclusion relationships associated with lattices.

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<u>The issue of continuity: a neighborhood perspective</u>

Representation theory focuses on issues surrounding the mapping of a group, ring, or algebra homomorphically into either a linear transformation of a vector space, or a group or a ring of matrices of a vector space. The vector space into which a group or ring or algebra is being mapped is known as the representation space. To map something homomorphically requires that one do so without destroying the structure of what is being mapped.

In topology, a figure is a point set. Topological figures that are homeomorphic have the same connectivity.

More specifically, suppose one has two figures, A and B. Suppose, further, that A is transformed into B such that the transformation does not involve any tearing, or pasting together, of A during the course of the stretching, bending and other deformations that are a part of the transformation.

In order for the two figures to be homeomorphic, there must be associated with each point p of A, a unique point f(p) in B. Furthermore, there must also be associated with each point p of B, a unique point of A. In short, the map f that relates each point p of A with its transform f(p) is a bijection of A onto B.

The no-tearing and the no-pasting requirement means that in any mapping f, if the mapping is bijective, then for any two points 'a' and 'b' of A that are sufficiently close together, one must find that the images of these two points -- namely, f(a) and f(b) also will be close together. In essence, this means that the two points -- a and b (along with their images) -- satisfy the condition of continuity.

From the perspective of the present volume, what makes any two given points "sufficiently close together" is the character of the latticework of phase relationships in which the two points are embedded and to which they give partial expression. This latticework ties the two points together through a web or set of phase relationships.

Among other things, this web of phase relationships establishes the constraints and degrees of freedom that determine the structural character of the 'neighborhood' that surrounds the points and through which the points are linked together. When the integrity of the set of constraints and degrees of freedom establishing the boundaries and parameters of the neighborhood are preserved, despite undergoing various kinds of transformations (such as bending, twisting and deformations), then the phase relationships that tie two points to a neighborhood (and, therefore, to each other) remain viable and operative.

Under such circumstances, the two points can be said to have been "sufficiently close together" for connectivity or continuity to have been preserved. In a sense, a 'neighborhood' gives expression to the structural character of continuity or connectivity in a given set of circumstances.

Notice, however, that the meaning of the term "sufficiently close together" might vary from one situation to another. This variance would be a function of: (a) the structural character of the neighborhood involved; (b) the nature of the web of phase relationships that tie together any two given points within that neighborhood; (c) the structural character of the forces that are brought to bear on the neighborhood, together with (d) any dialectic ensuing from the engagement of the neighborhood with such forces.

Although all of these four factors shape the character of the meaning of the term "sufficiently close together" in any given situation, obviously, the bottom line on this (and that which demonstrates whether two points are, or are not, sufficiently close together) will be whether or not one can show, in some way, that there is at least one phase relationship that still links the two points together after the two points have undergone one or more transformation processes. In short, one must have a demonstrable way of getting from one point to the other to show that connectivity or continuity has been preserved.

Moreover, in the hermeneutical and phenomenological contexts, connectivity and continuity are not the all-or-none phenomenon that they seem to be in many areas of mathematics. In other words, in order for connectivity or continuity to be preserved in the hermeneutical context, every link existing prior to a given transformation might not need to exist after the transformation.

The integrity of a neighborhood can be minimally preserved if at least one route or path ties the point-structures of a given hermeneutical neighborhood together. In effect, this means that at least one set of phase relationships must be the same both before and after a given hermeneutical neighborhood undergoes one or more transformations.

Thus, the neighborhood of a point could be seriously disrupted and, yet, still maintain the character of its structural integrity. Therefore, under circumstances of extensive disruption, in order for one to be able to say of any two given points in that neighborhood that they were sufficiently close together, those two points must fall within the perimeter of the set of phase relationships that mark a minimal path or route of connectivity through the latticework of the neighborhood.

On the other hand, if -- due to any combination of the four factors cited previously -- a hermeneutical neighborhood is pushed beyond its limits such that even the minimal structural integrity of the neighborhood is lost or breached, then the property of connectivity or continuity might disappear along with the neighborhood. One cannot be absolutely sure that all links between the two points have been ruptured since it becomes difficult, and sometimes impossible, to carry out the cross-checks and cross-referencing that are normally possible when the two points are rooted in a neighborhood and that are necessary for one to be able to trace whether certain phase relationships are still intact within the latticework of the hermeneutical neighborhood (much as an electronics expert might test to see whether different circuits are still operative or viable).

Indeed, sometimes one doesn't have the methodological means to gain access to the two hermeneutical or phenomenological point-structures in which one is interested. Under these circumstances, one only can make inferences about any links that might exist between the two points by looking at the structural properties of the surrounding neighborhood and trying to determine if any observed structural differences could be accounted for by the absence of a link between the two points in question. Consequently, when the surrounding neighborhood has been disrupted to the point that its integrity might have been breached and, as a result, any connectivity that might exist has fallen into the interstitial crevices that lie beyond the resolution capabilities of the methodological capabilities available to us, one has lost the context against which one can methodologically push in order to be able to arrive at hermeneutical determinations about the relationship, if any, between two point-structures in particular.

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Homeomorphic mapping in hermeneutical contexts

Bijective mapping involving homeomorphic figures might be thought of as a special case of analog structures. Or, approached from a slightly different angle, analog structures can be considered to be a more general and complex version of homeomorphic figures. In both cases, the essential issue is the preservation of a set of links or phase relationships across one or more transformations.

In the case of topological figures, transformations concern: stretching, bending, and other sorts of deformations. However, in the case of hermeneutics and phenomenology, the transformations involve different kinds of transduction in which waveforms of one sort become translated into waveforms of another kind -- such as sounds into sensations, or sensations into conceptual structures, or sensations into emotional structures, and so on.

Furthermore, whereas the points being discussed in a topological context are geometric points that hold position without occupying space, the points being discussed in a hermeneutical or phenomenological context are, or can be, structurally complex, involving a variety of fractal-like levels of self-similar modes of manifestation. As such, the "hermeneutical point" or the "phenomenological point" tend to be 'point-latticeworks or 'neighborhood-latticeworks' occurring within a larger latticework at junctures of intersection of interacting forces or dimensional dialectic within that larger latticework.

The dialectical forces operating through that juncture of intersection provide a relatively stable -- or, at least, temporarily stable -- neighborhood that helps shape the structural character of the larger latticework. This is done by giving expression to the phase relationships that contribute to the set of constraints and degrees of freedom that collectively constitute the larger latticework.

A 'structure' consists of a set of neighborhoods whose internal dynamics -- together with the dialectics of these neighborhoods with one another along their common boundaries -- give expression to a set of constraints and degrees of freedom that is capable of preserving the integrity of the neighborhoods and their dialectics over time. Almost by definition, a "common boundary" occurs whenever two neighborhoods interact with one another. Therefore, 'distant' neighborhoods can share a common boundary if the phase relationships of the given latticework within which the neighborhoods occur permit such interaction.

Structures are the end result of a process involving the placing of constraints on some aspects of various dimensions, as well as the permitting of the expression of some aspects of the degrees of freedom and constraints of various dimensions. This means one cannot really speak of the idea of dimensional dialectics being a reductionistic position. In point of fact, structures constitute a veiling, narrowing down or restricting of the dimensions that help give expression to the character of such structures, just as the dimensions constitute a veiling or restricting of the underlying order-field that makes dimensions and their dialectic possible.

As indicated previously, two figures, A and B, are said to be homeomorphic if there is both a continuous bijective (i.e., one-to-one-correspondence) map m of A onto B, as well as an inverse map m-1 that is also continuous. Such a map is referred to as a topological map or as homeomorphic.

Those characteristics of sets revolving around issues of connectivity are called topological. Furthermore, all homeomorphic images of a given set will possess the same topological characteristics as the set for which they are a homeomorphic image.

In view of the above, latticeworks and analog relationships seem to deal with certain topological-like properties a great deal since both are vitally concerned with, among other things (and in their own way), issues of connectivity. However, the latticeworks and analog relationships of hermeneutical/phenomenological contexts involve n-dimensional topological properties given that the kind of connectivity issues with which they are concerned involve multiple levels of inferential mappings and congruence relationships.

This aspect of n-dimensional topological properties would seem to raise some further issues. For example, if the structural character of chaotic systems encompasses multiple levels in which the character of each level is self-similar with other levels of the structure but not selfsame, what does this do to the issue of bijective mapping?

On the other hand, is it not conceivable – and, perhaps, even plausible -- to suppose that if the structural character of a latticework or neighborhood retains its integrity (and, therefore, preserves the property of connectivity in some minimal fashion) across the transduction/transformation process, then the structures (i.e., phenomenal and noumenal) which are possible analogs for one another will be homeomorphic since one can still show that they are minimally bijective? In other words, connectivity (in the form of a set of phase relationships reflecting the same kind of inferential/dialectical links, constraints and degrees of freedom as the image structure) still exists between them.

Therefore, one not only can map -- in a continuous and bijective fashion -- from one structure onto the other, but there is an inverse continuous map that exists as well. The very notion of two structures being minimally bijective suggests that some set of central, crucial, fundamental, essential or critical set of phase relationships, as well as constraints and degrees of freedom, have been preserved during the process of transduction or transformation. As a result, there exists a neighborhood in a hermeneutical structure that might be capable of being homeomorphically linked with a neighborhood in a structural aspect of the realm of noumena.

The total integrity of such neighborhoods will not be preserved completely from one fractal-like level to the next (or even across the transformation process on the same level). Nonetheless, there might be sufficient preservation of sets of phase relationships, constraints and degrees of freedom within such neighborhoods that one will be able to see how one level connects with another in a self-similar fashion that never strays beyond certain parameters of structural character. As such, self-similar structures or latticework figures manifest minimal, continuous bijective properties and, thereby, establish a basis for connectivity to be preserved -- albeit not as completely as would be the case with self-same structures.

In terms of the relationship of phenomena and noumena, the foregoing considerations can be construed in several ways. Either the noumena is mapped onto the phenomena and, thus, the latter is the image of the former, or, the phenomena is mapped onto the noumena, and, in this case, the noumena would be the image of the phenomena. Quite conceivably, both possibilities might occur in the sense that during the process of sensory transduction, the noumena is mapped onto the experiential field, whereas during the process of hermeneutical determination, the phenomena are mapped onto the noumena as mediated by, or represented in terms of, an experiential or a phenomenological field.

Here, of course, one would be working on the assumption that the transduced, phenomenal representation of some facet of the realm of noumena can be shown to satisfy criteria of bijectivity and, therefore, be homeomorphic with the aspect of the noumena to which identifying reference is being made. The latter often occurs (at least in non-mystical cases) in an indirect manner since it is really a matter of mapping phenomena onto a conceptual latticework (or theory or model) which attempts to account for why given phenomena have the structural character they do.

On the other hand, one could not automatically eliminate the possibility that the hermeneutical operator is capable of engaging certain aspects of realm of the noumena at the boundary manifold where the noumena and phenomenal meet and interact. Under such circumstances, the individual seeks out (that is, one tries to determine) those structural aspects of the boundary manifold that are contributed by noumena and that are congruent with the structural character of one's understanding.

Naturally, a key problem here is whether the hermeneutical operator is merely projecting itself, in the form of constructions of imagination, onto the character of ontology. The other possibility is whether the hermeneutical operator actually has established a legitimate bijective mapping, from the structural character of the understanding that it has generated in the phenomenology of the experiential field, to the structural character of some aspect of the noumena with which it is concerned. Nevertheless, the realization that such a problem exists is not at all the same thing as saying the problem cannot be solved ... as Kant seems to have been inclined to do.

There is a complex, fractal-like boundary that forms between noumena and phenomena. One explores the structural character of boundary systems in order to be able to come to terms with the different latticework systems that are at work shaping, organizing, and orienting that boundary.

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Brouwer's fixed-point theorem and reflexive consciousness

Brouwer's fixed-point theorem is considered to belong to topology because it deals with continuous mappings. Essentially, this theorem states that if one has a closed circular disc D (and this encompasses the perimeter of the disc as well), then every continuous map of a figure F into itself has at least one point that will be mapped into itself, and this point is referred to as a fixed-point. Stated in a slightly different way, the theorem provides a basis for arguing that if the disc D is distorted in such a way that the figure F continues to lie wholly inside the disk after the distortion, then there will be at least one point of the figure that will remain the same both before and after the distortion -- that is, the point will occupy the same position across the distortion.

Perhaps, an excellent phenomenological counterpart for the fixed point theorem is reflexive consciousness. Sometimes, of course, distortions or transformations occur that disrupt reflexive consciousness, and one becomes either temporarily dislocated or disoriented (e.g., short-term amnesia), or one becomes chronically disoriented and/or dislocated as in the case of schizophrenia (although even here one might want to argue that some points in the intensely distorted landscape of the schizophrenic might retain their original positions throughout the periods of deformation). On the whole, however, awareness of awareness is a kind of stabilizing feature that allows one to locate oneself in phenomenology despite the tremendous numbers and varieties of transformation and deformation that are occurring there.

More specifically, suppose: (a) one takes the horizon as describing a complex phenomenological/hermeneutical n-dimensional analog for a closed circular disc; (b) one treats focus or intentionality as constituting a structurally complex point within the n-dimensional "space" defined by the horizonal perimeter (which is actually a set of dimensional parameters or set of constraints and degrees of freedom), and (c) one takes the relation between focus and horizon to be a dialectic describing a phenomenological/hermeneutical process of transformation generating hermeneutical structures or figures that lie wholly within the n-dimensional parameters of the closed disk that are defined by the horizon. Given the foregoing three conditions, then for most deformations of the medium or "fabric" of the phenomenology of the experiential field in which such transformations occur, there will be certain points along the horizon, or focus, or their dialectic that will remain fixed. That is, such point-structures will occupy the same position within the phenomenology of the experiential field after the transformation as they did prior to the transformation.

The fixed-point aspect might be especially relevant with respect to the dialectic between focus and horizon since a fundamental feature of being able to demonstrate the fixed-point character of certain aspects of the phenomenology of the experiential field will revolve around the issue of connectivity or continuity. In other words, one must be able to establish a viable or plausible mapping between: (a) the neighborhood of a point in the pre-transformation phenomenology of the experiential field and (b) a given neighborhood of a point in the post-transformational phenomenology of the experiential field.

This mapping must be such that the relationships of the points in question with their respective surrounding neighborhoods will manifest minimal bijective mapping properties between the two neighborhoods. In effect, one is talking about the structural character of the identity of a given pre-transformational point/neighborhood relationship and the congruence of such a relationship with the structural character of the identity of another point/neighborhood relationship -- namely, a post-transformational relationship.

A few caveats with respect to the foregoing are in order. First, to speak of the horizon as being a closed curve in any simplistic sense would be very misleading. The fact of the matter is, the horizon of the phenomenology of the experiential field intersects with the structure of the rest of ontology to form a complex boundary-manifold structure.

The boundary-manifold is capable of changing its range of constraints and degrees of freedom as a function of the dialectic occurring along that boundary. The boundary-manifold is also a function of the way in which the internal dynamics of a given individual's hermeneutics of the phenomenology of the experiential field help lend shape to the dialectic along the aforementioned boundary.

As a result, the set of constraints and degrees of freedom describing that boundary dialectic can expand or contract over time. Nonetheless, at any given time, at least under most "normal" circumstances, the n-dimensional boundary that sets-off the phenomenology of an individual’s experiential field from the rest of ontology represents an analog for a closed circular disc in which any given level of scale represents a complex structural slice of that n-dimensional boundary.

A second caveat involves the issue of mystical states that seem to dissolve the boundary or barrier between an individual's phenomenology of the experiential field and the rest of ontology. These boundaries actually might be dissolved in some absolute sense. Or, the boundary/barrier "merely" might undergo an incredible change in the structural character of the level of scale.

Alternatively, the structural character of the dialectic across the boundary might undergo a transformation in which horizons merge such that one cannot separate one from the other even while the two remain distinct on some level of scale of sufficient refinement. Or, some combination of the second and third possibilities might be involved.

In this event, an individual's normal veils of perception and understanding that establish the set of constraints and degrees of freedom through which we normally interact and respond with the rest of ontology, are rendered inoperative. When this occurs, a less distorted, more deeply penetrating and more intense communion might occur than is usually described by our "normal" rationalistic or conceptual dialectic with ontology.

Memory and learning constitute complex structural "point/neighborhoods" that are the result of hermeneutical operator activities. Among other things, these activities generate mappings from a given focal/horizonal dialectic to those aspects of the phenomenology of the experiential field that are sensitive to receiving such mapping (e.g., the memory field).

These mappings might be bijective, non-bijective, or somewhere in between, depending on the extent to which congruence can be established between the memory point/neighborhood structures and the original focal/horizonal dialectic through which the hermeneutical operator mapping arose (i.e., a learning process). In fact, one might think of memory as a mapping onto, or into, reflexive consciousness that satisfies Brouwer's fixed-point theorem to varying degrees -- ranging from a minimum of one point (in the case of an extremely distorted memory) up to a bijective mapping (as in the case of, say, eidetic imagery) in which the present awareness of a memory structure is, despite a variety of distortions that might have occurred in the interim, homeomorphic with the latticework that was originally laid down at the time of experiential learning when the memory structure was first created or generated.

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Giving the Jordan curve theorem a hermeneutical twist

The Jordan Curve Theorem states that a simple closed curve, (i.e., one that does not intersect itself) divides the plane on which it occurs into two parts. This theorem has two aspects.

One aspect concerns the idea of a curve that does not intersect itself. The other aspect revolves around the idea of a plane that has been divided into two parts. Both of these aspects have topological properties.

The first aspect is topological because any given homeomorphic image of a simple closed curve will also be a simple closed curve since any given simple closed curve is a homeomorphic image of a circle. The second aspect is topological because the complement to a simple closed curve involves two disconnected parts, and this is also a topological property.

Although the theorem appears to be quite simple, it is often quite difficult to prove. One of the reasons for this is that one can run into considerable difficulty trying to determine whether any given point falls inside or outside of a given closed curve -- provided that such a curve is sufficiently complex.

One possible application of a modified version of the Jordan Curve Theorem to the context of phenomenology and hermeneutics might concern the noumena/phenomena boundary-manifold structure. This boundary structure could be construed as representing a complex closed figure of n-dimensions.

Moreover, one also could consider the way in which the boundary-manifold tends to separate the plane of existence into two parts. More specifically, this would involve: (a) those aspects of noumena that fall outside the boundary and, therefore, beyond the perimeter of the interface of ontology and the phenomenology of the experiential field; (b) those aspects of the phenomenology of the experiential field, including the points of noumena/phenomena interaction, that fall within the perimeter of the boundary-manifold.

As is generally the case with respect to the Jordan Curve Theorem, one also has trouble in hermeneutics trying to determine if a given point falls inside or outside the aforementioned boundary-manifold structure. This is an important point to establish.

It concerns one's ability to determine whether one is merely talking about some projection of imagination, or whether one is talking about some aspect of ontology that lies beyond the boundary structure and, yet, which helps make a boundary-manifold of such structural character possible. In other words, the point being raised concerns the issue of whether one has constructed something that is shaping the boundary structure in a distortive or veiling manner, or whether one has merged horizons with an aspect of the ontology that lies on the other side of the boundary structure and that is responsible for that aspect of the boundary structure having the character it does.

One possible source of difficulty with respect to the application of the Jordan Curve Theorem to the hermeneutical and phenomenological contexts concerns the following question: How does one deal with the fact that reflexive consciousness seems to constitute a case of a manifold intersecting itself, and, therefore, appears to fall outside the purview of the Jordan Curve Theorem that is about curves that do not intersect themselves?

By definition, the meaning of "simple" is non-intersecting. If a curve intersects itself, it cuts the plane into more than two sections and, therefore, falls outside of the purview of the Jordan Curve Theorem. However, in relation to the issue of reflexive consciousness, the property of intersection need not necessarily cause the manifold of the phenomenology of the experiential field to be compartmentalized into more than two sections.

If this is so, then in some cases (reflexive consciousness being one of them), one might be able to separate the issues of simplicity, on the one hand, and, on the other hand, the property of generating more than two sections in a manifold surface during the process of intersection. Thus, conceivably, in special cases a curve that intersects itself might not be simple and, yet, still qualify as a context for which the Jordan Curve Theorem has applicability.

The focal/horizonal structure could be considered as a closed curve that intersects itself under the condition or operation of reflexive consciousness. Although the focal/horizonal structure compartmentalizes the manifold of the phenomenology of the experiential field into two sections -- namely, that which falls within the focal/horizonal structure and that which falls outside the parameters of the boundary of that structure, nonetheless, when the operation of reflexive consciousness is introduced, no further compartmentalization occurs.

There are still just two compartments such that the boundary structure that separates 'inside' from 'outside' remains intact, the same as it was before. What has been added is a further dimension of awareness of the separation and the structural character of the boundary as having a certain set of latticework properties.

In fact, the focal/horizonal structure can be construed as a fractal-like version of the relationship that the manifold of the phenomenology of the experiential field has with the larger field of ontology within which it resides. Indeed, one even can take any given focal/horizonal structure and take it down to another level of scale by examining the details of any aspect of the larger focal/horizonal structure. This changing of perspective through switching levels of scale can be repeated as many times as one's methodology and ontology permit.

In some cases reflexive consciousness seems associated with instances in which the manifold of the phenomenology of the experiential field is compartmentalized into more than two sections. For example, phenomena such as fugue states, multiple personality, or the sorts of things that Gazzaniga and Fodor talk about in relation to the idea of modular consciousness, all seem to lead to the compartmentalization of the manifold of the phenomenology of the experiential field in a way that yields more than two sections of the manifold.

However, reflexive consciousness might not necessarily be the cause of such compartmentalization. Other kinds of forces or transformational elements might have introduced fissures into the manifold. When the operation of reflexive consciousness is introduced so that these compartments become aware of themselves as a structure of one sort rather than some other, everything is left as it was before, and no new compartments are introduced.

Consequently, considered in terms of any given compartment of the manifold, reflexive consciousness doesn't introduce new compartments. It highlights the character of the inside/outside distinction of the boundary structure of the compartment that gives expression to the focal/horizonal structure that has come into play.

The compartment's focal/horizonal structure is the closed curve, and everything that is not included in the latticework of that structure is, by definition, outside of the structure. There might be many compartments beyond the boundary parameters of the focal/horizonal structure, but they are all part of the same 'outside'. As a result, the Jordan Curve Theorem still holds in as much as we are still talking about a closed curve that divides the manifold into two sections despite its intersecting with itself through the operation of reflexive consciousness.

The reason a geometric closed curve that intersects itself divides the plane into more than two sections is due to the nature of the structural character of the points that generate the curve or from which the curve is constructed. Geometric points are said to have position, but they do not occupy or take up any space.

The idea of "position" refers to the relationships of proximity (as well as, 'before' and 'after) which points have with respect to another. Leaving aside considerations of whether one can speak intelligibly of points that do not occupy space, one can still locate points by describing their relationships with one another in the context of a given curve, figure or structure. Thus, if one is proceeding in a given direction along a curve, different points will be before other points, and other points will be after those points. Moreover, some points will be proximate to certain points and distant, relatively speaking, from still other points.

Considered in terms of these relationships, when a curve intersects itself, this cannot but help to affect the character of such relationships. By crossing the boundary structure of the curve, an intersection cuts through one or more of these relationships.

Thus, for example, one point that was next to another point is no longer next to that point. Each of those points is now next to a new point that has come between them. Or, whereas prior to the intersection, one point might have preceded another point in terms of when, respectively, one encountered those points as one traveled in a given direction along the curve, after the intersection, the point that previously had occurred after another point might now be encountered before that point as one traces a path along the curve.

If none of these sorts of changes in relationship occurred, then one would have to question just what the meaning of the idea of geometric intersection involved. Indeed, in geometric contexts, inherent in the very nature of the process of intersection seems to be the fact that the relationships among certain points are disturbed or affected in some discernible way. If there is no trace or evidence that such a disturbance of point-relationships has occurred, then in the geometric context, one has a prima facie case that intersection has not occurred.

Of course, a curve does not have a relationship with just itself. It also has a relationship with the plane on which it exists as a curve and that makes its existence as a geometric structure possible. This is where the aspect of compartmentalization of the plane comes into effect, for when a curve intersects itself, it alters the relationship that the curve has with the plane since the curve/plane relationship goes from (in the case of a closed curve) being one of two compartments, to one of being more than two compartments.

In the context of phenomenological structures, reflexive awareness of such a structure can be seen as a closed curve that intersects with itself without, at least as far as the issue of compartmentalization is concerned, altering the relationship that the focal/horizonal structure has with the rest of the manifold of the phenomenology of the experiential field. There was an inside/outside relationship before the operation of reflexive consciousness was introduced, and there is still the same inside/outside relationship after the operation of reflexive consciousness is introduced.

Such a structure might, or might not, be simple in the geometric sense, but it does not generate or introduce any new compartmentalization. Therefore, the operation of reflexive consciousness preserves the logical character of what seems, essentially, to be meant by the idea of simple curve - i.e., that which does not alter the relationship of the structure with the larger manifold context as far as to the issue of compartmentalization is concerned. In effect, one has one interior compartment (formed by the focal/horizonal dialectic) whose contents are constantly changing with shifts in the character of the focal/horizonal dialectic.

Thus, there is a sense in which boundary structures are crossed (focally and horizonally) as one goes from pre-reflexive awareness to reflexive awareness, and, therefore, the minimal conditions for intersection have been satisfied. Nonetheless, the change in boundary perspective does not lead to compartmentalization as in the case of geometric intersection, although the former does lead to a change in the character of the relationship that the focal/horizonal structure has with itself.

The geometric curve's intersection with itself affects the character of the pre-intersection relationships that points had with one another. On the other hand, in the case of reflexive consciousness, the change in the character of the relationship concerns the dimension of self-awareness and what that relationship makes possible. Such reflexive consciousness serves as a 'doorway' through which the hermeneutical operator can be introduced, dynamically and dialectically, in a conscious rather than in an unconscious manner, and in a directed rather than a haphazard manner.

Thus, the key issue in the whole aspect of intersection, as far as the Jordan Curve Theorem and reflexive consciousness are concerned, is a matter of compartmentalization. As Gazzaniga has demonstrated, on certain levels of scale, reflexive awareness can be associated with a compartmentalization of the phenomenology of the experiential field. However, as was suggested in the foregoing discussion, the nature of the intersection of the manifold of the phenomenology of the experiential field need not necessarily affect this facet of things.

In general, reflexive consciousness is a phenomenological manifold that intersects itself in, at least, two sets of neighborhood points. One set of neighborhood points is called the "horizon". The other set of neighborhood points is called the "focus". The structural character of the latticework that links focus and horizon is a complex vectored or tensored expression of the hermeneutical operator. This tensored expression often highlights the distinction between inner and outer. In this sense the effect of reflexive consciousness is congruent with certain aspects of the Jordan Curve Theorem.

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Several species of bijective mapping

One possible use of the Jordan Curve Theorem in the context of hermeneutics is, as indicated previously, to illustrate the problem of confusing methodology and ontology. Essentially, this problem arises when the individual fails to realize that a given methodology (consisting of a latticework of neighborhoods of varying hermeneutical character) does not provide a basis for bijective mapping with some given noumenal latticework or facet of reality on the 'other' side of the boundary structure of the closed curve of the phenomenology of the experiential field. The methodology produces, instead, a mapping onto some other aspect of the phenomenology of the experiential field within the boundary structure that circumscribes the field.

Usually, this 'other aspect of the phenomenology' is a conceptual or hermeneutical structure that one takes to be reality when it is actually a projection or mapping of certain aspects of the methodology onto the phenomenological manifold. Such a mapping might be phenomenologically bijective, but it does not establish a bijective mapping that would allow one to show a homeomorphic relationship between phenomenal and noumenal structures or figures.

Thus, there are two different kinds of bijective mapping that are possible. One kind of bijective mapping is between: (1) a neighborhood of experiential field or phenomenal point and (2) a given neighborhood of noumenal points along the boundary structure that separates phenomenological neighborhood point-sets from noumenal neighborhood point-sets. One must keep in mind here, however, that the idea of "separation" is dialectically complex. As a result, one is not always in a position to distinguish where one leaves off and the other begins. This first kind of bijective mapping emphasizes the role of the merging of horizons and the removing of methodological veils that interfere with the establishing of such bijective mappings.

The other kind of bijective mapping is between two different neighborhoods of experiential or phenomenal points such that one of these phenomenal neighborhoods is mapped onto the other by means of imagination, with little, or no, contact with noumena. In other words, the hermeneutical operator is in its projecting/construction mode rather than in its merging mode.

Naturally, there can be various kinds of combinations of the two sorts of bijective mapping. However, the more the ratio of the two kinds is dominated by the projection mode rather than the merging mode, the greater the individual will be removed from a true understanding of ontology and that which makes ontology of such structural character possible.

Consequently, all methodology constitutes a mapping process that attempts to establish various degrees of homeomorphism between phenomenal and noumenal point-set neighborhoods. Difficulties arise when methodology identifies a phenomenal neighborhood as a noumenal neighborhood, and, therefore, assigns an incorrect set of boundary parameters to that phenomenal neighborhood of points (i.e., designates a structure as being outside of, and independent of, the focal/horizonal boundary manifold, when, in point of fact, that structure really is inside of, and dependent on, the focal/horizonal boundary manifold.

Although the ideal case in hermeneutics would exist when a homeomorphic relationship held between two structures (that is, there is a merging of horizons), one is not likely to achieve this in very many, if any, cases. One reason for this is that, with the exception of all but the simplest issues, the ontological context tends to have an inherently richer structural character than does the hermeneutical context. In effect, this means congruence involves a special, limited case of homeomorphism ... namely, the existence of a latticework of neighborhood point-sets focusing on key or central or fundamental themes (which correspond to the idea of topological properties) as the criteria for determining whether or not one can say that one structure has a character that is reflective of the structural character of another latticework of neighborhood point-sets with which it is being compared.

The foregoing observation suggests one will have to differentiate between peripheral and essential neighborhood point-sets. As long as certain essential, hermeneutical neighborhood point-sets display homeomorphic properties with respect to certain ontological neighborhood point-sets, one might be able to tolerate the fact that various peripheral neighborhood point-sets do not display such homeomorphic properties. Nonetheless, one still is confronted with the task of distinguishing between the essential and the peripheral since being able to establish homeomorphic mapping relationships between peripheral structures, in the absence of mapping relationships with respect to essential structures, might serve little, or no, purpose.

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<u>The nature of a neighborhood in topology and hermeneutics</u>

The E-neighborhood of a point 'p' [UE (P)] can be defined as the set consisting of all those points having a distance from p which is less than some arbitrarily chosen positive number E. If p is part of a line, then, the E-neighborhood is an open interval of distance 2E.

If p is part of a plane, then, the E-neighborhood is an open disc of radius E, although the circumference of the disc is not considered to be part of the disc and, therefore, falls outside the radial distance of E. Finally, if the point p is a part of some three-dimensional space, then the E-neighborhood will be a sphere of radius E. Again, however, the surface of the sphere is not considered to be part of the sphere and, consequently, the sphere's surface falls outside of the E-neighborhood of the point.

In any given figure F, one can differentiate between boundary points, ' b ', and interior points, ' i '. Boundary points have an E-neighborhood in which some of the points in that set fall outside of the figure. On the other hand, interior points have an E-neighborhood that falls totally within the figure.

One thought that arises in relation to the foregoing concerns points along the complex boundary structure that separates/links the manifold of the phenomenology of the experiential field with the manifold of 'external' ontology or reality. Seemingly, for some, if not all, points along this boundary structure, the E-neighborhood would have some points falling outside of the boundary structure and, therefore, overlapping part of the external, ontological manifold.

On the other hand, the E-neighborhood of the same point would have some points that overlap with the phenomenology of the experiential field. Looked at in this way, one might want to speak of the phase relationships among different points of the E-neighborhood that tie the ontological manifold to the phenomenological manifold. Presumably, these phase relationships are the loci of transduction activity.

Consequently, at least in terms of the phenomenological/hermeneutical context, the E-neighborhood should not be thought of as merely a static structure that establishes a distance relationship with a given point p. The E-neighborhood also might constitute a sort of dynamic envelope that contains phase relationships linking manifolds on both sides of a given point of the boundary structure. The nature of these phase relationships would vary with the identity of the boundary structure point being considered.

A second idea to consider is the possibility that inference might be conceived of as a complex topological relationship involving a series of boundary points and interior points connected by a dialectical relationship of some sort. For example, one could consider an interior point to be an expression of focus, whereas a boundary point would be an expression of horizon. As such, these two points mark the structural 'distance' -- as measured by a particular inference gauge -- covered by the E-neighborhood surrounding some aspect (i.e., 'point') of the structural character of the latticework of a premise in a given inference network.

Both horizon and focus could be considered as essential features of the complex boundary manifold structure that like a macrophage has surrounded or engulfed a 'piece' of reality and begun the process of 'digesting' that chunk of ontology -- or, if not digesting, carrying on a dialectical relationship with the reality structure. Seen from this perspective, the phenomenology of the experiential field is a sort of complex membrane (or boundary manifold) that engages, and is engaged by, reality from a number of different directions and fractal-like levels ... including from "within'.

For example, the body impinges on that boundary manifold just as much as the 'external' world does. As a result, both focus and horizon can have E-neighborhoods that overlap with various aspects of 'internal' as well as 'external' reality.

Furthermore, one should keep in mind that horizon is part of the E-neighborhood of focus, just as focus is part of the E-neighborhood of horizon. As such, when memories come forth without being sought and engage different aspects of the structural character of focus, this is an example of focus being part of the E-neighborhood of horizon.

On the other hand, when one seeks out particular information one has learned in the past, this is an example of horizon being part of the E-neighborhood of focus. Thus, in any given case, the determining factor of which is to be considered to be the E-neighborhood of the other will depend on the direction of the hermeneutical vector or tensor to which identifying reference is being made ... that is, whether the dominant orientation of the dialectical engagement is from focus to horizon or from horizon to focus.

One could continue along the same line of thought as outlined above and think of "normal" consciousness as a relatively simple, closed, curve-structure or manifold of n-dimensions that is part of a fractal-like network in which there are different levels of scale in this network that fall beyond the perimeter of the parameters of normal consciousness. Indeed, as difficult as it might be for normal consciousness to come to grips with, normal consciousness actually might be quite near the bottom of such a fractal-like network.

All of this fits in with the work of, among others, Gazzaniga. However, one is not necessarily required to share Gazzaniga's position that there is no essential, unitive potential in consciousness capable of ordering, directing, orienting, shaping and integrating the various tensor contributions of different fractal levels of modular conscious structures.

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Adherency, Continuity and methodology

Open sets refer to sets consisting of only interior points, without any boundary points. Thus, for instance, when considered as an open set, a disc on the plane does not include the boundary points that form the perimeter of the disc. Furthermore, the point-set that constitutes a ball in three-dimensional space does not include the boundary sphere that surrounds it when that ball is construed as an open set.

If every E-neighborhood of some given point 'p' contains at least one point of a set X, then the point p is adherent to the set X. Essentially, what adherency means, is that if one has a set of points that is adherent to some given point-set X, then when the adherent points are not members of the set X, they are considered to be infinitely close to the set X.

Thus, in the case of a set of points that are adherent to a ball, B, of radius r about some point 'p', then aside from the points of the set that are part of the ball itself, the adherent points will involve those points of the set that are on the boundary sphere surrounding the ball. However, if it should be the case that the only points adherent to the point-set of the ball, B, are those points of the ball itself, then the point-set is said to be closed. Therefore, any open set of points can be converted into a closed set merely by adjoining all the boundary points surrounding the open set to that set.

This concept of adherency might connect up with the ideas of inference and entailment. For example, one might speak in terms of degrees of adherency in which there is a dialectic between, or among, the points of an adherent set that are not members of some given point-set X and those points of the adherent set that are members of the point-set X. The stronger, more multi-faceted and more nuanced the dialectic, the greater the degree of adherency and the more plausible would be the inference or entailment relationship being considered. As such, 'closeness' would not be a matter of distance but of inferential or entailment adherency.

A point-structure that was adherent to some other point-set structure X would have inferential or phase relationship ties with X. The greater the degree of adherency, the more dense would be the network of phase relationships linking the E-neighborhood of the adherent point-structure with the point-set structure X.

A further consideration surrounds the issue of whether one should consider the hermeneutics of the phenomenology of the experiential field to be a matter of an open set or a closed set. A further possibility is that, under some circumstances, the hermeneutics of the phenomenology of the experiential field might be closed in some respects but open in other respects. A lot might depend on the structural character of one's understanding at a given time.

Moreover, as odd as it might sound, a hermeneutical open set would be one that did not include horizonal input, whereas a closed set would be one that did include horizonal input. Consequently, if considered in these terms, a closed set would be more receptive to horizonal input than an open set.

An additional consideration is the following. One might treat degrees of adherency as a sort of measure of the openness or closedness of a point-set. If one were to do this, then the dialectic between a point-structure 'p' and the point-set structure X could be affected by how open or closed the point-set structure is since it would be a direct reflection of the extent to which points of the E-neighborhood of 'p' were part of the point-structure X, as well as the character of the closeness of those aspects of the E-neighborhood of 'p' that were not part of X.

A map from a point set X to a second point set Y is said to be continuous only if for every point 'p' of X, as well as for every E-neighborhood N of f (p) of Y, one can find a second neighborhood S of 'p' in X that can be mapped by f to a subset of N. If the inverse image of every open set in Y is also open in X, then the map f from X to Y is said to be continuous.

The foregoing characterization seems to make our understanding of continuity dependent on the methodological procedures one used in relation to any given 'p' in X and in relation to any given subset of N in Y. For example: How one goes about choosing or selecting point-structure candidates, or how one goes about deciding on a mapping structure from 'p' to a subset of N, or how one goes about selecting a given subset of N?

The foregoing sorts of considerations all could affect whether, or not, one will find the mapping to be continuous. Even if the decisions concerning the construction of the structural character of the mapping process are the key factors in establishing continuity (given that point-sets X and Y have certain structural properties that establish an envelope of constraints and degrees of freedom within which the mapping process must operate), nonetheless, continuity still would depend on the process that led to the construction of a map that could show one how to link any given point in X with its image in Y.

Moreover, while there might be a point 'p' in X for which there is no mapping f by means of which one can locate an image counterpart in a subset of N, nevertheless, until one establishes such a non-homeomorphic relationship, one still would have an evidential basis for treating the mapping as continuous. In other words, our understanding of continuity again would be dependent on the underlying methodological procedures and concomitant capabilities of demonstrating or proving or showing that a given mapping is homeomorphic or non-homeomorphic.

Having said the foregoing, one last caveat is in order. A distinction must be made between our understanding of continuity in any given set of circumstances and the actual structural character of those circumstances independent of our understanding of them.

What we take to be continuous, on the basis of our methodological procedures for constructing or generating maps, might not, in fact, be continuous. However, our procedures might not, yet, have been able to establish this or are inherently incapable of doing so.

Alternatively, the actual structural character of a given aspect of the 'fabric' of ontology might be continuous, but that structural character might not be continuous in the way that our methodology indicates (or fails to indicate) is the case. As a result, there is a confusion between our conception of continuity in a given case and the actual structural character of continuity in such a case.

A further possibility is that our concept of continuity in a given case might be an analog for the actual structure of continuity in that set of circumstances. However, unless we properly understand the nature of that analog relationship, we might have a distorted understanding of what makes continuity possible in that case.

As far as the notion of continuity is concerned, what might be fundamental to any given 'space' or latticework is not a series or set of points. Point-structures, themselves, might be a function of an underlying fractal-like set of ratios of constraints and degrees of freedom. This fractal-like set would have resulted through the dialectic of dimensions that has been structured and arranged by the order-field that penetrates and permeates the different levels of scale on which these fractal-like sets are given manifestation.

If this is the case, one need not accept the idea that there are any elementary, simple point-structures such as those posited in modern physics. Thus, for example, electrons, photons, quarks and gluons might not be 'simple' in structural character. They might have a complex structure that is dependent on a more fundamental set of dimensional-order themes.

All so-called point structures might merely be 'openings' on a given level of scale. Through such openings a given ratio of constraints and degrees of freedom might be given expression.

These ratios might, themselves, be manifestations of a deeper fractal-like dialectic of dimensionality that, in turn, is dependent on an underlying order-field. This underlying order-field determines what the character of each dimension will be as well as determines how, when, and under what circumstances such a dialectic of dimensions will occur.

The character of the continuity that is given expression through the unfolding of an order-field is a function of a shifting ratio of constraints and degrees of freedom as one moves about a given latticework or neighborhood that is the manifestation of such an order-field. In other words, the ties or links binding a latticework/neighborhood together are the phase relationships that give expression to the spectrum of constraints and degrees of freedom that the underlying order-field makes possible. This occurs in the form of a latticework within which different aspects of that spectrum are manifested in the form of point structures that represent dominant themes, on a given level of scale, of the intersection of the dialectic of dimensions.

Each point structure in the latticework or neighborhood is, in effect, a ratio of constraints and degrees of freedom drawn from the spectrum of possibilities in the underlying order-field. Consequently, as one moves about a given latticework or neighborhood, one will encounter different manifestations of the set of constraints and degrees of freedom ratios that constitute the envelope of values that govern or regulate the ontology of the given latticework in question on a given level of scale.

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<u>Tensor matrices</u>

One can generalize descriptions for the points of $E_3$ Euclidean space to an n-dimensional context in the following way. Each and every point 'p' of $E_3$ can be designated in terms of a triplet of real numbers [$r_1$, $r_2$, and $r_3$] since there is a one-to-one correspondence mapping that can be established from the point set of $E_3$ onto the set of real numbers (and, therefore, the mapping is bijective). Similarly, one can characterize $E_n$ in terms of the set of n-tuples [$n_1$, $n_2$, ..., $n_x$] in which each n-tuple constitutes a point structure that gives expression to, and is shaped by, n different elements or real numbers.

The foregoing ideas could be applied to a hermeneutical context if one were to make a few adjustments. In any given latticework structure (which has a role somewhat comparable to the fixed Cartesian coordinate system of Euclidean space), a designated point-structure within that latticework gives expression to an n-tuple of dimensions that intersect or engage one another at that juncture to give expression to the point structure of observed character.

As such, this kind of n-tuple is a way of summarizing the structural character of the spectrum of nodes contained in the latticework in question. However, this n-tuple is not an array of real numbers. It is an array of what might be referred to as a dimensional tensor matrix.

Each dimensional tensor matrix constitutes an envelope of constraints and degrees of freedom that give expression to a complex set of shaping forces. Just as a mathematical tensor allows one to take into account the different ways a given set of forces twists, stretches and distorts a given aspect of a manifold, so too, a dimensional envelope of constraints and degrees of freedom constitutes a complex shaping force, represented in the form of a matrix. This matrix weaves together a much larger set of components than is the case for a 'normal' tensor that gives expression to, say, three components.

A matrix is described as a rectangular array of numbers. Matrices can be of any size, but when they are square matrices, in which the number of the rows and columns are the same, this number is usually referred to as the order of the matrix.

When one adds two matrices of the same order together, the rules for combining them are fairly simple. One just adds the corresponding entries or cells of each matrix.

Multiplication, on the other hand, is somewhat more involved. One has to multiply the rows of the first matrix by the columns of the second matrix, a cell at a time and, then, one adds together the resulting products of each such multiplication. Usually – at least in mathematics -- matrices are non-commutative under the operation of multiplication.

In the context of hermeneutics, a matrix is not a rectangular array of numbers. It is a latticework array of cells. These cells are capable of giving representational expression to a wide variety of possibilities, including: experiential point-structures, neighborhoods, phase relationships, various vectors and tensors forces, as well as hermeneutical operations.

Generally speaking, the hermeneutical operations that combine different matrices together will be more dialectical in character than is the case with their mathematical counterparts, such as addition and multiplication. In effect, in a hermeneutical matrix, any cell is capable, at least potentially, of interacting with any cell of the matrices that it engages, as well as the other cells of its own matrix environment.

Consequently, although one can write down a general form for the idea of a hermeneutical dialectic between (among) two (or more) matrices or latticework arrays, the structural character of the dialectic will be affected by the nature of the values one substitutes into the various cells of the matrices. In other words, rather than being able to encompass the possibilities for interaction within the framework of a rule (such as exists for the multiplication of matrices in mathematics), the dialectic of hermeneutical/phenomenological matrices is rooted in a principle involving the hermeneutical operator that often forms a chaotic attractor basin, resulting in self-similar but not self-same products.

The simplest case of the hermeneutical dialectic involves focus and horizon. Each cell of the matrix giving expression to this simplest-case hermeneutical dialectic constitutes an interaction or current between focus and horizon.

As such, a cell describes a point-structure of a determinate set of constraints and degrees of freedom. How these cells are filled out in any particular case -- that is, the values they will assume -- will depend on the individual and the circumstances being engaged.

In effect, the above matrix is a product matrix that gives expression to the general form of the way two matrices -- namely, a focal matrix and a horizonal matrix -- dialectically interact with one another. One also must keep in mind that the foregoing matrix is merely a slice of an n-dimensional manifold in which there are a variety of vectored currents or forces of dialectical interaction that are operating on each cell of a given matrix from other dimensions.

Furthermore, the angle of engagement or orientation of these dimensional currents might touch on, or interact with, certain cells but not others. In other words, some cells are susceptible to such dimensional currents, while others are not -- or, at least, might not be under certain circumstances.

In addition, each of these cells is capable of establishing phase relationships with other cells within the matrix array. However, those cells that are connected through phase relationships need not be contiguous. Yet, whether or not they are contiguous, the phase relationships that link a series of cells form a neighborhood.

The hermeneutical operator is the simplest expression of a hermeneutical tensor matrix. It indicates that each cell of the matrix is being shaped by a variety of forces (in this case, the various components of the hermeneutical operator) that are stretching, squeezing, and, in general, altering the structural character of the phenomenological fabric of the experiential field being given expression during the operator's dialectical engagement of various aspects of that fabric.

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Functional analysis, structure and abstract space

Functional analysis has arisen largely during the last sixty to seventy years. It is predicated on two facts: (a) an extremely diverse collection of mathematical operations share a remarkable number of similar features; (b) when such operations are performed on a variety of mathematical objects, these objects manifest properties in relation to those operations that are extremely similar to, if not the same as, one another, despite the dissimilarities among these mathematical objects. As such, functional analysis is concerned with the exploration for, and determination of, the structural character of those properties that seem to be most essential and fundamental to mathematical operations and mathematical objects in general.

The idea of a structure in mathematics can be described in the following way. First, there must be a set of objects whose character gives expression to the structure of that set. These objects are manifestations or carriers of the structure of the set in question.

Secondly, there must be some manner in which these objects are related to, or interact with, one another. This mode of interaction is usually defined in terms of operations, functions, relations, and so on. Finally, there must be a set of distinguished elements in the carrier that serve as indicators or indices for the structure carried by the set of objects to which identifying reference is being made.

The set of carrier objects, together with the operational processes and the set of distinguished elements contained in the carrier, all are said to constitute the signature of the structure. When one takes a given system of axioms and applies that system to a particular signature in a way that establishes the constraints and degrees of freedom within which the elements of that signature are to manifest themselves, then a mathematical structure is said to be generated.

In its own way, hermeneutics -- at least as envisioned in this chapter -- shares many of the same concerns as do functional analysis and general structure theory. Among other things, hermeneutics seeks to discover those structures that seem to be most fundamental to hermeneutical operations and phenomenological objects. For example, one could think of a latticework as the most fundamental hermeneutical object, and the simplest form of a latticework would be a dialectical phase relationship that links two point structures -- namely, focus and horizon.

Furthermore, one also could think of the hermeneutical operator as being the most fundamental expression of a hermeneutical operation. In general, all rational operations are a function of some combination of, or series of, constraints and degrees of freedom as shaped, organized, oriented, and structured by a recursive use of the hermeneutical operator on one or more latticeworks within the phenomenology of the experiential field.

In functional analysis the idea of space is far removed from any geometrical sense of the word. Moreover, the space of functional analysis is quite different from the idea of space in the normal day-to-day sense of the term. However, because there are a number of aspects of the concept of space in functional analysis that bears a sort of family resemblance to the concept of 'space' as used in linear algebra and analytic geometry, the term "space" has been retained for use in relation to the objects of functional analysis. Similarly, although terms such as "length", "distance," and so on are still used in functional analysis, they no longer carry the meanings that they have in a geometrical context.

As understood in functional analysis, the term "abstract space" is used in reference to a given set of elements for which a limiting process has been given a well-defined meaning. Thus, for any given sequence of elements $e_1$, $e_2$, $e_3$, ..., $e_n$ that tends toward some limit $y = \lim y_n$, with $n \to \infty$, such a sequence constitutes an abstract space.

Sometimes, when studying the relationship among a number of elements of an abstract space, one would like to establish whether the elements are 'close together' or 'far apart'. In order to do this, one requires a distance function. More specifically, a distance function is a real-valued function, $d(x, y)$, which is greater than or equal to zero, and that is defined for all pairs of elements within the abstract space to which it is applied. Any space for which a distance function has been defined is known as a metric space.

Normed spaces refers to those spaces in which there is a procedure for assigning a non-negative, real number to each of the elements of the space. This assignment process serves as an index or measure of the magnitude of the element involved in that process, and the numerical index is known as a norm. This is written in the following way: ||x||, and so on.

Moreover, for any given ||x||, there must be certain properties that are present:

(a) ||x|| > 0, for x not equal to 0 and ||0|| = 0;

(b) ||(lambda) (x)|| = ||lambda|| X ||x||, and 'lambda' is any given real or complex number;

(c) ||x + y|| is less than or equal to ||x|| + ||y||.

One can derive a metric from a norm in a relatively simple manner. This can be done by specifying that the distance function between any two given elements of a space is to be the norm of their difference: d(x, y) = ||x - y||.

A linear space is a space for which: (a) the operation of addition for any two elements of that space must be defined; and, (b) the operation of multiplication involving elements of that space together with real and/or complex numbers must also be specified. More specifically, in the case of (a), for each pair of elements (x, y) of a space, there is unique element x + y in that space. In the case of (b), there is a unique element Lx associated with each number L and each element x of that space. In addition, such operations must satisfy a variety of conditions involving commutative, associative and distributive properties.

Hilbert spaces are actually special cases of normed linear spaces. In Hilbert spaces a complex-valued function (x, y) is defined for every pair of elements x and y in that space. This function is referred to as a scalar product, and it must have certain properties in order to qualify as being an example of Hilbert space.

The notions of "abstract space", "distance", "magnitude", and "Hilbert space" all seem to have implications for the hermeneutics of the phenomenology of the experiential field. However, appropriate modifications and alterations need to be introduced.

For instance, the limit process, that is at the heart of the idea of abstract space in functional analysis, could be construed in terms of the recursive hermeneutical process through which one approaches reality as a limit by means of the hermeneutical operator acting on the latticework objects of the phenomenology of the experiential field. If successful, such a process generates an understanding that is similar to, or reflective of, the original structural character of reality that it reflects.

However, since the two are not self-same, a person's understanding approaches reality as a limit but does not ever quite become one with it. This is especially the case in view of the fact that, for the most part, any given hermeneutical understanding is largely restricted to certain levels of scale, whereas reality cuts across innumerable levels of scale. Therefore, as far as rational hermeneutics is concerned (and, leaving aside the issue of trans-rational or mystical hermeneutics), such understanding only approaches, as a limit, one structure of reality on a given level of scale.

Furthermore, latticework objects are a set of elements that are to be ordered and shaped and organized both within themselves, as an individual latticework, as well as among themselves, as a collection of latticeworks, that are linked together by various phase relationships. This ordering aspect is comparable to the sequential feature of the elements of an abstract space in functional analysis.

In addition, the idea of order-space might stand behind (in the sense of being a more essential, fundamental source of) the general notion of 'space' as a non-geometrical concept. As characterized in mathematics, abstract space, linear space, metric space, normed space, and Hilbert space, all seem to be about certain kinds of structural and structured relationships. Although such relationships do not occupy space in any geometric or everyday sense of the term, they do presuppose some sort of context within which, and through which, the relationships can be expressed, operated on, organized, shaped, oriented and shaped. Therefore, one might characterize order-space as that which:

(a) makes expression of such relationships possible,

(b) specifies the structural character or properties or set of constraints and degrees of freedom that such relationships might assume under different circumstances or conditions, and

(c) designates the structural parameters that any dialectic might have that occurs between, or among, elements occupying this sort of space.

As such, abstract space, linear space, metric space, normed space, and Hilbert space are all special cases of the more essential and fundamental expression of order-space.

Indeed, all of the foregoing varieties of spaces are derived by using the hermeneutical operator on latticework objects of the phenomenology of the experiential field. The experiential field is a more general structural form than any of the various structured spaces that might arise in it. So, the hermeneutics of the phenomenology of the experiential field is the more general structural form underlying the mathematical notion of abstract space, while the hermeneutics of the phenomenology of the experiential field is, itself, made possible by an underlying order-space.

Nonetheless, in all of these cases, the space being talked about is not geometric in any sense, nor is it extended in any way such that it can be said to occupy or constitute a physical/material medium. Order, in and of itself, need not be extended in any way. It specifies the parameters, constraints, degrees of freedom, and so on which any operation, relationship, dialectic, condition, event, process, state dimension or object might have as an expression of what such order makes possible.

Seen from this perspective, a dimension is a specialized structural expression of order-space that is unique in the set of constraints and degrees of freedom to which it gives expression. That is, no two dimensions possess the exact same profile of constraints and degrees of freedom. Therefore, each dimension leaves its own particular signature or trace in any dialectical engagement in which it is involved.

In a way, a dimension is like a gene on a chromosome that has characteristic DNA sequences specifying the constraints and degrees of freedom associated with that gene. Like a gene on a chromosome, the gene does not activate itself but must be moved to action by something that operates on it -- namely, other aspects of order-space. These aspects of order-space assume the role of activating forces that stipulate that dimensional genes will be activated at what time and under what circumstances. This whole dialectic between order-space and a dimension assumes the shape of an 'ontological operon' that governs the expression of the dimensional gene.

Finally, to take one last term of functional analysis and transplant it to the hermeneutical/phenomenological context, consider the concept of distance. In a hermeneutical and phenomenological context, the idea of distance or a distance function might be about the structural character of the phase relationships between two point structures, especially with respect to the 'closeness' or 'distance' of the inferential link between the two structures.

In this sense, any given point structure is inferentially closer to some point structures, while being inferentially farther away from other such point structures. This holds true whether one is discussing inferential relationships within a latticework or among latticeworks. Although the meaning of 'closer and 'farther' might be construed in terms as simple as how many inferential mapping steps does it take to get from one point structure to another point structure, there is no reason why these terms couldn't be expressed in ways that involve other hermeneutical structural properties such as homeomorphism, continuity, connectivity, neighborhood, analog features, fractal-like dimensional character, or ratio of constraints and degrees of freedom.

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<u>The idea of congruence</u>

If two plane figures are of the same size and have the same shape, the figures are said to be congruent. More specifically, when one plane figure is congruent with some other plane figure, then each figure can be mapped into the other by means of a transformation that:

(a) moves points;

(b) does not affect the incidence relations existing between points and lines;

(c) permits parallel lines to remain parallel;

(d) leaves the areas of the figures intact;

(e) does not change the length of line segments;

(f) does not alter the angles that exist between the lines of the figure.

Two congruent figures are said to be directly congruent when, as a result of their having the same orientation in relation to a given fixed orientation of the plane, they can be transformed into one another after one has performed a series of translations and rotations of the plane.

Translations, rotations and reflections are all examples of congruence transformations. Such transformations can be used, singly or in combination, during the course of an analysis of plane figures in order to establish whether or not any two figures found on the plane are congruent.

Similarity is a somewhat less stringent basis for comparison of plane figures than is provided for by congruency. Two geometric figures are said to be similar when they have the same shape even if they do not have the same dimensions.

As such, the figures being compared do not have to be exactly the same as long as either: (a) the sides or line segments of the respective figures maintain the same ratios with respect to each other (this is known as the ratio of similarity); or, (b) all the corresponding angles of the two figures are the same. Two figures that are similar can be transformed into one another by means of any one-to-one geometric transformation that leaves the corresponding angles of the figures intact.

Two structures are said to be hermeneutically congruent if one structure can be mapped into the other structure by means of a sequence of hermeneutical transformations that preserves the following properties and conditions:

(a) The ratio of constraints and degrees of freedom of the structure into which another structure is being mapped is not altered on the level of scale into which the mapping is done;

(b) On any given level of scale, the character of the phase relationships of the structure into which it is being mapped are not changed;

(c) For any given ontological point structure on a given level of scale, its hermeneutical image can be shown to manifest some 'minimal' degree of adherency in its E-neighborhood in relation to the ontological point structure to which identifying reference is being made.

What constitutes a "minimal degree of adherency" will vary from situation to situation. However, in all circumstances, the number of points of the E-neighborhood that overlap with the ontological point structure must lend plausibility to the mapping and not just possibility.

Something considered to be a possible mapping (i.e., according to what the structural character of a context might permit in the sense of being consistent with the character of the structural context) becomes plausible when one can point to at least several pieces of evidence that support a given mapping possibility. In other words, in order to be permitted to go from possibility to plausibility, one is being asked to produce a mapping that goes beyond merely conforming to, or being consistent with, the structural character of the latticeworks being connected through the mapping.

The more pieces of evidence there are to support a given mapping, the more plausible the mapping becomes. Obviously, some mapping proposals are more plausible than others are.

(d) There must be a homeomorphic or bijective mapping capable of being established on any given level of scale between primary or key point structures of the ontological latticework and primary or key point structures of the hermeneutical latticework. This suggests that one might have to distinguish between essential and peripheral congruence. Moreover, the essential/peripheral congruency distinction connects up with what is meant when speaking of a minimal degree of adherency since this would concern essential congruency, rather than peripheral congruency.

Similarly, plausibility concerns essential congruency among a given set of E-neighborhoods that are considered to constitute key or primary point structures in the latticeworks being considered. At some point, a mapping proposal goes from being highly plausible to being reflective when both essential and peripheral congruency has been established.

(e) The relationship between the ontological latticework and the hermeneutical latticework must be, at a minimum, analogical in character;

(f) Obviously there are degrees of congruency that can be affected by the extent to which any given mapping can satisfy the foregoing conditions;

(g) The congruency mapping that is established through a series of hermeneutical operator transformations cannot leave an implausible tension between the interrogative imperative and congruency relationships such that the former overshadow the latter (this is the remainder theorem discussed in an earlier chapter). In effect, this means that although some degree of this kind of tension can exist without undermining the claim for congruency, if there are too many unanswered questions of an essential or key nature, the claim for congruency becomes implausible, even if it subsequently turns out that in the light of further experiential data, reflection, and the use of a new sequence of hermeneutical transformations, the two structures can be shown to be congruent.

(h) The greater the number of levels of scale on which congruency mappings can be established, the greater will be the congruency between a given hermeneutical structure and a given ontological structure. This means that if one is comparing two sets of congruency mappings in relation to one and the same ontological structure, that mapping that is effective across a greater number of levels of scale will be the more congruent of the two mappings;

(i) Hermeneutical similarity requires a less exacting correspondence or set of mapping functions between hermeneutical and ontological structures than is required by hermeneutical congruence.

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Chapter 5: Quantum Meditations

Black-body radiation: A crisis in turn-of-the-century physics

When black-bodies are heated, they glow with different colors at different temperatures. However, using as a basis for calculations the relationship between light and matter discovered by Maxwell, classical physicists had predicted that the color of light given off by heated black-bodies should be blue at all temperatures. The difference between observed values and predicted values could not be accounted for within the framework of classical physics.

Max Planck addressed himself to this anomaly in 1900. Part of his search for a way of resolving the issue involved making an assumption that helped to render the problem more mathematically tractable. Essentially, this move consisted in placing constraints on the vibrational character of a particle. Instead of permitting particles to have unlimited degrees of freedom with respect to how they vibrate, he required particle vibrations to conform to the following principle: E= nhf.

In this equation, E represents the energy of the particle under consideration, and 'f stands for that particle's vibrational frequency. 'h' is a constant that was specified by Planck, and "n' gave expression to an integer value. In effect, Planck's mathematical equation limited the energy of a given particle to integer multiples of the product of the particle's frequency and the constant 'h'.

Planck's intention had been to use his simplifying assumption during the process of calculating energy values for different particles and, then, to subsequently cancel the effect of that assumption by permitting 'h' to fall to zero. However, when he gave 'h' the value of zero, he arrived at precisely the same result as everyone else in classical physics -- namely, that the color of light radiation given off by a heated black-body should be blue, irrespective of the temperature to which the body had been heated. On the other hand, when he assigned 'h' a specific value, now known as Planck's constant, he was able to calculate answers that were accurately reflective of the observed results from experiments with black-body radiation.

Over the next five years classical physicists dismissed Planck's results for the most part. They did this despite the fact that Planck's results removed the anomaly of differences between predicted and observed values for black-body radiation.

Their unwillingness to accept Planck's approach to the problem was largely due to the arbitrary character of Planck's simplifying assumption. There was no compelling physical reason for making that kind of an assumption. The assumption appeared to be merely a mathematical device for removing some of the complications surrounding the process of calculating energies.

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Waves and/or particles?

In 1905, however, Einstein published his paper on the photoelectric effect. This paper gave a central role to Planck's constant.

Because Einstein's explanation of the photoelectric effect was highly successful, the prominence he had given to Planck's constant suggested, rather strongly, that this constant was something more than an arbitrary, mathematical convenience. Apparently, something had been stumbled upon that was of considerable significance.

Einstein's exploration of the photoelectric effect focused on what happens when light particles, or photons, are absorbed by the electrons of the surface atoms of a given metal. Arthur Compton, on the other hand, investigated what happens when light -- in the form of x-rays -- is scattered by the atoms of a gas. Compton discovered that if one gave the scattered photons a momentum of p -- where p is equal to hk and k is the spatial frequency (i.e., the number of wavelengths per centimeter) of the photon -- then the results of the scattering experiment seemed to indicate that light behaves as if it is particle-like.

Planck's study of black-body radiation in which he introduced the constant 'h', together with Einstein's account of the photoelectric effect, as well as Compton's x-ray scattering experiments, all pointed in the direction of light having particle-like properties under certain conditions. These findings were in direct contradiction to earlier optical studies (e.g., Thomas Young's two-slit interference experiment) that indicated that light has wave-like properties. Moreover, these findings were totally at odds with the prevailing interpretation of light that was provided by Maxwell's electromagnetic theory. Maxwell had said that light is a wave phenomenon that is propagated by an electromagnetic field.

The plot of the story of physics in the early 20th century thickened, so to speak, when Louis de Broglie introduced a new wrinkle into the discussion by means of his doctoral thesis. De Broglie maintained that not only could one show, as Einstein had done, that light was capable of behaving as a particle, but, as well, 'particles' also could be shown to have wave properties.

More specifically, de Broglie attempted to put forth arguments that indicated there were spatial and temporal wave frequencies associated with a particle. The spatial frequency, k, was given in the relation advanced by Compton -- namely, $p = hk$ -- whereas the temporal frequency, f, was given in Einstein and Planck's equation: $E = hf$.

Many of the most intriguing, yet perplexing, characteristics of quantum theory arise in relation to the strange way this theory amalgamates or juxtaposes particle and wave properties in one and the same entities. There are a number of fundamental differences involved in construing quantum entities as waves and construing such entities as particles:

(a) waves are capable of superposition -- that is, waves can interpenetrate one another without this process altering their characteristics as individual waves. Particles do not exhibit this characteristic of superposition;

(b) waves are dispersed across large regions of space, whereas particles are localized in space;

(c) waves are able to travel in a variety of directions simultaneously, but a particle is restricted to a single direction of movement at any one time.

In addition to a blurring of the differences between particle and wave, there was a further, though related, difficulty. Classical physicists made a very clear demarcation between two fundamental concepts: (a) matter and (b) fields. For the classical physicist, matter generated fields, and fields were the source of the forces that affected the dynamics of matter. With the advent of quantum theory and through the influence of the work of Planck, Einstein, Compton and de

Broglie, the classical distinction between matter and field was becoming obscured and, therefore, no longer clearly demarcated.

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Four basic approaches to quantum calculations

There are four basic approaches to quantum theory, three of which came independently at various times in 1925 and one of which came more than 20 years later. These approaches are: Heisenberg's matrix mechanics; Schrodinger's wave mechanics; Dirac's transformation mechanics, and, finally, Feynman's "sum over histories" mechanics.

Heisenberg devised a system of matrix mechanics in order to be able to describe the various characteristics and properties of different kinds of quanta. Associated with a given quantum, are a number of matrices or arrays of values.

Each individual matrix is a summary statement, so to speak, of one of the physical aspects or quantities of a given quantum. Quantities such as: position, velocity, mass, charge, angular momentum, energy, and so on, were assigned values in separate matrices.

Moreover, each matrix was assigned values expressing the probability that a given quantum had the property being described through the matrix. Each matrix also was assigned values that indicated the strength of linkage for various values of the property being represented by the matrix.

The rules describing how the various matrices underwent transformations, transitions, and so on were contained in what came to be known as matrix mechanics. One of these rules turned out to have considerable importance. This rule stipulated that the multiplication of matrices is not commutative, and, therefore, the sequence in which the multiplication is carried out makes a difference in the outcome of the operation.

Erwin Schrodinger represented quanta in terms of various kinds of waveforms. Quanta possessing different properties would be represented by waveforms that reflected those properties.

In order to describe the dynamics of the transitions and transformations of various kinds of waveforms, Schrodinger introduced a wave equation that specified how waveforms behaved when different variables were substituted into the equation. Thus, his quantum theory is referred to as wave mechanics.

Quantum theory uses different waveform families to represent various properties of the entities inhabiting the quantum realm. For example, the property of spin (including both magnitude as well as orientation) is expressed in terms of the spherical waveform family. The impulse waveform family, on the other hand, is used in connection with a quantum entity's positional character. Additional examples include: energy properties construed in terms of the temporal sine waveform family, as well as, the spatial sine waveform family used in conjunction with the property of momentum.

The aspect of quantization that becomes associated with many of these waveform families is apparent in the formulae that are used to calculate the values for some of the variables involved in quantum theory. Thus, the spin magnitude of a particle is determined by means of the formula $S = hn$ -- where n is the number of nodal circles, and h is Planck's constant. The energy, moreover, that is to be assigned to a given particle, is provided by: $E = hf$ -- where f is the temporal frequency of the waveform associated with the particle. Furthermore, the momentum of a particle is calculated on the basis of $P = hk$, where, as previously indicated, k is the spatial frequency of the waveform assigned to the particle.

In each of these cases, Planck's constant is introduced as the basic unit of quantum of action that is juxtaposed next to various wave properties. Therefore, the determination of values for both dynamic and static properties is a function of the interaction, at least mathematically, of discrete quanta together with properties rooted in continuous wave functions.

A vector or arrow that rotated in a multi-dimensional abstract space was used by Dirac to represent the properties of a given quantum. According to Dirac, one could describe the dynamics of a quantum's transformations and transitions by keeping track of the way the vector rotated over time.

Since there were various ways of establishing a coordinate system through which to assign values to the rotating vector, Dirac developed a method for translating between different modes of devising such coordinate systems. His method of translation is known as transformation theory.

Dirac maintained that the quantum theories of both Heisenberg and Schrodinger were, in fact, limiting cases of his more generalized theory. Consequently, the three theories are really a matter of using different mathematical means to provide a method of description for quanta and the transformations.

Schrodinger's wave equations are usually used to solve for certain variables involving relatively slowly moving quantum entities. When, however, one needs to solve for variables involving quantum entities moving near the speed of light, physicists often use Dirac's equations that are capable of taking corrective, relativistic effects into account.

According to Feynman, quanta could be represented by means of a technique referred to as the 'sum over histories' method. In effect, one takes into account all the states possible for a given particle and, then, adds together the amplitudes of these possibilities to arrive at the wave function for the particle.

In the case of any given actual particle, many of the possibilities will cancel out one another. As a result, whatever particle-histories remain at the end of the summing-over process will express a range of probability values that will encompass the way the particle actually behaves in a given set of circumstances.

In order to keep tabs on which histories had already been summed-over, Feynman invented a method of diagramming that provided a summary account of such histories. These are known as Feynman diagrams.

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<u>A question of ontological status</u>

From the perspective of classical physics, properties such as mass, charge, momentum, velocity and position were intrinsic aspects of a particle. Consequently, the classical physicist believed a particle had determinate properties at any given point in time.

The vast majority of quantum physicists, however, do not accept the classical viewpoint concerning the ontological status of the various properties of any given quantum entity. In other words, neither the belief that all of the properties of a particle are necessarily intrinsic to the character of the particle, nor the idea that particles must always have, in every respect, definite, determinate properties at each point in time, coincide with the perspective of the vast majority of quantum theorists.

The predominant view of quantum physicists (namely, the so-called Copenhagen interpretation) does acknowledge that any given species of particle can be described, in part, by a fixed set of properties. These sorts of property values will not vary from one member of a particle-species to the next. Such properties include spin magnitude (i.e., larger, heavier particles have a larger spin magnitude than do smaller, lighter particles), as well as mass and charge.

Nonetheless, quantum theory maintains there are other properties associated with a particle (such as momentum, position, and spin orientation) that are not intrinsic to the particle per se. These variable properties are a function of the way the process of measurement and observation engage, or interact with, a given particle.

Questions about the nature of quantum reality focus on the so-called non-intrinsic or dynamic properties of a particle, as opposed to its fixed or static properties. For example, quantum physicists ask: How does a particle acquire such non-intrinsic or dynamic properties? Or, once acquired, what is the precise character of the relationship between a particle and its non-intrinsic or dynamic properties?

In addition to the static versus dynamic theme, there is another related theme that highlights an important difference between the classical and quantum perspectives. This second theme concerns the extent to which different dynamic variables can be said to be independent of one another.

On the classical view, the various properties of, say, an electron can be measured independently from one another. This means, for example, that one can focus on establishing the value of a given electron's momentum in a particular context while remaining indifferent to the character of the values for the other properties of the electron.

From the perspective of the Copenhagen approach to quantum theory, however, the various properties of, for instance an electron, are not always independent from one another. Some of these properties involve conjugate variables.

Such variables are so inextricably intertwined that measuring one conjugate variable will affect, and be affected by, what is happening with the counterpart to the conjugate variable. In other words, one can measure one of the two conjugate pairs with some degree of precision, but in doing this, one loses the capacity to measure the second of the conjugate pair with any degree of accuracy.

The character of the relationship of conjugate variables was first expressed by Werner Heisenberg in the form of an uncertainty principle concerning measurements involving momentum and position. Heisenberg claimed that (Δ-p) (Δ-x) > h; where (Δ-p) represents measured variability involving a particle's momentum; (Δ-x) refers to measured variability in a particle's position, and h is Planck's constant. Essentially, the uncertainty principle states that the combined precision of simultaneously measuring a particular conjugate pair (in this case, momentum and position) can never be less than the value of Planck's constant.

Quantum theory deals only with predicting the character of the results one will get during the process of measurement. There is universal agreement among physicists about how quantum theory is to be applied and about what sorts of results are to be expected in any given measurement process involving the quantum realm. However, quantum theory does not provide an account of what occurs outside the context of measurement or between measurements.

Each sub-atomic entity has a wave function, ψ (psi), assigned to it. This wave function is not necessarily considered by physicists to be an actual wave in the sense that an ocean wave is a concrete, observable wave out there in the real world. Usually, physicists tend to treat the wave function as a means of obtaining certain values that are useful in making predictions about the likely character of a given measurement process.

The wave function associated with a given quantum entity exhibits most of the features of 'real' waves such as phase, interference, amplitude, and the principle of superposition. However, unlike a normal wave, the quantum wave possesses no energy.

The amplitude of a wave is an indication of the maximum displacement that occurs during the course of a given wave's cycle in relation to some arbitrarily chosen 'rest point of that wave. Normally speaking, the intensity of a wave provides an index of the amount of energy which exists at any given point in the wave and is proportional to the square of the amplitude.

According to quantum theory, however, a quantum wave has no energy associated with it. The intensity of a quantum wave is a reflection of a set of probability values that is to be associated with the quantum waveform. These probability values are indications of the likelihood that a given quantum will have certain properties under specified circumstances.

Because the quantum wave has no energy, it is not directly observable or detectable. Nevertheless, scientists are able to infer the general properties of the probability or proxy wave by keeping track of the character of the pattern that is formed over time by, for example, a series of electrons striking a phosphor coated screen.

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<u>The principle of superposition and random phase</u>

One also can approach some of the foregoing issues by considering the principle of superposition. Essentially, this principle stipulates that when two waveforms engage one another, they combine to form one waveform in which the amplitude is the sum of the amplitudes of the two individual waves.

Moreover, when the two waves disengage from one another they retain their original amplitude identities, as it were. In other words, they emerge with their pre-engagement amplitude intact.

Sometimes, however, when waves engage one another under certain circumstances, the waves do not conform to the superposition principle. For example, if the amplitudes of regular, everyday sorts of waves are too large, such waves will not exhibit the superposition principle when they combine with one another. These sorts of waves and conditions are referred to as non-linear.

When one considers the principle of superposition in the context of oscillatory systems, one must take into account the phase relations of the waves when adding together the amplitudes of the waves that are interacting with one another. The character of the combined amplitude of the interacting waves will be shaped by the patterns of constructive or destructive interference that arises as a result of the way in which the interacting waves are, respectively, in phase or out of phase with one another.

Thus, although the principle of superposition still applies and, therefore, the amplitudes of the interacting waves are added together, the manifestation of the combined amplitudes can range all the way from: (a) the amplitudes canceling out one another when the waves are totally out of phase, to: (b) a doubling of the individual amplitudes when the waves are totally in phase and provided that the amplitudes of the two waves are the same. Between the extremes of being totally out of phase or being completely in phase, are an indefinite number of combinatorial possibilities that depend on the extent to which two waves are in or out of phase.

In oscillatory systems, therefore, the principle of superposition manifests itself as function of the interference patterns that arise according to how the waves interact with one another. More specifically, interference patterns are an expression of the way the interacting oscillatory systems are responsive to the property of phase in one another.

When the phase of a wave exhibits variability during the process of measurement, one observes what is referred to as: random phase. Random phase includes a mixture of phase values.

If one adds together the amplitudes waves that are identical in every way except that they exhibit random phase characteristics, one gets a result that is, roughly, intermediate (but tending toward the 'in phase' side of things) in range between what one would get if one were adding together the amplitudes of these waves under conditions of: (a) being totally out of phase; (b) being completely in phase. This means that when random phase occurs, peaks tend to be flattened out somewhat, and troughs tend to be lessened somewhat. In short, the interference properties become somewhat blurred, with peaks and troughs becoming less distinct.

In the case of ordinary, everyday oscillatory wave systems characterized by non-random, or determinate phases, adding the amplitudes of waves conforming to the principle of superposition means the energies of the interacting waves will not add everywhere, but only at those points involving constructive interference. However, if these interacting waves exhibited random phase, then the energies of the interacting waves will add everywhere.

The foregoing also applies, with certain qualifications, to quantum waveforms. In the case of quantum waves, one is not talking about energies, since, according to quantum theory, quantum waves have no energy. One is, instead, talking about the intensity of the quantum wave as expressed in terms of probabilities.

When quantum waves with determinate phase interact with one another, the probabilities do not add everywhere. The probabilities add only where their phase relations permit it. On the other hand, when the quantum waves being added together involve random phase, then the probabilities add together everywhere in the wave.

The set of ideas involving: the principle of superposition, constructive and destructive interference, as well as random phase, might have considerable implications for the educational context involving the relationship between teacher and students, or curriculum and students, or system and students, or system and teachers. More specifically, suppose one treats a hermeneutical system as a latticework of linked oscillators. How the complex, multi-faceted amplitude of a given individual's hermeneutical system (which is the sum of the amplitudes of the various lattice-oscillators that shape that individual's hermeneutical system) interacts with the hermeneutical systems of other individuals (whether students, teachers, textbooks or the educational system in general) will depend, to a large extent, on the phase characteristics of the hermeneutical latticework waveforms that are interacting with one another.

Where the aforementioned latticeworks are out of phase, destructive interference occurs. Where they are in phase, constructive interference occurs, and if they exhibit random phase characteristics (in which there are a mixture of phase elements), there will be summing process that leads to no particular hermeneutical focus, direction, orientation, significance, purpose or value. In other words, in the latter case there is a blurring of the structural character of the hermeneutical waveforms that are engaging one another, both with respect to the student as well as the teacher and the system in which they are rooted.

The task of: a teacher within an educational system, the curriculum being used in such a system, and a student who is part of that educational system is to work toward creating an interaction of waveforms with a determinate phase and in which the amplitudes are in phase. The determinate phase comes with a clear-cut, hermeneutical orientation, purpose, or significance. The in-phase aspect comes from people who share that orientation and who cooperate to make sure that all of the different parameters of the waveforms complement one another.

However, in addition to the need for waveforms with determinate phases as well as wave forms that are in phase with one another, there also is a further need. There is a need to ensure that the phase character or orientation character of the hermeneutical latticework waveforms that emerge in the educational context are capable of accurately reflecting the structural character of certain themes of ontology.

Stated slightly differently, there is a need to ensure that the phase character or orientation character of the hermeneutical latticework waveforms that guide a teacher, student, system or society are capable of being accurately reflective of, or give expression to, a methodology that is capable of leading the individual, the teacher, the system, and the greater society toward a system of unobtrusive measures. These sorts of measures permit individuals increasingly less distorted access to various aspects of experience and reality.

Unfortunately, too frequently, modern day education is beset with tendencies toward either destructive interference or wave forms with random phase. In the former case, educational problems are due to the way in which the hermeneutical latticework waveforms that are brought to the educational setting by teachers, by students, by institutions, or by society, work antagonistically or destructively against one another, to varying degrees.

On the other hand, sometimes, educational problems are due to the components of randomization that are prevalent in the sort of diversified environment that often exists in democratic societies. When education is randomized, then student, teacher, the educational system, as well as the surrounding society are pulled in a variety of different phase orientation directions.

For example, when a society or an educational system attempts to please everyone one ends up with a randomization of the phase relations of the various hermeneutical latticework waveforms that shape that society or educational system. In effect, the randomization of phase relations gives expression to anarchy in which energy is distributed or dispersed everywhere and, as a result, there is no concerted, in-phase, dialectical interaction of the waveforms making up that society or educational system.

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The problem with interference

Airy patterns (named after George Airy, who was the first individual to provide an explanation of the phenomenon) are a series of alternating, dark and light, concentric circles. These circles are the result of the diffraction and interference patterns that are created when a wave is sent through a circular hole. The alternating bands of light and dark are manifestations of interference. The circular character of these bands is due to the diffraction of the wave by the circular hole.

So-called electron guns generate electrons by heating a metal filament. As the filament heats up, electrons are released. The rate at which the electrons are released, as well as the level of momentum that electrons have when released, can both be controlled. In fact, one can fine-tune the rate at which the electrons are released so that just a single electron is emitted.

The electrons are directed toward a glass screen, the back of which has been treated with a phosphor paste. Such a treated screen is capable of detecting the presence of electrons.

Essentially, the detection process works in the following manner. The inactivate phosphor molecules in the paste tend to be in their lowest energy state that is known as the ground state.

When any given phosphor molecule in the ground state is hit by an electron, the molecule becomes excited by the transfer of energy from the electron's kinetic energy. When the phosphor molecule enters into the excited state, it tends to return to the ground state by giving off a photon.

The intensity of the photon that is emitted will depend on either the rate or the energy (or both) of the electrons that come in contact with the phosphor molecule(s). Finally, once the phosphor molecule has returned from the excited state to the ground state by emitting a photon, the molecule has been re-set, so to speak, to respond to the impact of further electrons from the electron gun.

If one sends a beam of electrons through a circular hole set up in front of a phosphor screen, the character of the pattern on the screen will depend on the size of the hole through which the electrons are sent. Above a certain size, the pattern on the screen remains just a spot. However, the spot on the screen will become increasingly smaller as one shrinks the size of the hole down to a critical limit.

On the other hand, below a certain size value, the spot on the phosphor screen not only becomes progressively larger as one reduces the size of the hole, but alternating bands of light and dark concentric circles appear around the center spot of the pattern. When this occurs, one is observing an Airy pattern.

The character of the Airy pattern will change as one alters the voltage of the electron gun. If, for example, one reduces the voltage, the Airy pattern expands. However, if one increases the voltage, then the Airy pattern will become more constricted. If one continues to increase the voltage to a sufficient degree, then eventually, the Airy pattern will become a small dot.

One can use the alteration in the character of the Airy pattern as a function of voltage to show the relationship between an electron's momentum and wavelength. In other words, the electron diffraction experiments provide one with a means of linking the particulate and wave modes of the electron in a very fundamental way. In its simplest form, the relationship can be stated as: $p = h/L$, where: $p$ is the momentum, $h$ is Planck's constant, and $L$ is the wavelength of the electron that is derived from Airy's formula: $\theta$ (theta) = $70(L/d)$ ...'d' being the diameter of the aperture through which the electrons are shot.

Although the presence of the Airy pattern in experiments involving electrons does seem to indicate wave phenomena are involved, nevertheless, one is confronted with a problem when one reflects on the following consideration. These wave patterns are constructed and shaped by a set of events that, according to all measurements, appear to be particle-like or discrete in character. In other words, although the large scale character of the display on the screen is an Airy pattern, which suggests a wave phenomenon, this pattern is the result of a large number of individual electron collisions with the phosphor molecule, which suggests a particle phenomenon.

Neither the particle perspective nor the wave perspective, considered as individual explanations, is capable of accounting for what is observed in the above outlined electron gun experiment. Both a wave and a particle perspective need to be combined in order to provide a framework that is capable of accurately describing what is observed.

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Measuring quantum events: a lingering issue

Quantum physicists do not have a satisfactory explanation for two questions that are of critical importance to an understanding of what is really going on at the quantum level. The first question concerns the measurement process -- namely: what actually takes place during the act of measurement of quantum events?

Secondly, to what does a wave function give expression? Does it actually reflect something real, or is it a happy coincidence that merely provides a key to calculating certain variables?

There are a number of ways of raising the quantum measurement problem. They are all variations on a basic theme.

Essentially, the problem revolves around the following question: How does a determinate result (namely, a measured particle with specifiable dynamic attributes) get generated from a state of multiple possibilities or probabilities in which the particle is devoid of determinate, dynamic characteristics (i.e., the pre-measurement state)? Another way of asking the same sort of question is this: What is the nature of the transition process that takes a quantum event (i.e., a pre-measurement phenomenon) and permits a classical event to evolve out of it (i.e., the measurement phenomenon)? A third way of asking the same essential question is as follows: What actually happens when the wave function collapses?

Although a number of suggested resolutions to the quantum measurement problem have emerged during the last fifty years, there are no differences among the various interpretative approaches as far as the mathematical or experimental aspects of quantum mechanics are concerned. They all accept the results of mathematical calculations, and they all agree on what can be expected to be observed in different experimental circumstances. Consequently, at the present time, there is no experimental means of determining if any of these interpretations is 'the' correct interpretation of the nature of quantum reality.

According to the Copenhagen approach to quantum theory, one will not be able to find an explanation for the world of our everyday experience in the realm of quantum reality. One starts, instead, with the world on the macroscopic level as a given and uses quantum theory as a means of mapping certain kinds of engagement relationships between the macroscopic measuring devices of the classical world and various aspects of the quantum level of reality.

Although one can employ quantum theory to make accurate predictions about various aspects of the way classical measuring devices engage quantum reality, quantum theory cannot explain: (a) why such engagements have the character they do; how such engagements come about; or, (c) what the precise character of the relationship is between classical reality and quantum reality. Indeed, from the perspective of the Copenhagen school of quantum theory, the realm of quantum reality remains forever inaccessible to our classical modes of experience.

Moreover, according to the Copenhagen school, the quantum realm is beyond our comprehension since it operates in a way that defies and eludes logical or rational analysis. Consequently, as far as this school of thought is concerned, the quantum measurement problem can never be answered in any definitive, satisfactory manner.

John von Neumann took a different approach to the quantum measurement problem from that of the Copenhagen perspective of Bohr and Heisenberg. Unlike the latter individuals, von Neumann did not feel comfortable with a bipartite division of reality into classical and quantum realms. Von Neumann preferred a unified view of reality, but he maintained that reality is entirely quantum in character, without any trace of classical influences.

Von Neumann maintained that quantum theory does not constitute a method for relating classical measuring devices and the non-classical quantum realm. He described everything in terms of quantum proxy waves, but he distinguished between different states of the proxy wave. More specifically, he speaks of Type I and Type II processes.

Type I processes involve proxy waves outside the context of measurement. These sorts of processes consist of proxy waves expanding throughout the universe. Type II processes, on the other hand, give expression to the contraction of a proxy wave in the context of measurement.

While the contraction of the normally expanding wave of possibility during a Type II process results in a determinate outcome, the outcome is still, nonetheless, a proxy wave rather than a classical entity of some sort. When physicists talk about the collapse of the wave function, they are referring to a Type II process.

Irrespective of whether one is referring to a Type I or Type II process, the way in which yon Neumann construes the proxy wave is in opposition to way in which most modern physicists have come to treat the proxy wave. Whereas in the latter case, the proxy wave tends to be considered as a convenient methodological device without any physical reality, von Neumann considers the proxy wave to have physical reality.

Consequently, for von Neumann, the quantum jump that occurs when a Type II process replaces a Type I process (i.e., the wave function collapses) describes an actual physical event. However, there are a number of questions, concerning the physical character of the jump, to which neither von Neumann, nor anybody else, has been able to provide a satisfactory answer: (a) just how does the jump from a Type I to a Type II process take place? (b) At exactly what point during the process of measurement does the collapse of the wave function occur?

Von Neumann failed to come up with a solution that provided details concerning the physics of the jump. He eventually decided the 'cause' of the jump is the human consciousness that is part of the Type II measurement process. In other words, according to von Neumann, the dynamic properties of a particle come into being with an act of consciousness. In effect, consciousness creates, at least in part, the properties of a particle.

Von Neumann's 'consciousness-creates-reality' theory sounds very similar to approaches to the quantum measurement problem that are rooted in an observer-created-reality (e.g., the theories of Fred Wolf). However, there are fundamental differences between the two perspectives.

In the latter case, the character of reality arises as a function of the choices made by a given observer concerning that dynamic property to measure. Thus, if one focuses on the conjugate properties of position and momentum, a decision to measure a particle's position will affect one's interaction with the particle's momentum. As a result, an observer would have affected the mode of property through which the particle manifests itself to the individual.

In addition, in an observer-created quantum interpretation, one does not have to use human beings to make the observation. In other words, from the perspective of this approach to the interpretation of quantum reality, the 'observer' does not have to be conscious in order to be able to affect the property mode through which a given particle manifests itself. Thus, one can use machines or various forms of technology to act as a surrogate observer.

However, in von Neumann's 'consciousness-created-reality' approach to the interpretation of quantum theory, machines cannot create reality since they have no consciousness. Determinate values for a given dynamic property can only be generated through the presence of consciousness. Consequently, whatever the nature of the machine/quantum reality interaction, the results require an act of human consciousness to provide those results with a determinate value.

Another difference between the 'consciousness-created-reality' position and an 'observer-created-reality' position is as follows. Whereas the latter approach determines only what property will be manifested and not its precise value, consciousness-created reality specifies a particular value for the property that is to be manifested.

Neither the 'observer-created-reality' approach nor the 'consciousness-created-reality' approach is giving expression to Bishop Berkeley's contention that existence is a function of perception. Both of the former views are speaking only about the dynamic properties of various quantum entities.

The so-called static properties of a particle, such as mass or charge, have a substantial, permanent reality independently of whether or not they are observed. These static properties are not created by either the act of observation or the presence of consciousness.

In addition to his distinction between Type I and Type II measurement processes, von Neumann put forth an argument that he claimed proved that there could be no hidden or deep reality with respect to the dynamic properties of a particle. According to von Neumann, if one wished to claim dynamic properties are intrinsic to the structural character of a given particle, then descriptions of that particle must necessarily come into conflict with the predictions of quantum physics.

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<u>Phase entanglements, pilot waves and configuration space</u>

David Bohm came up with a counter-argument to von Neumann's 'proof' in 1952. According to Bohm, one of the essential characteristics of reality concerns its quality of undivided wholeness.

Central to his perspective is the notion of phase entanglements. Unlike normal waves of the everyday world that separate cleanly following interaction, the proxy waves associated with quantum entities do not separate cleanly following interaction. The respective phases of the different quantum entities become intertwined. Apparently, the reason why the proxy waves behave differently from the everyday variety of wave concerns the kind of space through which each sort of wave is given expression. Whereas normal waves are transmitted in 3-space, proxy waves are transmitted in what is known as configuration space.

Each quantum entity has a proxy wave (known as a "pilot wave") that exists in three dimensions of configuration space. If one has n-quantum entities interacting with one another, then the associated proxy waves of these interacting particles will occupy (n)(3) dimensions of configuration space. However, rather than there being 'n' different waves in configuration space, there is just one wave in n-dimensions.

Consequently, the phase character of this wave becomes very complex, but that character is of a unified -- though multi-dimensional -- nature. In fact, from the perspective of individual proxy waves, the phases of these waves appear to be entangled with one another.

One of the functions of the pilot wave is to convey information, instantaneously, to the particle concerning any changes that are encountered by the pilot wave. This information is used by the particle to adjust its dynamic attributes, such as position or momentum, in accordance with the character of the information transmitted via the pilot wave.

Among the contextual changes encountered by the pilot wave are those that involve acts of observation or measurement. The dialectic between a particular act of, say, measurement and the pilot wave would alter the character of the pilot wave's form to reflect certain aspects of that process of measurement.

This alteration in waveform character would, then, be transmitted to a given particle, and the particle would alter its position or momentum accordingly. With different kinds of observational or methodological engagements, different sorts of pilot wave forms would arise.

Although Bohm argued that the dynamic properties were intrinsic to a particle, he also provided a means, through the agency of the pilot wave, for those properties to be: (a) sensitized to environmental or contextual changes, and (b) capable of manifesting appropriate sorts of adjustments. Thus, Bohm had proposed a model that permitted particles to possess a definite momentum and position at all times. Yet, his model was, nonetheless, still able to generate results that mirrored the predictions of quantum mechanics -- something that von Neumann had claimed so-called hidden variables could not do.

The feature of phase entanglement gives rise to an intriguing, but problematic, possibility. More specifically, in theory, the idea of phase entanglement suggests the possibility of action-at-a-distance in which events in one part of configuration space are capable of being transmitted instantaneously to other parts of configuration space despite the fact that the quantum entities with which the proxy waves are associated might be separated by distances that prohibit (if one accepts the tenets of Einstein's special theory of relativity) the possibility of instantaneous communication.

However, one must keep in mind that configuration space is a mathematical construct and does not necessarily have any actual ontological counterpart. Moreover, the multidimensional aspect of configuration space (which is at considerable odds with the, apparently, limited dimensionality of our everyday experience) led many physicists to conclude that the waves occupying such space were not 'real' physical waves.

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Is quantum theory incomplete?

Although Einstein accepted the idea that quantum theory is capable of accurately describing all experimental results, he, nonetheless, continued to express his distaste for, among other things, the intrinsic random quality of quantum theory. He did so by contending that quantum theory was incomplete. Because of the inherently statistical character of quantum theory, Einstein believed the theory contained lacunae in relation to certain aspects of physical reality. In short, while quantum theory might provide a complete description of measured phenomena it did not provide a complete description of reality.

In 1935 Einstein, along with Boris Podolsky and Nathan Rosen, put forth the first of a series thought experiments. Einstein believed such experiments would demonstrate the incomplete nature of quantum theory. As originally conceived, the experiment focused on two electrons that had correlated momentums at the beginning of the experiment.

David Bohm came up with a simpler version of the same idea when he substituted polarization-correlated photons for the momentum-correlated electrons of the EPR experiment. The following discussion uses Bohm's version of the experiment, but the principle involved is the same in both cases.

In Bohm's experiment, two photons are emitted from a given light source. These photons exhibit a form of phase entanglement that is known as the state of parallel polarization. In this state, the angle of polarization of each photon is the same as the other photon's angle of polarization.

The state of parallel polarization actually reflects an aspect of configuration space in which the two photons manifest a single waveform of determinate value. In other words while neither photon, individually, has a definite proxy wave associated with it, the two photons exhibit phase entanglement and, therefore, do have a definite waveform associated with them as a combined unit.

Essentially, the question that Bohm raises with his experiment (and, the same question is raised in the slightly different experimental version conceived of by Einstein, Podolsky and Rosen) is as follows. Will either of these photons have a definite angle of polarization after their point of release but prior to the time that either of them is measured at some subsequent point where they have been separated from one another by distance during some given period of elapsed time?

From the perspective of the Copenhagen school of quantum interpretation, the dynamic properties, one of which is the angle of polarization, cannot have any definite value outside of the context of measurement. The determinate value only emerges during the process of measurement.

According to Bohm (and Einstein), the particle will have determinate dynamic properties in between the time of release and its subsequent measurement. Furthermore, since the two particles are traveling in opposite directions at the speed of light, there can be no communication between the photons concerning what is happening to one another during the process of their respective measurements.

This is so because of the restrictions of the locality assumption that are imposed by the special theory of relativity. If one has ignorance about the character of the dynamic property of either of the particles when they are in between release and measurement, this is a case of classical ignorance and not a matter of some sort of intrinsic ignorance involving quantum randomness.

In effect, the thought experiments of Bohm and EPR, are logical arguments about the possibility of certain aspects of reality falling beyond the boundaries of quantum theory. Logical arguments do not prove quantum theory is wrong or that quantum theory makes predictions that can be shown to be incorrect. What such arguments suggest is that quantum theory is not able to account for certain aspects of reality that occur outside of the context of measurement and, therefore, is incomplete.

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Bell's interconnectedness theorem

No one was able to either refute or to confirm the foregoing sorts of thought experiments until around the mid-1960s. Then, John Bell came forward with his theorem on interconnectedness.

The problem that initially attracted Bell's attention -- and which would eventually lead to the development of his theorem of interconnectedness -- was David Bohm's counter-response to von Neumann's 'irrefutable proof'. This proof allegedly showed how all hidden variable theories were necessarily inconsistent with the results of quantum mechanics.

During the mid-1960s, John Bell decided to investigate Bohm's model in order to try to determine how it could succeed when, supposedly, von Neumann had proven that a model of the sort proposed by Bohm could not possibly be successful. Bell discovered that von Neumann's argument was not as ironclad as many physicists had believed it to be. More specifically, von Neumann had claimed that if objects that had dynamic properties as an intrinsic part of their nature were to be combined in ' reasonable' ways , then one would not be able to use such combinations in a way that would allow one to replicate the predictions of quantum theory.

While Bohm's combination of a pilot wave and a particle was quite reasonable (the signal problem aside) and while his model was entirely capable of duplicating the results of quantum theory, it fell outside the parameters of what von Neumann had in mind as being a reasonable sort of combination. In other words, von Neumann's proof was faulty in as much as it rested on an untenably narrow conception of what constituted a reasonable combination of objects.

Having laid bare the limitations of von Neumann's proof, Bell continued to explore the issue of whether or not there were necessary limitations to the character of the ontological ground in which quantum facts were rooted. He subsequently put forth a proof, now known as Bell's theorem, which claimed to show that all models of reality must necessarily be non-local in character.

By the term "non-local" Bell means the following. The values attributed to a given physical event during the process of measurement are a function of not only local factors that are contiguous or proximate to the event being measured, but such measured values are also the result of non-local influences. Non-local influences are so distant from the measured event they would have to travel faster than light in order to be considered contiguous or proximate to the measured event.

Physicists believe that whenever a particle moves, its associated field is distorted. The structural character of the distortion initially occurs near the object that is moving, and, then, the distortion spreads out through the field.

According to Einstein's theory of special relativity, there is an inherent limit on how quickly not only a field distortion, but also, how quickly the associated particle, can move through space. This limit is the speed of light.

This inherent physical limitation on the rate of transmission or movement imposes constraints on the idea of locality. Essentially, the constraint means locality has an upper limit that is defined by the velocity of light. Anything that falls outside the so called light cone in a given set of circumstances falls beyond the horizons of the conditions of locality.

Generally speaking, the notion of non-local influences is interpreted to mean that such influences are transmitted instantaneously and would not fall off with distance. Furthermore, non-local influences, unlike local forces, or influences, do not require mediation.

Consequently, according to Bell's theorem, any given physical event is subject to influences from many different parts of the universe. Moreover, these influences occur irrespective of whether they can be shown to be contiguous or proximate in any usual sense of these words.

The general structure, in brief, of Bell's argument is as follows. He begins by accepting, at least tentatively, the assumption of locality. This means that not only must interaction among particles take place on a contiguous basis, it also means the transmission of influences or signals cannot be superluminal in character. He, then, proceeds to show, by means of simple arithmetic, that there is a certain inequality (which has come to be known as Bell's inequality) that must be satisfied by all experiments of the sort proposed by EPR, Bohm and others. Finally, he notes this inequality is not satisfied whenever such experiments are run, and, therefore, he concludes the original assumption of locality is not tenable.

If the assumption of locality is not operable as a basis for interactions in the physical universe, the only alternative seems to be maintain that interactions are governed, at least in part, by the principle of non-locality in which influences, forces and so on are transmitted through an action-at-a-distance process. Such processes are unmediated in the sense that a given force or influence is transmitted from, say, one particle to the next without requiring any intermediate steps.

Bell maintained that irrespective of whether: (a) one advocated a model of reality that presupposed that dynamic properties are intrinsic to an object's structural character (as Bohm did in his pilot wave model), or, (b) one advocated a model of reality that presupposed that dynamic properties arise external to the object (as the Copenhagen school proposed), both models required the presence of non-local influences. These sorts of influences are required in order to be able to account for the structural character of quantum facts.

In other words, there seems to be an aspect of any given ontological context that necessarily is an expression of, and shaped by, faster than light transmission. Such influences are manifested in the quantum facts that have arisen from the experimental data.

Therefore, any model of reality, no matter what its position on the issue of dynamic properties, must incorporate non-local influences into the model in order to be able to adequately reflect the character of the actual facts of quantum phenomena. Stated in another way, Bell's theorem stipulates that any attempt to introduce a hidden-variable approach to account for the observed data of quantum physics cannot succeed unless it incorporates one or more features that are superluminal (i.e., faster than light) in character.

The theorem proposed by Bell emerges out of the same kind of modified version of the original EPR experiment as had been devised by David Bohm. Essentially, the experimental set up involves the following elements.

A light source emits photons in opposite directions from one another. At some distance from the light source there are calcite detectors. Calcite is a birefringent crystal that is capable of distinguishing between photons according to whether their plane of polarization is directed along the optical axis of the crystal or at right angles to that optical axis. These detectors are capable of providing a polarization measurement at various angles when the photons from the light source engage the detectors.

Finally, although the states of polarization of any given pair of photons reflect one another precisely when they are measured at the same angle at different calcite detectors, nonetheless, taken as a collective group, consisting of many pairs of emissions over time, the photons are unpolarized. This is so since no matter what angle is selected for measuring the various photons, one gets an unpredictable, 50-50 mixture of the two possible orientations for their planes of polarization.

Bell focuses on the property of correlated polarizations. Correlated polarizations are, in contrast to the description given in the previous paragraph, independent of the angle at which the two photons are measured by their respective calcite detectors. In other words, although the angle at which polarization measurements are taken at two calcite detector sites might be different, if the measurements indicate the same state of polarization in each of the photons, this is counted as a match, otherwise it is a mismatch.

According to quantum theory, the property of correlated polarization depends only on the relative angle between the two calcite crystals and does not depend on the specific angle settings at the two calcite detector sites. In other words, as long as one keeps the relative angle between the detectors the same, one can choose any angle setting one likes at the two calcite crystals, and quantum theory predicts the photon pairs will exhibit correlated polarization states. Moreover, this prediction has been confirmed through a variety of experiments.

Bell was interested in looking at the character of the correlation patterns at different angles (running from 0 to 90 degrees) for long runs of emitted photon pairs. Such correlation patterns can be expressed as a fraction of matches to mismatches (i.e., correlation versus no correlation) that ranges from perfect positive correlation of 1 -- when all pairs exhibit correlation -- to a correlation of 0 when there are no matches in the emitted pairs.

Furthermore, Bell wanted to examine the above mentioned variation in the correlation pattern at different angles under the assumption of locality. Translated into the terms of the photon experiment outlined previously, locality means one works on the assumption that what is occurring at one calcite detector site cannot affect what is happening at the other calcite detector site.

Thus, when one varies the angle setting of one calcite detector, this should affect only the measurement at the site where the angle setting has been altered. The measurement at the other calcite detector site should be independent of such changes.

Bell's inequality is rooted in the assumption of locality. Essentially, the inequality says: the fraction of matches to mismatches one gets, when comparing the polarization states measured at a given angle at the two calcite detection sites, should be equal to, or less than, what one gets with measurements made when the calcite detectors are misaligned by a factor of twice their current angle values. The possibility of coming up with a fraction that is less than twice what one would expect at the larger angle is to acknowledge that the way of counting matches and mismatches might overlap on some occasions as one varies the angle of measurement.

The problem with the predictions that are made on the basis of the assumption of locality, via the Bell inequality, is that experiments do not confirm it. In fact, experiments indicate the fraction of mismatches to matches will exceed the Bell inequality when the calcite detectors are misaligned by a factor of twice the previous angle values at which correlation values were recorded.

Since experiments have shown that Bell's inequality is violated, one must consider what has to be jettisoned as the problematic factor that leads to experimental results contrary to what theory predicts. As it turns out, there is only one component of the theory underlying the experimental set up which cannot be verified independently of Bell's experimental proposal. The unconfirmed component is the assumption of locality.

Consequently, in light of the experimental results, the assumption of locality seems not to be tenable. Furthermore, this conclusion, apparently, forces one, in turn, to suppose the condition of non-locality governs physical reality. That is, unless one assumes the condition of non-locality prevails, how does one account for the experimental results that violate the Bell inequality?

The experimental basis for Bell's theorem concerning the interconnectedness of all aspects of the universe lies with his demonstration that the inequality that is rooted in the assumption of locality is not supported by experimental evidence. In other words, Bell's demonstration is not based on having experimentally verified the existence of the condition of non-locality. The nature of his argument is that he has shown something that is consistent with the assumption of non-locality and, therefore, serves as a sort of indirect verification of the assumption of non-locality.

Generalizing the results of the photon polarization experiment to physical events is based on the idea of phase entanglements in configuration space. More specifically, assuming conditions of non-locality have been established in a particular case, one might argue that phase entanglements offer the perfect opportunity for the condition of non-locality to be given expression across all manner of events. Thus, if one assumes the condition of non-locality holds, then when various influences and forces are passed on through phase entanglements, events that are separated by distance, can, nonetheless, affect one another.

In effect, Bell's theorem has raised the status of the idea of phase entanglement from: one of representation in the mathematical creation of configuration space, to: an actual ontological entity that has real, experimentally verifiable results. Although not all physicists accept Bell's arguments or his conclusions, nonetheless, no one to date has come up with a plausible alternative to Bell's position.

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The ontology of quantum theory

Although most quantum physicists claim not to be concerned about the actual character of quantum reality and say their only interest is in being able to generate reliable methods for solving various problems of prediction and calculation in relation to quantum events, there is, nonetheless, an underlying ontological perspective that is tacitly held by the vast majority of quantum physicists. Moreover, this perspective (which Herbert refers to as the orthodox ontology) is rooted in a postulate about the character of unmeasured quantum entities that is neither logically defensible nor experimentally verifiable.

Essentially, this fundamental postulate stipulates the following. Quantum entities represented by the same wave function are not only in the same state, they also are identical to one another in all physical respects.

However, while quantum physicists contend there is a sameness of being among all quantum entities that can be represented by a given wave function, this ' fact' of the sameness of being does not guarantee that a sameness of result will ensue. Indeed, according to the tenets of orthodox ontology, there is an inherent randomness in the character of reality such that identical conditions are, nevertheless, capable of giving rise to variable results.

For example when electron diffraction experiments are considered from the point of orthodox ontology, all the electrons released from the metal filament at a given setting of voltage, and so on, will be precisely the same. However, the identical electrons will engage a variety of different phosphor molecules at various points of the screen due to the element of intrinsic randomness that is a characteristic of ontology at the quantum level of scale.

There is another feature that follows from the two fundamental postulates of orthodox ontology [i.e., (1) quantum entities in the same state are ontologically identical and (2) the intrinsically random nature of ontology]. This additional feature concerns the relationship between the statistical character of quantum events and the character of any given individual quantum entity among the entities being collectively tabulated by such a statistical description. In effect, from the point of view of orthodox ontology, there is no real difference between a statistical description and an individual description. The statistical description is merely the individual description writ large.

Consequently, even if one cannot always deal with individual quantum entities, statistical descriptions will permit one to have access to the same sort of information as if one were studying individual quantum entities. In short, quantum statistical descriptions will accurately reflect the character of individual quantum entities.

The feature of intrinsic randomness plays a key role in the Copenhagen school's contention that the quantum theory's statistical description of events is as complete as one is ever going to get. The quality of intrinsic randomness leads the proponents of the Copenhagen school to conclude there are no hidden variables that must be sought in order to get a more complete and determinate account of the way things are.

For instance, on the above view, there is no hidden cause why identical electrons turn up at different points on the phosphor coated screen. The differences in are simply an expression of the property of intrinsic randomness at work. As a result, the search for hidden variables is really misguided and doomed to failure.

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Dimensional dialectics: an alternative perspective

Neither particles nor waves are the basic "stuff" of the universe. Both are effects of an underlying spectrum of constraints and degrees of freedom that constitutes the structural character of a given object, event, condition, process, or state as it unfolds over time through engaging and being engaged by various aspects of ontology.

A spectrum of ratios of constraints and degrees of freedom is the manifestation of the dialectic of dimensions that is generated, set into motion, shaped, and regulated by an order-field. The dialectic of dimensions establishes the parameters, themes, currents, and so on, out of which arise, on another level of scale, wave-effects and particle-effects of various structural character.

Space, time, consciousness, will, life, intellect, energy, emotion, and materiality are all examples of dimensions. The foregoing list of 9 dimensions do not necessarily exhaust dimensionality, but they are the ones with which we are most familiar. When they dialectically interact with one another, they are capable of generating much of the physical, intellectual, and emotional phenomena that are normally encountered during the course of day-to-day experience.

Each of these dimensions introduces a particular thematic orientation that is peculiar to that dimension and not shared by any other dimension. The temporal dimension, for example, has one kind of orienting influence, whereas space and consciousness have quite different orienting influences.

One cannot derive space from time or vice versa, nor can one derive consciousness from temporality or spatiality, just as one cannot derive temporality or spatiality from consciousness. The same is true of all the other dimensions. In short, each dimension is capable of being expressed as a unique set of constraints and degrees of freedom.

Therefore, on the view of the foregoing perspective, instead of treating space as being 1, 2, 3, or n-dimensional (depending on how many different axes are used to set up a coordinate system to represent the ordered n-tuples constituting the points of the various aspects of that coordinate system) space can be considered to be just one dimension, consisting of n-degrees of freedom. Thus, space that has breadth, width, and height would have three degrees of freedom, whereas, space that required fewer or more axes to describe its characteristics would have fewer or more degrees of freedom. Furthermore, associated with each degree of freedom are one or more constraints that mark the limits of that degree of freedom.

Similarly, on the basis of the perspective outlined above, time is not the fourth dimension. This terminology is often used because in scientific/mathematical descriptions time is usually the fourth axis of a coordinate system or the fourth component of a given algebraic n-tuple. However, time is just one dimension among a number of dimensions, and, like other dimensions, it has a certain number of degrees of freedom and a certain number of constraints that are associated with these degrees of freedom.

One of the special characteristics of the temporal dimension is the way in which it interacts with all the other dimensions. In a sense, time is a common currency (there might be other common currency dimensions as well) of the multi-dimensional manifold that constitutes ontology. By means of the phase relationships that time forms with every dimension, a common ground arises through which different dimensions can dialectically interact with one another. These phase relationships are like currents running through the temporal dimension.

The dialectic of these temporal phase currents generates complex waveforms containing phase information components from many different dimensions. Within these phase waveforms, considered individually, and during the interaction of these waveforms, between and among themselves, phase information is exchanged.

Phase information has the capacity to bring about shifts or transitions in the way in which those dimensions involved in the interaction express themselves. Through these shifts, a given spectrum of constraints and degrees of freedom gives expression to a mode or facet of its structural character that is different from the mode that was being manifested prior to the exchange of phase information.

In effect, the above position suggests human beings are rooted in phase 'space'. In 'phase space', focal awareness marks the point of origin of a multi-dimensional co-ordinate system or manifold. This manifold consists of point-structures that give expression to ordered n-tuples of phase relationships. These n-tuple point-structures combine together to form: neighborhoods, lattices, and latticeworks of complex inter-dimensional character.

The hermeneutical operator is capable of combining together different phase n-tuple point structures and operating on these point-structures in a variety of ways. As a result of the activity of the hermeneutical operator, complex structural waveforms can be generated, shaped and modified in ways that alter the structural character of previously existing point-structures, neighborhoods and latticeworks.

The modified or new structures that are generated through the activity of the hermeneutical operator give rise to a new set of phase relationships. Thus, the capacity of human beings to be a multidimensional, multi-level-of-scale phase relationship processor, through the common currency of the temporal dimension, allows qualitatively different kinds of dimensions to be brought together to form various kinds of complex, structural, phase waveforms.

The character of the dialectic of dimensionality is an expression of what goes on, on yet another level of scale. This new level of scale is the order-field, and it permeates all other levels of scale. Or, said in another way, all other levels of scale are rooted in, generated by, and give differential expression to, the order field.

Thus, the order-field forms an even more fundamental common currency basis for the exchange of various kinds of information among different dimensions than do phase relationships. In fact, phase relationships are a manifestation of this common currency aspect of the order-field. On any given level of scale, and for any given point-structure, neighborhood or latticework, a spectrum of ratios of constraints and degrees of freedom is, ultimately, an expression of the different modes through which the order-field manifests itself.

Seen from this perspective, although different dimensions have different spectra of ratios of constraints and degrees of freedom associated with them -- or to which they give expression -- the 'stuff' out of which the various structures of the world are constructed is an expression of the manner in which the order-field, first, generates and, then, brings into dialectical interaction, the various dimensions. Thus, the exchange of information takes place on the level of the common currency of ontology -- the order-field -- and is, subsequently, given manifestation through the phase relationships that arise among different ratios of constraints and degrees of freedom on a variety of levels of scale as those dimensions play off against one another.

The order-field (which generates, shapes and regulates the dialectic of dimensions) is somewhat like a Turing machine that is completely self-regulating or autonomous. The order-field is capable of spontaneously creating and reading out its own codes and, then translating these codes into dimensional attractors. Moreover, the order-field is capable of establishing the set of sequences through which all of this is to be done, as well as: how, to what extent, when, and for how long, different dimensional attractors are to engage one another.

Seen from a slightly different perspective, the order-field is like a fully integrated, but extremely complex, genetic system consisting of all the necessary components for a full complement of order-field counterparts to anabolic and catabolic functioning. Therefore, the order-field can generate, support, maintain, regulate, dissolve, and vector the dialectic of dimensions in whatever way is indicated by the order-field itself.

In this context, the dimensions are like genes that interact with one another to give expression to various characteristics through different dimensional counterparts to the phenotypic levels of scale, ranging from cell bodies (such as ribosomes, Golgi complex, nucleus, etc.), to simple cells, to tissues, to organs, to integrated organisms. Consequently, wave-effects and particle-effects would be phenotypic-like manifestations on an appropriate level of scale of dimensional ontology.

As a particular kind of dialectic of dimensional 'genes' is turned on or activated, a wave-effect manifests itself. As another kind of dialectic of dimensional genes is turned on, a particle-effect manifests itself. Furthermore, under certain circumstances, both sorts of dialectics of dimensional genes might be operational simultaneously.

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<u>The Necker cube-analog</u>

Another way of looking at the nature of the spectrum of ratios of constraints and degrees of freedom associated with the dynamics of dimensional dialectics is through a sort of Necker cube-analog. If one were to treat the complete structure of some given quantum entity as a set of ratios of constraints and degrees of freedom, then particle-effects could be considered to be a subset of the overall set of constraints and degrees of freedom that constitutes the structural character of the quantum entity being considered. Wave-effects, on the other hand, might be considered to be another subset of the overall set of constraints and degrees of freedom. The Necker cube-analog aspect arises during the transition between the particle-effect and wave-effect arrangements of a structure's spectrum of ratios of constraints and degrees of freedom.

Alternatively, wave-effects could reflect the transitions between, or among different particle-effect phase states. The phase relationships between, or among, such states have a Necker cube-like character in which the structural character of a given sub-atomic entity is able to switch back and forth between, or oscillate among, different phase states. Wave-effects are due to the oscillatory character of the phase relationships that link the different ways in which a given structure gives manifestation to its phase states.

The cause of these phase transitions or shifts could be the result of spontaneous factors that are internal to the dialectic among the various subsets of a given quantum entity's structure. The phase shifts also might be the result of external factors that induce such a transition in the phase relationships that tie together different subsets of constraints and degrees of freedom in the quantum entity as a whole.

Necker-cube analog phase transitions can be characterized in the following way. They refer to any transition resulting in an individual or multiple change of the expression, orientation, engagement, or value of the phase relationships among various point-structures, as long as such transitions are not also accompanied by any change in the structural character of the point-structures, latticeworks, or neighborhoods being linked through such phase relationships.

The shifts that can be observed in the two dimensional Necker cube is a simple example of the kind of transition being alluded to in the foregoing. However, there are some important qualifiers that must be kept in mind.

The Necker cube illusion is generated by the way in which the human visual system engages a two-dimensional figure constructed in an appropriate fashion. Similarly, in the case of Necker cube analog phase transitions, such shifts arise in the context of the dialectic between a given hermeneutical system and the way that system dialectically engages phenomenological structures. Nonetheless, the transitions that arise out of this engagement are not necessarily an illusion.

The basic reason why the Necker cube is referred to as an illusion is because it helps give rise to an experience in which movement in the Necker cube is suggested without any movement actually having occurred in that structure. However, there is an important sense in which this illusion approach to the phenomenon misses an opportunity to focus on a key aspect of the process that is not illusory in the least. More specifically, the capacity of the human visual system to be able to look at something in a variety of ways, to get a variety of readings on the structural character of a given object, event, process, and so on, is an extremely fundamental and heuristically valuable tool that can be a source of important insights, perspectives and understanding.

Suppose one were to characterize the links between the nodes of a Necker cube as being phase relationships between different aspects of a hermeneutical or phenomenological structure, rather than merely as being lines connecting the vertices of a geometric structure. Given the foregoing, one might construe the shifts in perspective that can occur with respect to Necker cubes as probes of, for example, the inferential mapping component of the hermeneutical operator, or of congruence functions attempting to establish connections of a certain structural character between, or among, different point-structures of a given object, event, state, and so on.

Moreover, another feature to which attention is being drawn by means of the idea of Necker cube analog phase transitions, concerns the way such transitions seem to occur almost instantaneously, without going through any intermediary stage. This is consistent, or appears to be so, with how a structure gives expression, over time and under various circumstances, to different facets of its spectrum of ratios of constraints and degrees of freedom.

More specifically, previously, I have spoken of the switching on and off of various 'dimensional genes'. This occurs with respect to different sets of phase relationships that are given expression through the dynamic dialectic that arises amidst the tension existing between the constraints and degrees of freedom that constitute a given dimension's structural character. The switching on and off of those sets of phase relationships is somewhat like the change of perspective that occurs in relation to the visual engagement of the Necker cube.

In each case, the switch seems to go directly from a pre-transitional structural configuration to a post-transitional structural configuration. In other words, seemingly, one set of phase relationships has been switched off or de-emphasized (namely, the pre-transitional structural configuration) and another set of phase relationships has been switched on or emphasized (namely, the post-transitional structural configurations). In short, one set of phase relationships has been replaced by another set of phase relationships, and the switch over has not necessarily proceeded through any intermediate stage.[1]

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The yin-yang principle of phase relationships

There is a further aspect to the Necker cube analog phase relationship notion. In both the case of the Necker cube 'illusion', as well as in the case of the hermeneutical counterpart to the visual illusion, one of the features being emphasized is the way in which each of these phenomena is rooted in the process of engagement between two or more systems.

However, there is another possibility that should be mentioned as well. This further possibility involves the internal dialectic of a given structure independent of its being engaged by, or engaging, other structures.

Part of what is meant by the spontaneous, dynamical activity of a given structure is an expression of the Necker cube analog phase relationship idea that has been outlined above. The patterns of emphasis/de-emphasis, or switching on/switching off, that occur with different sets of phase relationships to which a structure's spectrum of ratios of constraints and degrees of freedom give expression, seem to reflect the various properties of the Necker cube analog phase relationships process.

One might suppose there are a number of fundamental thematic sets of phase relationships (i.e., the basic harmonics of a structure), together with an additional number of secondary, tertiary, and so on, sets of phase relationships that dialectically interact with one another and that constitute the internal dynamics of the structure. These secondary (etc.) themes are comparable to, but not exactly the same as, the second, third and forth harmonics of a given structure ... the difference being that these additional thematic sets are not necessarily multiples of the primary harmonic themes as is the case in normal waveforms.

Conceivably, the various sets of phase relationship themes run through cyclical patterns (whether periodic or aperiodic) in which they induce one another to turn on or off, or to become modulated in one fashion or another. The continued, spontaneous oscillatory character of the dialectic would be responsible for providing the structure with many of the main themes of phase relationships that go into making the spectrum of ratios of constraints and degrees of freedom have the character it (the spectrum) has for such a structure.

Other secondary or tertiary (and so on) properties of the structural character would emerge during the process of engagement with other kinds of structures. These other properties would emerge as different aspects of the spectrum of ratios of constraints and degrees of freedom to which a given structure is capable of giving expression were induced into, or spontaneously generated, some given form of manifestation.

A structure (whether an object, event, process or state) consists of a spectrum of ratios of constraints and degrees of freedom. This spectrum of ratios is capable of expressing itself in a variety of ways under different circumstances.

At any given point in time, a particular ratio gives expression to one of the phase states of a structure's spectrum of ratios. The full character of such a structure is capable of giving expression to other phase states. Thus, although the basic spectrum of ratios of constraints and degrees of freedom remains the same, different facets (i.e., ratios) of that spectrum become actively emphasized or switched on while other facets (i.e., ratios) are de-emphasized or switched off.

As one runs through the various phase state possibilities of a given structure, there is a transition or shifting from one pattern of switching on and off to another pattern of switching on and off. Or, said in a slightly different way, there is a transition from one ratio of constraints and degrees of freedom to another ratio of constraints and degrees of freedom.

The transition or shifting is effected through the phase relationships that tie together the various constraints and degrees of freedom of different ratios that are drawn from the structure's overall spectrum of ratios. Moreover, such phase relationships are an expression of the dialectic of the various ratios of constraints and degrees of freedom that constitute the structural character of a given object, process, event, and so on.

As the constraints and degrees of freedom that constitute a given object interact with, and play off against, one another, they give expression to, as well as generate, phase relationships. When the internal character of that dialectic changes its mode of expression -- either spontaneously or through being induced to do so -- phase shifts or phase transitions result. Among other things, these phase shifts or transitions involve various patterns of emphasis/de-emphasis, or switching on and off, involving different combinations and facets of the constraints and degrees of freedom that make up the structural character of the object, event or process.

Each constraint or degree of freedom of a particular structure's spectrum of ratios is a manifestation of different phase relationships that have been generated through the dialectic between, or among, a variety of dimensions. Moreover, each phase relationship of the dialectic between, or among, various dimensions has, in a sense, two themes. One theme concerns the property of a degree (or degrees) of freedom. The other property concerns the property of constraint. This is the yin-yang principle of phase relationships.

When one engages different levels of scale of ontology, one is, in actuality, engaging different levels of scale of dimensional dialectics. In this respect, wave-effects and particle-effects are just certain phase states that give expression to Necker cube-like analog phase relationships, all of which have been established through the dialectic of various dimensions.

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<u>The structural character of quantum events</u>

If one considers the ground state of a hydrogen atom, the wave function for the orbiting electron describes a sphere. The size of this sphere is larger than the size of the proton about which the electron orbits.

According to the Copenhagen school of quantum theory, as long as an electron is not being measured, the electron does not actually exist at any given point within the sphere of its orbit. The electron is said, instead, to be spread throughout the sphere.

Only when the electron is engaged by a process of measurement, does the sphere collapse down to the size of the point-like electron that is observed in the experimental context. What the electron does when it is not being measured or how the electron does whatever it does while occupying the sphere defined by its wave function is entirely unknown.

Another unknown is the precise nature of the collapse of the wave function. In other words, just how does the act of measurement cause the wave function to collapse? Just how does the process of measurement engage a cloud of probability or cloud of possibility in order to eliminate all possibilities but one: namely, the one that is observed at the time of measurement? Furthermore, given that the proxy wave or probability wave is not considered to be anything real, how does a real process such as the act of measurement engage an entirely fictional entity?

There are three possible excited energy states for the hydrogen atom. Such states last only a few billionths of a second.

The orthodox quantum theoretical position maintains that entirely random factors intrinsic to the ontology of the atom will determine when a photon will be emitted -- thereby returning the excited atom to the ground state. Thus, if one takes exactly the same atom and excites it again, although another photon will be emitted, the time of emission will differ from the previous time of emission due to the intrinsic random factors that shape the of quantum phenomena.

Furthermore, in one of the excited states of the hydrogen atom, the character of the electron's wave function describes two disjoint proxy waves. Squaring the amplitude of this wave function indicates there is an equal probability (.50) that an electron will turn up in either section of the disjoint figure, but there is zero probability the electron will manifest itself anywhere between the two disjoint areas.

The perspective being proposed in this chapter would account for the wave function that represents the disjointed phase state of the hydrogen atom in the following way. The wave function actually describes portions of the spectrum of ratios of constraints and degrees of freedom that constitute the structural character of the electron.

Included in this description is a set of on/off patterns of phase relationship that are made possible by the dialectic of the ratios of constraints and degrees of freedom that constitutes the electron's structural character. Which pattern of on/off phase relationships is being manifested by the electron at the time of measurement will determine: (a) where the electron will show up at the time of measurement, as well as (b) the state of that electron when it is engaged during the measurement process.

Furthermore, the reason why there is zero probability of finding the electron in the zone separating the two disjointed areas described by the wave function is because Necker cube-like analog phase relationships are involved. In other words, in order for a possibility to exist, it has to be an expression of one of the ratios from among the spectrum of ratios that constitutes a structure's character. Since there is no ratio of constraints and degrees of freedom that corresponds to the zone between the disjointed regions described by the wave function for the electron of the hydrogen atom that is in a given energy state, then there is no possibility for such a ratio to manifest itself.

On the other hand, there are ratios that correspond to the two disjointed possibilities described by the wave function. These possibilities will manifest themselves in Necker cube-like fashion according to the internal dynamics of the hydrogen atom in a given energy state.

In other words, while orbiting about the hydrogen nucleus, the electron is busily running through its spectrum of on/off patterns of phase relationships.

The transition from one pattern to the next is Necker-like in character. This means there are no intermediate stages between one pattern and the next.

However, although the individual states are discrete in character, the sequence or order in which the various states succeed one another is continuous. The sequence is continuous in the sense that as one pattern or ratio becomes de-emphasized, another pattern or ratio becomes emphasized, just as if one runner in a relay race had passed on the baton to the next runner.

If one collectively describes all of the patterns or ratios that are manifested by the electron over time, one will have given expression to the shape of the wave function for the electron in such an excited state. In this sense, the wave function is like a time lapsed photograph. However, if one engages the electron by means of measurement while it is orbiting the nucleus, then one will be catching the electron in a given phase relationship pattern.

In a way, the manner in which the electron (or any particle really) runs through its spectrum of phase relationship patterns is sort of like Feynman's sum-over-histories method. The major difference is that rather than describing all the possible paths (with cancellations of some occurring as a result of being in opposite phase states), one is describing only the set of phase state patterns that are capable of arising from the dialectic of the electron's spectrum of ratios of constraints and degrees of freedom.

Consequently, Feynman's sum-over-histories is actually a description of the effects of the underlying phase relationship dialectics. As such, his approach is at least one level of scale removed from the internal dialectic that makes possible paths that have the structural character that Feynman is describing through his method.

An obvious question concerning the spectrum of ratios of constraints and degrees of freedom notion is this: what is being constrained or given degrees of freedom? Is it a substance or materiality of some sort? The answer depends on what dimensions are dialectically engaging one another.

Ultimately, what is being constrained or given degrees of freedom, is the autonomous, self-regulating order-field. By its very nature, it spontaneously places constraints on itself and permits itself various degrees of freedom, across a variety of levels of scale.

This spontaneous activity of the order-field ranges from the generation of dimensions, to their dialectical activity, to the phase waveforms that are the effects of such dialectical activity. So, on whatever level of scale one wishes to consider, the phase relationships that are manifested on that level and that give expression to the constraints and degrees of freedom on that level mark the presence and activity of the order-field as it dialectically interacts with itself.

Consequently, from the perspective of the foregoing position, there are no fundamental particles in any classical sense of a structure that contains or gives rise to certain static and dynamic properties. What is treated as a particle is a spectrum of ratios of constraints and degrees of freedom that arise as a result of the dialectical interaction of different dimensions that have been generated and set in motion by the underlying order-field.

The point of intersection for this dialectic of dimensions takes place not in space but in the temporal dimension. This means the point of intersection is not spatial in character but rooted in phase relationships.

However, because information is transmittable to the other dimensions by means of phase relationships, certain kinds of localized effects will be manifested in, for example, the spatial dimension. These effects might be observed to radiate out from the spatial side of the intersection, but the source of the radiation is not really in geometric space but in ‘dimensional space’.

Thus, one has a spectrum of ratios of constraints and degrees of freedom that is expressed in terms of phase relationships that are not particles, but that can produce particle-like effects. Moreover, when these phase relationships oscillate in some periodic or aperiodic fashion, they are capable of giving rise to waveforms.

From the perspective of the foregoing view, what hits the phosphor molecule of the detector screen is, in a sense, a ratio of constraints and degrees of freedom. This is the part of a complex phase state generated by a dialectic of dimensions that spills into the $E_3$ space of everyday sensory experience.

This part of the phase state gives expression to the dynamic and static properties of the "particle" that are, to some degree, measurable. These properties are manifested in such a way that they have -- when observed from a certain level of scale -- the appearance of a traditional/classical particle in as much as the properties that are given expression are localized. Moreover, part of the reason why a 'particle' is localized is that the effects will be tied to the spatial-material-energy aspects of the dialectic of dimensions ... all of which help to determine the context of the spatial locus or loci through which phase relationships will be translated.

One is reminded of some of the drawings in Rudy Rucker's book, *The Fourth Dimension*, in which a higher dimension interacts with a lower dimension. Only those aspects of the higher dimension that are compatible with the lower dimension are observable in the lower dimension. Furthermore, the way that the aspects of the higher dimension are observable in the lower dimension cannot be made sense of in terms of the physics or mathematics that is limited to the structural character of the lower dimension.

Similarly, the way in which other dimensions make their presence felt in a given dimension cannot be explained in terms of hermeneutical systems that are strictly bounded by the dimension into which the influences of other dimensions have been introduced by means of appropriately translated phase relationships. In other words, although certain aspects of other dimensions make their presence known through the aspects of phase information that are compatible with the dimension(s) in which the influence or effects is being manifested, much of the structural character of the dialectical activity giving rise to that influence or effect will be 'out of sight' of the dimensional context through which the effect or influence is being manifested.

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<u>Short-run and long-run effects of dimensional dialectics</u>

In the previous account quanta have been described as being neither waves nor particles. They have been characterized in terms of the spectrum of ratios of constraints and degrees of freedom that are capable of generating effects that have wave and/or particle properties. (Notice that this has a certain resonance with Faraday's idea – outlined in the chapter on fields – in which electric and magnetic phenomena were differential expressions of an underlying unified field of some kind.)

Moreover, the spectrum of ratios supposedly gives expression to shifting patterns of emphasis and de-emphasis with respect to phase relationships. These on/off patterns create, in turn, oscillating systems.

In view of the foregoing sorts of contention, an obvious question to ask is this: Under circumstances in which there is an absence of conditions conducive to both interference and diffraction, why don't electrons being shot at a phosphor coated screen show wave characteristics? Shouldn't the wave properties that are capable of being produced by the oscillating internal dynamics of the electron register at some point during the experiment?

In the short run (i.e., focusing on engagements between, say, "particular electrons" and "particular phosphor molecules"), there will be no wave properties that manifest themselves on the screen. The basic reason for this is as follows.

Measurement processes that do not involve interference or diffraction phenomena as part of an experimental set-up tend to engage quantum phenomena while the latter are in a particular phase state. Such states are a function of a set of phase relationships that are generated by the dynamic tension between, or among, the constraints and degrees of freedom being manifested by a structure at a given point in time.

Although each phase state constitutes a slice of the overall oscillatory character of the quantum entity's dimensional structure, the character of the engagement process to which short-run measurement gives expression is not geared to be sensitive to, or reflective of, that oscillatory character. Under the conditions previously stipulated, the nature of the short-run measurement process is geared to be sensitive to, and reflective of, a series of isolated phase states drawn from the spectrum of possible ratios of a number of different electrons.

In other words, the nature of the short-run methodology is such that it is incapable of tapping into, and displaying, the oscillatory character of the on/off or emphasis/de-emphasis transitions in phase relationships that lead to, as well as give expression to, shifts in the way different ratios of a given structure's spectral character manifest themselves. All the short-term methodology can accomplish is to take samples of a given electron in a given phase state as the electron encounters one of the phosphor molecules coating the screen at particular points in time.

On the other hand, in the long-run, effects will register on the screen that seem to indicate the presence of wave characteristics. Indeed, experiments have been done (initially by accident) in which an electron gun was left on for a number of days, and the results showed a wave pattern had formed on the screen.

The wave pattern that emerged in the foregoing set of circumstances was not an Airy pattern. However, as is the case with Airy patterns, although the collective form on the screen had the characteristics of a waveform, the collective pattern was produced as a result of an indefinite number of discrete engagements between electrons and the phosphor molecules coating the detector screen.

The reason there are wave-like effects that show up during the long-run measurement process is due to the way an electron's spectrum of constraints and degrees of freedom unfolds across time to give expression to various ratios and combinations of phase relationships. These manifested ratios and phase relationship values will conform to a distribution pattern that will have a wave-like character. In point of fact, the distribution pattern represents a sort of time-lapsed record of various aspects (such as primary, secondary and tertiary themes) of the structural character of the electron's spectrum of ratios of constraints and degrees of freedom manifesting themselves over time.

A distribution pattern for a long-run measurement process has the character it does (i.e., it is wave-like) because the internal dialectic of the spectrum of ratios is undergoing transitions from the time an electron leaves the heated metal filament until it reaches the phosphor coated screen. Even in the case in which certain phase states are preserved over a period of time, there is an oscillation of phase relationships maintaining those states.

However, the characters of these oscillatory systems tend to produce or give expression to self-similar rather than self-same properties As a result, there will be variability in, among other things, the character of the location of where the electrons will engage the phosphor molecules of the coated screen.

What shows up on the detection screen is, in a sense, a time-lapsed reflection of an individual electron's structural character writ large as a distribution pattern. More specifically, over time, different phase relationship patterns of emphasis/de-emphasis will be manifested as a result of the electron's own internal dialectic involving the various ratios of the spectrum of constraints and degrees of freedom that constitute the structural character of an electron.

Since these shifting patterns are oscillatory in character (although they are aperiodic oscillations), the general form of the pattern that shows up on the screen will be wave-like because the electron-phosphor molecule engagement occurs at different stages of the oscillatory cycle of the internal dialectic of the electron, resulting in slightly different values from one engagement to the next. Eventually, there will be a sampling from nearly every phase state of the aperiodic, cyclical character of the electron's internal dialectic of phase relationships as this dialectic gives expression to shifting ratios of constraints and degrees of freedom.

However, the wave-like effects that show up on the detector screen during the long-run measurement process should not be confused with the oscillatory character of the electron's internal dialectic of phase relationships and shifting ratios of constraints and degrees of freedom. The former effect is, in fact, indirect evidence for, and made possible by, the latter phenomenon.

The long-term measurement process is, in a sense, more sensitive to the presence of oscillatory properties in the electron's structural character than in the case with respect to the short-run measurement process. This enhanced sensitivity is largely due to the capacity of the former measurement process to provide a sampling technique, unintended though it might have been originally, which engages the internal dialectic of the electron at different phases of its cyclical character. As a result, one is able to develop a better portrait of the electron as it runs through the various ratios that constitute the spectrum of constraints and degrees of freedom that gives expression to an electron's structural character.

Nonetheless, the portrait of the structural character of an electron derived through the long-run measurement process is not really a wave-phenomenon. It is an artifact of the sampling character of the measurement process. If one assumes all electrons have, more or less, the same basic structural character, then by engaging a lot of different electrons during different phases of their oscillatory, one, in effect, can construct a representation of what, very likely, goes on in any given electron over time.

On the other hand, although the result of the long-run measurement process is not itself a wave phenomenon per se, it does provide evidence that is consistent with an interpretation that construes the internal dialectic of the electron in terms of oscillatory properties. However, one should keep in mind that the nature of such oscillatory properties is a function of Necker cube-like analog phase relationship transitions. These transitions are manifestations of different ratios of constraints and degrees of freedom that replace one another in a continuously discrete, or discretely continuous fashion ... such as occurs in the previously discussed idea of a relay race.

Thus, after being shot from the electron gun, the interim period of the electron's flight to the phosphor coated screen is spent manifesting a variety of phase states in an oscillatory manner. This means the electron is capable of giving expression to wave while in transit, even though it will engage the phosphor molecule in just one phase state and, therefore, appear to have a particulate character at the point of impact.

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<u>Phase states, Airy patterns and the two-slit experiment</u>

The foregoing discussion has focused on contexts that do not involve experimental set-ups designed to generate interference phenomena. However, one could extend certain aspects of that discussion to contexts that give rise to phenomena involving interference. For example, consider the points below.

The particular character of an Airy pattern (in terms of the intensity of each light circle and the diameter of each dark ring, as well as in terms of the size of the angular diameter of the central solid spot -- known as the Airy Disc) will be a function of the dialectic between the diameter of the hole through which the electrons are shot and the wave length of the electrons that are shot through the hole. The nature of this dialectic could be construed in a variety of ways.

One possible way to construe the above-mentioned dialectic is as follows. The electrons that form part of the molecules that make up the material in which a hole has been placed, and through which electrons from the heated filament are shot, give expression to a field that is capable of interacting with the field of the electron from the gun. This interaction might lead to the generation of interference patterns.

On the other hand, one might wish to argue that the field associated with the electron shot from the gun gets pinched or distorted as it goes through the hole. This pinching process disturbs the shifting patterns of phase relationships in the internal dialectic of the electron, thereby leading to the generation of interference patterns.

In effect, the electron from the gun gets thrown-off its routine sequence of shifting arrangements of ratios and phase relationship patterns. As a result, this disturbance generates a certain amount of bifurcation in the ratio arrangements and phase relationship patterns.

The bifurcation process causes different aspects of the internal dialectic of the electron to go out of phase with one another. Therefore, interference activity ensues.

The Airy interference patterns might also, of course, be a combination of the foregoing factors. However, whatever the precise source of the interference might be, the end result is to cause out-of phase variations, either within the internal dialectic of the electron or between the interacting fields of the electrons from the gun and the molecules making up the material with the hole through which the former electrons are shot. These variations give expression to interference phenomena that, in turn, show up on the screen.

The pattern on the screen is generated by an interference process. Nonetheless, like its non-interference counterparts discussed in the previous section of this chapter, the interference pattern is constructed by a series of discrete engagements between the phosphor molecules on the screen and the in-coming electrons.

Moreover, like its non-interference counterparts, the interference pattern on the screen is a time-lapsed portrait of structural character. However, in the case of the interference process, the pattern is a reflection of the effect that interference has on the way different electrons give expression to their internal dialectics under such circumstances.

Thus, the pattern on the screen is not, strictly speaking, a direct portrait of interference. It is an indirect portrait that is, at least, one step removed from the actual process of interference occurring while the electron from the gun is on its way to the screen. As such, the pattern serves as a characteristic indicator of the presence of interference processes since the pattern constitutes the tell-tale effect-signature or imprint or trace that interference leaves on the structural character of an electron's internal dialectic at some point prior to impact with the screen.

In view of the foregoing, although one is able to derive a number of patterns in different experimental situations suggesting that interference phenomena are somehow involved, this constitutes a misinterpretation of the meaning of the patterns that emerge in the different contexts. In only one case, namely the Airy pattern, is interference present.

In both cases, however, the structural character of the pattern on the screen is consistent with the presence of oscillatory that is generated by the shifts in the arrangement of ratios and phase relationship patterns in the electron's spectrum of constraints and degrees of freedom during its journey from the gun to the screen. Differences in the character of the patterns on the screen are reflections of the variations in the way in which the internal dialectic of electrons manifest themselves in different circumstances.

The above comments apply equally well to the two-slit experiment of Thomas Young. Like the Airy pattern, the Young experiment involves elements of interference phenomena. Moreover, like the Airy pattern, the Young experiment generates a set of discrete events that give differential expression to light's spectrum of ratios of constraints and degrees of freedom.

This spectrum reflects the presence of interference. However, one of the basic differences between the various electron gun experiments and Young's experiment lies with the sensitivity of the detection equipment.

In the simpler, two-slit experiment, the detection equipment is a piece of paper or cardboard. The piece of paper or cardboard cannot show that the form of the shadows on the screen are generated through individual electrons engaging the molecules and electrons of the screen while they are manifesting specific phase states.

What one sees on the paper or cardboard screen is an outline of the aggregate or collective form of the individual electrons engaging the screen in a discretely continuous fashion. In this sense, the two-slit paper/cardboard screen does not have the capacity for resolution of its more sophisticated phosphor-coated counterpart.[2]

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<u>Intensity, probability and the dimension of energy</u>

Quantum physicists' interpretation of the squaring of a waveform's amplitude as a probability index or measure is not entirely wrong, just incomplete and misleading if left by itself. In point of fact, the probability distribution represented by the squaring of the amplitude in the Schrodinger wave equation is really a sort of mathematical sketch of the structural character of a given entity's ratio of constraints and degrees of freedom as they express themselves over time in various arrangements of emphasis/de-emphasis or on/off patterns of phase relationships.

The reason why one can assign probability values is because the ratio of constraints and degrees of freedom has an oscillatory character in which certain tendencies (i.e., certain ratio arrangements of emphasis/de-emphasis or on/off patterns of phase relationships) are more likely to be expressed under certain circumstances than are other such tendencies. These tendencies assume a distribution pattern over time. Moreover, since the internal dialectic is non-linear in nature, the probabilities only indicate tendencies rather than determinate, fixed, self-same patterns of manifestation.

Therefore, the probabilities are not drawn out of thin air as if there were neither rhyme nor reason as to why different quanta have certain kinds of probability distributions associated with them. In addition, the probability distributions have a referent beyond that of a given quantum.

In other words, the structural character of a quantum entity is not somehow amorphous as if that character had no causal or physical principles to which it gave expression or manifestation. Probability distributions describe certain tendencies of a given quantum's structural character as a function of the internal dialectic of shifts in emphasis/de-emphasis among the ratios and phase relationships of the quantum entity's spectrum of constraints and degrees of freedom that makes a structure of such character possible.

The tendencies of a given ratio of constraints and degrees of freedom to manifest some combinatorial sets of emphasis/de-emphasis or on/off patterns of phase relationships rather than others, is not necessarily a function of the energy that is to be associated with every point of a given quantum entity. In fact, the manner in which energy is utilized to maintain structural integrity or to give expression to shifts in the way in which the spectrum of ratios manifests itself is also regulated and shaped by various ratios of constraints and degrees of freedom being given expression through the collective character.

Indeed, energy distribution and manifestation are themselves expressions of a multi-faceted dimensional dialectic, of which energy is only one of the dimensional components. Schrodinger's wave equation is capable of providing information about certain aspects of that dialectic in the form of, among other features, the amplitude of a given quantum entity's waveform. Such information can be used as a basis for drawing a sketch of certain aspects (e.g., its tendency to behave in one way rather than another) of the structural character of the entity to which the wave equation is making identifying reference.

On the other hand, there is, undoubtedly, some quantity of energy that is available to a given entity and that forms part of the ratio of constraints and degrees of freedom that gives expression to that entity's structural character. This seems to indicate that, in an important way, the manner in which the ratio manifests itself over time will be a reflection of, and reflected in, the modes through which energy is present and is expended over time. Therefore, even if the square of the amplitude of the wave function does not serve as a measure of the energy that can be assigned to every point of the quantum entity with which the wave is associated, there is, nevertheless, an energy value, which must be derived in some other way, that is associated with the ratio of constraints and degrees of freedom that give expression to the structural character of the given entity being investigated.

The foregoing seems to indicate that energy -- expressed as intensity -- both is, and is not, associated with every point of the structural character of a given quantum entity. Energy is associated with every point in the sense that should any particular aspect of the entity's spectrum of ratios of constraints and degrees of freedom be given expression, it does so because it has access to, and is being "funded" by an energy supply that is associated with the dimensional dialectic that generates such an entity's structural character.

On the other hand, the reason why one cannot say the intensity of the quantum wave is an index of the energy at every point of the probability wave is because, from the perspective of physics, to say the less likely possibilities have the same amount of energy associated with them as do the more likely possibilities is problematic, or makes no sense. After all, if all the possibilities that are assigned various probability values have the same energy associated with them, then why aren't all these possibilities equally likely? What is constraining them? Indeed, the idea of constraints suggests, perhaps, more structure in relation to point-particles than quantum physicists feel comfortable with.

Consequently, an assumption is made, apparently, that the intensity of the quantum wave cannot refer -- as is the case with 'normal, everyday' varieties of waveforms -- to the energy that is to be associated with each point of the quantum entity with which the wave function is associated. The intensity function is interpreted, instead, in terms of a probability distribution concerning the likelihood of a certain kind of property or set of properties being manifested at a given point in measured time and space. However, such an interpretation tends to gloss over the underlying dimensional dialectic in which probability distributions are rooted and out of which they emerge during the course of the measurement process.

As indicated previously, intensity provides a sketch of the structural character of the internal dialectics of the ratio of constraints and degrees of freedom as expressed in terms of combinatorial sets of emphasis/de-emphasis or on/off patterns of phase relationships. Furthermore, as also was indicated earlier, the intensity value provides, at the same time, an index of the energy that is available to each of the sets of phase relationships should they manifest themselves.

Manifestation occurs when some threshold (which is set by one, or more, of the ratio components making up the spectrum of constraints and degrees of freedom) is exceeded. When this threshold is exceeded, it opens a dimensional gate permitting shifts in ratio arrangements and phase relationships to proceed.

However, as indicated previously, the energy that is available to a given quantum entity is not necessarily to be found at every point of that entity's structure. The availability of energy, which is a dimension distinct from the dimensions of space and time, is via the mediation of a complex of phase relationships that shift, in accordance with transitions in the phase states of the internal dialectic. These shifts and transitions lead, in turn, to the opening and closing of dimensional gates that permit (or prevent) energy to be (from being) expended through the form of a particular mode of manifestation.

So, under appropriate circumstances, every aspect of a given quantum entity's structural character can have access to the energy that forms part of the entity's spectrum of ratios of constraints and degrees of freedom. Yet, this energy value does not exist at every point of the structure. The energy exists as another dimension that manifests itself in a particular form, as well as at a particular locus and time, when the dialectic of dimensions generates appropriate combinatorial arrangements of ratios of emphasis/de-emphasis or on/off phase relationship patterns to mediate the interaction of such dimensions.

Consequently, energy is not stored or housed in any spatial or material sense. Energy exists as a separate dimension altogether. However, energy can be expressed in spatial/material contexts in terms of Planck's constant, according to the manner in which the shifting of phase relationships opens and closes gates that -- in accordance with the principles inherent in the underlying order-field -- link the material, spatial, and energy dimensions, as well as any other dimensions that might be affected by, or involved in, such a dimensional dialectic.

In fact, Planck's constant is an index of the presence of phase relationship activity between the energy dimension and various aspects of, for example, the spatial and material dimensions. The rate, location, orientation, and intensity of the flow (in the aforementioned sense of discrete continuity) of the bundles of energy that are described by Planck's constant will be a function of dimensional dialectics. Indeed, the quantum of action, in which Planck's constant has a prominent place, is an attempt to sum up, at least from the physical side of things, the structural character of a given instance of dimensional dialectics involving space. energy and materiality.

Generally speaking, there might be only trace amounts of energy (and not enough to create the self-energy problem) constantly available to a particle. This energy might trickle through the dimensional gates and permit certain kinds of minimally necessary shifts in ratio arrangements as well as transitions in phase relationship activity to take place that govern the internal activity of a given point-structure (for example, an electron or photon) in a 'resting' state ... that is a state in which there is little, or no, interaction with other 'point-structures'.

In this sense, a minimal energy state (the so-called ground state) is a sort of idling state that is capable of sending signals (through phase relationships) that the dimensional gates should be operating differently as circumstances change ... for example, when external forces impinge on such a package of constraints and degrees of freedom through the exchange of various kinds of boson vectors. When a particle engages a given boson, the material side of the structure breaks down (i.e., the phase relationships connecting a given structure with the material dimension are temporarily ruptured) leaving an energy component that will reassemble the residue (by reestablishing a new set of phase relationships with the material dimension) into a structural configuration or configurations that can, in a stable manner, express the new information that has been passed on by the boson through the mediation of phase relationships.

The foregoing perspective lays down a basis for dealing with the self-energy problem that has haunted the corridors of physics throughout the 20th and 21st centuries. By treating energy as a dimension that is separate from, but capable of closely interacting with, the spatial and material dimensions, one has provided a potential means of eliminating the anomalies that arise when one supposes that energy is inherent in the material dimension and must somehow be housed within the confines of a point-structure. Energy is 'housed' or stored in a separate dimension and only manifests itself at material and spatial loci as the circumstances of the dimensional dialectic require or permit.

The foregoing approach would keep intact such laws as: $E = mc^2$. All that is being altered is the interpretation of these sorts of laws.

Thus, on the basis of the perspective outlined above, the equivalency of mass and energy, which is given expression in Einstein's equation, means the dimensional dialectic, that is set in motion by the order-field, permits a spectrum of phase relationships that can translate the character of material dimensional structures into equivalent energy dimensional structures, and vice versa. In short, Einstein's equation is a way of showing the existence of a translational equivalency between certain aspects of the structural character of the separate dimensions of matter and energy. This translation is mediated by the exchange of phase information that gives expression to structural equivalencies in the respective dimensions under the appropriate circumstances and conditions.

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<u>Expanding the horizons of the concept of dimensionality</u>

Although the idea of a multiplicity of dimensions is fairly well established in mathematics and, to a lesser extent, perhaps, in certain aspects of science, there seems to have been little consideration given to just how qualitatively different dimensions interact with one another. One suspects the reason why mathematicians and scientists have focused on the idea of a multiplicity of spatial or spatial-like dimensions is due, either consciously or unconsciously, to a desire to avoid the problems that emerge when one is thinking about the dynamics or dialectics of qualitatively different dimensions.

Traditionally, the problems arising in relation to the interaction of qualitatively different dimensions are usually sidestepped by merely restricting attention to the geometry of 4-space, or the algebraic representation of 4-space. One, then, proceeds to treat time as if it were merely another kind of geometric space that is amenable to being described as part of a coordinate system consisting of the appropriate number of axes and whose ordered n-tuples are expressed in terms of the real number or complex number systems.

Furthermore, the tendency has been to suppose that the relationship between (or among) any two (or more) given dimensions will be somewhat similar to the relationship that exists among the more familiar three spatial dimensions that always have at least one dimensional boundary in common. However, when one begins to think about the interaction between, what very likely are, qualitatively different dimensions -- such as time and space -- one cannot necessarily reason by analogy from the relationships among the so-called three spatial dimensions.

One cannot continue to sweep problems beneath a coordinate or n-tuple carpet. One cannot continue to assume that because one has a means of representation, therefore, such a mode of representation accurately reflects the structural character of either the dimension of space or time that the mathematical framework is being used to describe.

For instance, just to mention one facet of such modes of representation that has been a source of constant aggravation, one should consider the manner in which the infinite character of the real number and complex number systems has introduced paradoxes and difficulties galore into all manner of calculations involving space and time. The result has been to create a lot of confusion and distortion concerning the character of the relationship between the system of representation and that which is being represented. In effect, the structural character of methodology is often presumed to give expression to the ontology of that to which such methodology is making identifying reference.

Of course, along the way, various individuals have attempted to resolve such difficulties. For example, Karl Weierstrass' ε/δ (epsilon/delta) technique provides a way around some of the difficulties involving infinities that arose in relation to the calculus. However, Weierstrass' ε/δ (epsilon/delta) technique does not solve the problems alluded to above, as much as it allows one to proceed, or get on with the job of making useable -- and within certain limits -- accurate calculations.

Furthermore, when one comes to an issue like the problem of continuity and what is meant by continuity, Weierstrass' technique is of no value because it cannot answer the questions that are at the heart of the continuity issue. Indeed, Weierstrass' approach is designed to avoid precisely the sorts of problems that are introduced by, among other things, the issue of continuity.

Another example of an attempt to get around certain problems involving infinities is re-normalization theory. By finding ways of getting the positive and negative infinities, which arise during the process of calculation, to cancel one another, thereby leaving a finite solution, one, sometimes, can come up with a satisfactory mathematical technique for dealing with the problem of infinities in certain aspects of particle physics.

Nevertheless, one should not be too quick to assume that what one has done mathematically has an ontological counterpart. Indeed, such mathematical techniques introduce elements of arbitrariness and an ad hoc aesthetic messiness into physics that has left a variety of scientists feeling extremely uncomfortable. For instance, the name of Paul Dirac, one of the leading architects of modern quantum theory, comes readily to mind as one of the many who have felt unhappy with re-normalization theory despite the fact that, at least on paper, it was able, some of the time, to eliminate embarrassing problems in physics.

In any event, aside from whatever problems are introduced into science by using coordinate systems, along with real or complex number systems to represent various dimensions that are not necessarily expressions of geometric properties, such methods also tend not to address what is meant ontologically when qualitatively different dimensions interact. In other words, to say a given point in a coordinate system can be represented as an ordered n-tuple of the intersection of n-axes really says nothing about the character of the dialectic or dynamic of the dimensions that are supposedly being given representational expression through the intersection of axes or the n-tuple of ordered points.

For example, the so-called marriage of space and time into space-time that was suggested by Minkowski is really a very static concept in which two ideas are juxtaposed without any real exploration into the possible ontological meaning of the marriage dynamics that have been proposed. The only dynamics or dialectic such a proposed marriage permits is that which is allowed by the assumptions, postulates, and so on of mathematics. However, such assumptions might have little, or nothing, to say about how one is to translate such quantitatively mathematical dialectics into qualitative aspects of ontological or dimensional dialectics.

As outlined in the early part of this essay, the ontology underlying quantum theory (so-called "orthodox ontology") makes a number of assumptions. In addition to the postulates of ontological identity (with respect to the fundamental particles of a given 'species') and intrinsic randomness, the orthodox ontology also assumes the fundamental quantum entities are mathematical point structures (i.e., having position but no size).

All of the foregoing assumptions are at odds with the sort of position that is being advanced in the perspective being given expression through the present chapter. However, only the first assumption, concerning the ontological identity of all fundamental particles of a given species, will be discussed in the following pages.

From the view of the perspective being presented in this chapter, quantum entities that are represented by the same wave function are not necessarily identical in all respects. More specifically, when a given wave function is supplied with the appropriate values for different variables, although such a wave function might be able to describe something of the spectrum of ratios of constraints and degrees of freedom giving expression to a particular quantum entity at a given point in time and under certain conditions of measurement, the wave function into which specific values have been substituted is but a sampling of the quantum entity's overall structural character – and this is, to a degree. alluded to by the use of different wave form families to mathematically represent or 'capture' different facets of a given particle's physical profile ... such as the spherical waveform family; the impulse waveform family; the temporal sine waveform family, and the spatial sine waveform.

Suppose one were to measure the values for electrons as they leave the electron gun. Let us further suppose that all these values are the same and, therefore, they can be represented by the same wave function. Despite these givens, there is no guarantee that, as the structural character of the various electrons unfolds over time, the spectrum of ratios of constraints and degrees of freedom of the different electrons will manifest identical shifts in ratio arrangements of emphasis/de-emphasis or on/off patterns of phase relationships.

Conceivably, one could have instances in which the general wave functions for, say, two electrons are identical, but there might be a variety of arrangements of ratios and phase relationship patterns that are capable of generating phenomena capable of being described by the same wave function. In other words although the values that are measured by the wave function might remain constant between the point of release and the target, the wave function does not necessarily exhaustively describe the structural character of the electron that goes from a given release point to a given target. The mathematical forms describe only what present modes of methodology are capable of engaging.

In short, the differences that are observed in relation to particles that, according to the values given by the wave function, are identical, might arise from the realm of dimensional dialectics. This dimensional dialectic is expressed through the shifts in arrangements of emphasis/de-emphasis or on/off patterns of phase relationships among the ratio components of the spectrum of constraints and degrees of freedom that constitutes the particle's structural character as manifested across time and circumstances.

Superstring theory has begun to investigate, at least mathematically, certain features of the role that dimensionality might play in the way the fundamental forces are related to one another. Of course, finding ways to experimentally verify the mathematics of various versions of superstring theory is quite another matter and seems, on the basis of current technology, very unlikely in the foreseeable future.

In any event, the premise on which almost all versions of superstring theory are operating treats dimensionality almost exclusively in terms of spatial terms. Indeed, the exploration and development of various approaches to compactification theory is an attempt to find a mathematical way of allowing the extra dimensions that are being proposed in many versions of superstring theory to fold up and remain hidden from the three-space coordinate system that seems to describe the spatial character of the 'normal' world so well.

Presumably, these extra dimensions are construed as being spatial in character and, therefore, inconsistent with the spatial structure of our everyday experience. Otherwise, one fails to see why compactification theorists seem to feel compelled to find a plausible means of eliminating the extra dimensions in spatial terms.

There seems to be a very strong tendency in modern thought (a tendency that is rooted historically in a variety of traditions in mathematics and science) to suppose that dimensionality necessarily involves some sort of surface, or plane or space. Consequently, almost unconsciously (although, perhaps, tacitly would be a better way of stating it), even if the real and complex number systems are used to give representational expression to the idea of a non-spatial dimension, the points of such number systems often are intuitively construed in a spatial sense even while it is simultaneously maintained that the 'space' being described is an abstract one.

One could conjecture, perhaps, that one of the reasons why investigators traditionally have been frustrated in their attempts to grasp the character and origins of time is precisely because it does not appear to be readily reducible, if at all, to some combination of surfaces, planes, spaces, geometric points, or number systems. Of course, surfaces, planes, spaces, points, and number systems are all used to represent the temporal dimension, and this has led to the spatialization of time. However, the spatialization of time has, in turn, led to a variety of distortions in our understanding of the character of time since we are inclined to confuse our methodologies -- mathematical or otherwise -- with the temporal aspects of ontology that the methodologies purport to describe, represent or model.

The real and complex number systems, of course, do not necessarily entail, in and of themselves, spatial dimensions. After all, both number systems permit a wide variety of operations, transformations, mappings and so on, that need not involve curvature or a metric, or the like. Nonetheless, questions arise, concerning the meaning or significance of the point sets of the real and complex number systems when applied to the idea of, say, non-spatial manifolds or dimensionality.

A common assumption seems to be that irrespective of the structural character of a given manifold or intersection of dimensions, the real and complex number systems are legitimate ways of representing or interpreting those manifolds or dimensional systems. Yet, we lack real insight into the structural character of the non-spatial dimensions alleged to lie hidden beneath, or outside of, the so-called 4-space world in which we live day-to-day.

Therefore, we have difficulty constructing a solid foundation on which to base a non-spatial interpretation of, or assign a non-spatial significance to, the real or complex n-tuples and the operations that are applied to these sorts of ontological manifolds or systems of dimensions. In addition, although mathematics might be able to offer tremendous precision and rigor when dealing with the issue of non-spatial dimensionality, nevertheless, one is not always clear about what it is that one is enjoying such rigor and precision.

The traditional mathematical manner of talking about or describing dimensionality proves quite elusive and unsatisfactory as far as enabling one to get a handle on what constitutes the nature of dimensionality in and of itself. To say that a dimension can be represented by a given axis in a coordinate system or that a dimension can be represented by one of the components of a given n-tuple in an algebraic system, does not really say what a dimension is ... not even if the dimension being represented is a 'spatial' one.

Such modes of description or representation permit one, to some extent, to map out the constraints and degrees of freedom of a dimension. Such modes of representation also permit one to characterize a dimension in different ways.

However, none of these modes of description or representation necessarily tells one what, say, space is. They tend, instead, to be ways of: engaging dimensionality, sampling it, operating on it, interacting with it, rendering it into operational terms, and/or reflecting on its various properties.

Nonetheless, when one needs to establish a definition or characterization that captures the essence of a given dimension, mathematics appears to be just as helpless as philosophy is in this regard. Somehow, the essence of dimensionality always seems to slip through our conceptual grasp.

In other words, dimensionality seems to have a sort of interstitial status. As such, the ontology of various kinds of dimensionality continues to fall into the holes surrounding and permeating the methodological and conceptual edifices that have been constructed by human beings down through the ages.

In view of the interstitial character of dimensionality, there would seem to be considerable 'space', if not need, for seeking new approaches to the problem of dimensionality. Ideally, these new approaches would prove to be of much greater heuristic value, across a more diverse set of topics, than is the case with prevailing perspectives concerning the issue of dimensionality that have been heavily influenced and shaped by the spatialization of dimensionality that is, and has been, quite pervasive in science, as well as mathematics.

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The hermeneutics of dimensionality and hidden variable theories

The hermeneutics of dimensionality might also play a central role in providing a way out of, or around, some of the problems discussed earlier in relation to issues such as: von Neumann's supposedly incontrovertible proof against hidden variable theories, Bohm's pilot wave idea, Bell's interconnectedness theorem, and Einstein's restrictions on the rate at which signals might be transmitted. More specifically, a promising avenue to pursue might involve gaining a proper understanding of the process of dimensional dialectics, especially in relation to the role of the temporal dimension with respect to such dialectics.

Einstein's special theory of relativity places a restriction on signaling with respect to physical transmissions across spatial distances. However, his theory says nothing about the possibility of transmitting signals or information by means of phase relationships.

The temporal dimension appears to have 'contact', of some sort, with space everywhere, but there is no evidence to indicate the temporal dimension is contained by, or in, space anywhere. In other words, there is no evidence requiring one to suppose that time either occupies space, or that time involves spatial distance.

The Minkowski marriage of space and time into space-time is a mathematical convenience that allows one to describe certain aspects of the way time and space dialectically interact. Yet, this convenience says absolutely nothing about the ontology of time.

Let us suppose, for the sake of argument, that Bohm's pilot wave were an expression of the order-field that has been discussed on several occasions earlier in this chapter. Let us further suppose that the pilot wave 'communicates' with, or signals to, various particles by means of the phase relationships that are generated through the dimensional dialectics set in motion by such an order-field. Finally, let us suppose there is no spatial distance involved in such signaling or communication. Given the foregoing suppositions, transmission of information concerning the state of different particles at different places in the universe could take place instantaneously without violating the restrictions that had been introduced in Einstein's special theory of relativity.

In other words, on a level of scale involving spatial relationships, the capacity of objects to influence one another without any apparent mediation -- and despite being separated by spatial distances -- might appear to be violating the locality assumption. Nevertheless, on another level of scale involving phase relationships, there might be instantaneous transmission of information concerning various kinds of influences since no spatial distances are involved in the transmission.

Therefore, the process of influence or interaction can be seen as a purely local phenomenon, but one that involves other non-physical or non-material dimensions. One still could advocate a locality position, but it would be quite different from the usual sense of locality that is restricted to a spatial and material context.

Whether or not a given signal or piece of information will be transmitted depends entirely on whether or not, for whatever reason, there are barriers that seal off a given phase relationship from, or makes it insensitive or resistant to, the presence of other phase relationships. Thus, transmission is a matter of the receptivity, sensitivity, or openness of one phase relationship, or a set of such relationships, to other phase relationships. When that receptivity or sensitivity is there, transmission is instantaneous.

The foregoing discussion seems to leave open the possibility of, in principle at least, a mode of time travel. For instance, by becoming sensitive to, or open to, the right aspect of phase relationships, one apparently could gain access to other time frames.

There are several reasons why the foregoing possibility is unlikely. First, and foremost, are the problems of: (a) determining the precise character of the phase relationships being given expression through a particular time-space-material-energy (to name just a few dimensional components) dialectic for a specified event, state, condition or process; (b) determining how one is to render oneself sensitive or open to such a set of phase relationships in order to gain access to a given event, etc..

Quite conceivably, there are intrinsic barriers capable of preventing one from realizing (b) even if one could establish (a). Furthermore, figuring out the proper character of (a) would seem to be fraught with methodological difficulties.

However, having said the foregoing, quite possibly, the reason why some people have photographic memories or eidetic imagery memories is because they are capable of tapping into certain aspects of phase relationships. On the other hand, these sorts of individuals cannot recreate the whole complex set of phase relationships that would permit the individual complete access to the original ontological dialectic. People with this kind of memory have access to only a portion of the original set of phase relationships -- namely, those that permit the individual to recreate, in a limited sense, scenes in which one participated.

There is another application of the foregoing approach to the dialectic of dimensions that also involves, albeit in a different way, issues of locality and action-at-a-distance. More specifically, consider the saltation process of the action potential in myelinated axon fibers. In the saltation process, the action potential leaps from node of Ranvier to node of Ranvier, apparently without being mediated by any intervening medium between one node and the next.

This saltation phenomenon might be an example of how dimensions dialectically interact to produce phenomena that cannot be explained in terms of, or reduced to, mediated interactions within the confines of the conventional notion of 3-space, construed as spatial dimensions. In other words, the phenomenon of saltation has characteristics that might be explicable in terms of an interaction involving, besides the action potential, one or more non-spatial and non-material dimensions linked to the spatial/material realm by means of various phase relationships. Once the interaction takes place, some of the phase relationships ensuing from that interaction might manifest themselves as a continuation of the action potential being transmitted from the previous node via the unseen dimensional dialectic.

Once again, Rucker's drawings, together with his explanation, in his book: *The Fourth Dimension*, are suggestive here. More specifically, he has indicated that when a being or object of a higher dimension intrudes into the world of a lower dimension, the higher dimension being or object will manifest characteristics that seem extraordinary by the standards of the lower dimensional world. For example, the higher dimensional being or object could seem to dip into the lower dimensional world and, then inexplicably (as far as the lower dimensional beings are concerned) disappear, only to show up at some other portion of the lower dimensional world.

Rucker's account, when translated into the context of the notion of a dimensional dialectic, seems quite compatible or consistent with many of the characteristics of the saltation mode of transmission of the action potential in myelinated axons. In fact, there are some very intriguing possibilities emerging out of this combination of ideas that might have a great deal of heuristic value.

For example, one possibility is that information concerning sensory and bodily processes could be transmitted to other non-spatial or non-material dimensions through phase relationships ... phase relationships that are not, in and of themselves, spatial or material. Similarly, the dimensional dialectic could provide a means of accounting, at least in general terms, for how non-spatial and nonmaterial influences might be transmitted to brain functioning.

Moreover, the possibility that the saltation process associated with the action potential involves a dialectic of dimensions -- not all of which are spatial or material in character -- also potentially provides another sort of explanation. For example, consider cases in which various kinds of intellectual functioning are impaired or disappear when certain kinds of damage are done to the brain through disease, lesions, or some other form of trauma.

Essentially, one might contend the trauma to the brain interrupts the latter's dialectic with other dimensions providing critical phase information for brain functioning. Such disruption could occur by either shutting down the saltation process or interfering with processes leading to, or subsequent to, the saltation process. In either case, the critical dimensional dialectic never occurs or its information is not transmitted or the nature of the transmission is distorted or garbled in some fashion.

Even if, at some future time, someone discovers that the saltation process is rooted entirely in a physical/material process that is not currently detectable, the general principle being suggested in the foregoing should not be ruled out automatically. All that such a discovery would have shown is that the saltation process might not be the agency through which inter-dimensional communications are transmitted.

Given the present state of our understanding, however, the saltation process is very useful as an illustration of how such nonmaterial/non-spatial transmission might occur. Furthermore, it might even turn out to be an actual exemplar of the principle that is being illustrated.

Nothing that is being proposed in this essay violates any of the laws of physics. What the proposals do is induce one to re-think a variety of basic concepts that might be distorting the character of our current approach to, and understanding of, the way things work in the universe.

What is being suggested in this essay is capable of offering solutions to a variety of problems that have plagued physics for many years. Moreover, what is being proposed here leaves completely intact various methods of calculating mathematical solutions.

The only things that have to change are: (1) one's understanding of the significance of the aforementioned sorts of calculation, as well as: (2) the meaning of certain concepts central to the methodological theory that stands behind such calculations. Without these kinds of changes, one has difficulty understanding how quantum physicists intend to resolve a variety of diseases that have infested the theoretical roots of the modern quantum perspective.

These diseases include: (a) the arbitrary and unfalsifiable character of the randomness postulate; (b) the problem of self-energy; (c) the difficulties surrounding the treatment of fundamental particles as being like mathematical points; (d) the rather ad hoc character of the manner in which re-normalization theory attempts to rid theory of infinities; (e) the tendency to project (implicitly if not, at times, quite explicitly) the structural character of quantum methodology (especially in relation to its mathematical techniques and processes) onto ontology, confusing the former for the latter (e.g., Heisenberg's uncertainty principle); (f) the tendency to interpret dimensionality in an almost exclusively spatial manner; and (g) the rather implausible (and Herbert himself admits as much in his book) ideas that have worked their way into the interpretation of quantum theory.

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Footnotes

1.) One further possibility connected with the idea of the Necker cube analog concerns a property of particle spin that has been something of a puzzle for quantum theorists since the introduction of the spin feature into the quantum model. Although all of the basic characteristics of spin can be quantitatively described, an explanation for what actually is occurring in relation to the phenomenon of spin has eluded theorists.

The problem is this. Experimental evidence indicates that a particle must go through what amounts to two "revolutions" before it is able to return to its starting point.

Consequently, the following question arises: What sort of process could account for such an effect? One would expect that just one 'revolution' should be sufficient to return any "normal" or conventional (i.e., conforming to everyday sorts of experiences) particle to its starting point.

In line with the perspective of the current chapter, the above problem might be resolved in the following fashion. Suppose one were to propose that particles were not like mathematical points. In other words, let us suppose that all so-called elementary particles had an internal structure that was somewhat analogous to a more complex n-dimensional version of a Necker cube. Thus, instead of being limited to the several degrees of freedom of a Necker cube, particles are to be characterized as n-dimensional ... with f-degrees of freedom and c-degrees of constraint with respect to its internal structure.

Furthermore, suppose that in order for such a particle to make a complete circuit of its internal states, the particle must 'turn-on' or run through a certain number or subset of the aforementioned ratio set of f-degrees of freedom and c-degrees of constraint. If one were to assume that the process of running through this subset of the particle's internal structure of f-degrees of freedom is continuous (although discretely so in the manner of a relay race), then a particle's internal dynamics serves as an analog for the manner in which, say, a sphere revolves. However, rather than requiring only 360 degrees to make a complete circuit, as is the case with a normal sphere, particles actually run through a sufficient number of degrees of freedom to generate an analog process for 720 degrees of rotation in a normal sphere before the particle returns to its starting point state.

2.) Sheldon Glashow in his book *Interactions* (see pages 53 - 54) describes a variation on the two-slit experiment that he contends is capable of demonstrating "both the wavelike and particle-like nature of the electron at the same time". According to Glashow, each complementary facet of the electron can be exhibited within the experiment just by moving the detector to different points in the experimental set-up.

As the current discussion in the present chapter is attempting to suggest, there is another way of interpreting the foregoing experiment. More specifically, one is being asked to think of the electron as the expression of an internal dialectic of dimensions.

This dialectic establishes a spectrum of ratios of constraints and degrees of freedom through which the "electron" manifests, in Necker-like analog fashion, its structural character. From the foregoing perspective, the differential results produced by moving the detector around in the experimental set-up can be interpreted to represent alternative modes of methodologically engaging or sampling the spectrum of ratios of constraints and degrees of freedom that are generated by the underlying dialectic of dimensions.

More specifically, the internal dynamics or dialectic of dimensions has an oscillatory character (albeit it is of a discretely continuous nature). These oscillations of the internal dynamics are analogs for wave phenomena in the sense that the Necker-like oscillations preserve the structural properties of waveforms but do so through a non-waveform medium. When these analogs for wave phenomena are methodologically engaged in certain ways by placing the detector at specific locations in the experimental set-up, there will be interference effects that are produced.

These effects are generated through a process that is not a function of waves. The interference effects are, instead, a function of the way the discretely continuous oscillatory character of the internal dynamics of the electrons is thrown out of its normal arrangement of phase relationships. In effect, the double-slit set-up pushes the spectrum of ratios of constraints and degrees of freedom of the various electrons into a chaotic transition state on the detector side of the slits.

This condition of chaos can reflect either the internal dynamics of an individual electron or the dynamics of a number of interacting electrons or both together. In any of these cases, the transition state marks the manner in which phase relationships generate a cascade of bifurcations as the internal dynamics of the particle(s) 'seek' to reestablish the set of phase relationships that characterized its (their) pre-slit state of in-phase stability.

However, the interference-like pattern also is due to the change in the angle through which the detector engages the incoming, altered (i.e., post-slit) spectrum of ratios of constraints and degrees of freedom of the various electrons as a result of the manner in which the detector is moved. The change in the detector's position in the experimental set-up brings about a mode of sampling that engages a different facet of the altered spectrum of ratios than will be the case when the detector is placed at other positions within the experimental set-up. In a sense, the detector only can 'see' or detect the cascade of bifurcations that produces the interference-like pattern from certain angles. From other angles, the cascade of bifurcations that marks the chaotic state of transition is not 'visible' to the detector screen and, as a result, one observes just a particle-like effect.

Thus, certain changes in the detector's angle of engagement cause the detector to emphasize, in the samples taken, patterns of on/off or emphasis/de-emphasis states that exhibit interference-analog effects. Other changes in the detector's angle of engagement cause the detector to emphasize or feature, in the samples taken, patterns of on/off or emphasis/de-emphasis states that exhibit particle-like effects.

One must keep in mind that chaotic states are not random states. The cascade of bifurcations of phase relationships that occur during the interference-like process take place within a set of determinate parameters. Consequently, how such a state is sampled or methodologically engaged might affect the structural character of the observed results ... producing interference-like patterns when taken from one direction, while generating particle-like patterns when taken from another direction.

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Chapter 6: Chronobiology

Jeremy Campbell indicates (in *Winston Churchill's Afternoon Nap*) that Einstein had removed time and space from their traditional metaphysical pedestal of unchanging absoluteness. In other words, the effect of relativity theory was to physicalize space and time. As a result, time and space became fluctuating components of the physical universe capable of entering into dynamic interactions with other facets of that universe.

Just as time was physicalized through the efforts of Einstein, Campbell contends time has been "biologized and psychologized" through the work of a variety of recent experiments and explorations. According to Campbell, just as Einstein seemed to show that time interacted with the motion of a given system, biologists have been introducing experimental data indicating biological clocks are affected by the conditions of life that surround such clocks.

When Einstein physicalized space and, especially, time, he was culminating, as well as transforming, a process popularized by Galileo (though this process did not begin with the latter). Galileo treated time as a continuous and uniform entity that could be represented by a straight line. Thus, time was construed in a spatialized manner within a mathematical framework.

As such, time came to be treated as if it were a fourth spatial direction that is continuous in the same way that space is supposed to be continuous. In other words, both space and time were alleged to consist of an infinite number of points, all of which can be mapped on to the real number line.

Consequently, the modern conception of time has deviated rather substantially from the idea of time that had prevailed for nearly 2000 years. In the traditional view, time was considered to be some sort of absolute master clock that was independent from all of physical/material reality. Today, time has become just another component of the physical world that is capable of fluctuating under a variety of conditions.

However, all of these changes in the way in which time is, and has been, conceived might be more a reflection of the way time is methodologically engaged than they are a reflection of the structural character, or actual ontology, of time. In other words, what really might have changed in the last 2000 years is the way in which time is methodologically engaged.

These transitions in methodology have led to comparable transformations in the way that time is conceptualized. None of these changes, however, necessarily has anything to do with giving insight into the ontology of time.

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Organisms are not only oriented in space, they are also oriented in time. Chronobiology is the science that studies the role that temporality has in biological functioning. A great deal of relatively recent experimental findings suggests there are innate mechanisms in a large number of species of organisms that give expression to a variety of temporal rhythms. These rhythms regulate different facets of biological and behavioral processes in various species.

For example, consider animals living in burrows. Such animals have an internal, biological clock that is entrained by the temporal rhythm of alternating patterns of night and day.

Each day, the internal, biological clocks of these animals are reset to reflect the changing relationship of the ratio of daylight hours relative to nighttime hours. When they wake up in the morning, their internal clocks, not the light of day, has awakened them.?

Franz Halberg introduced the term circadian rhythm to describe those instances of temporal entrainment, such as in the case of the burrow animals mentioned above, that are based on a period lasting roughly one day. Alternating cycles of day and night act as a zeitgeber or 'time giver'. Organisms use this as a temporal frame of reference to set its circadian biological clock.

When an organism is disentrained -- that is, when an organism is unable to make contact with the temporal frame of reference provided by the relevant zeitgeber (in this case, the alternating cycle of day and night), such a disentrained organism will operate on the basis of the intrinsic properties of its internal biological clock. This clock, left on its own without any external standard by which to set itself, will run either somewhat longer than a 24-hour period, or somewhat shorter than a 24-hour period.

Organisms entrained by various kinds of temporal rhythms, of which circadian rhythms are but one example, do more than just reset their internal clocks to synchronize with various rhythms of the external world. Entrainment means virtually every biological process that goes on in a given organism will have a determinate phase relationship with events occurring both in other parts of the body, as well as in various aspects of the external world.

The phenomenon of diapause is an example of how the behavior of an organism can be governed by the phase relationships that the biological clock of that organism establishes with respect to certain features of the external world. Diapause refers to the period of inactivity or quiescence exhibited by many insects during relatively regularly occurring periods of detrimental weather conditions, such as drought or winter weather.

However, the preliminary stages of diapause occur much in advance of the forthcoming, adverse weather conditions. Insect activities such as the storing of food or the building of shelters are steps that are preparatory in nature and that take place independently of any specific stimuli of drought or cold or snow.

The preparatory activity is an expression of the phase relationships that exist among: (a) certain biological clocks of the insect; (b) various motor systems in the insect, and (c) the changing ratio of sunlight to nighttime. As the character of these phase relationships changes, behavioral patterns emerge that are preparatory to the later set of phase relationships that constitute diapause proper - that is, the actual period of quiescence.

Therefore, biological clocks are part of a system that enables an organism to grasp (although not necessarily on a conscious level or in a self-reflexive manner) the character of a changing set of phase relationships in the dialectic between organism and environment. In a sense, there is a process in which certain rules of temporality are internalized. These rules have the effect of placing constraints on the freedom of an organism to act.

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From the perspective of the present essay, the internalization of rules of temporality is not really an accurate way of describing the situation. More specifically, the organism consists of a spectrum of ratios of constraints and degrees of freedom. This spectrum establishes a set of parameters within which, and through which, the organism is capable of responding or manifesting itself under appropriate circumstances of dialectical interaction with the environment.

Although phase information might be exchanged, and although the effect of this exchange of phase information might bring about a transition in the aspect of the organism's spectrum of ratios that is being manifested, no rules, temporal or otherwise, are internalized by the organism. A principle is activated, instead, through the dialectical activity.

The term "principle" refers to certain kinds of ratios of constraints and degrees of freedom. Such ratios might be manifested in the form of hermeneutical point-structures, neighborhoods, or latticeworks.

What makes a given ratio of constraints and degrees of freedom, or set of such ratios, a principle has to do with the structural character of the phase relationships that exist in the ratio(s). A principle consists of a set of phase relationships that form an attractor basin.

The attractor basin might be either linear or chaotic, depending on the nature of the principle. However, usually speaking, principles involve chaotic attractors, not linear attractors.

Rules, when they do arise, tend to be associated with linear attractors. Such attractors are fairly, narrowly defined and do not permit much, if any, deviation from the scope of the parameters that describe a rule.

Principles, on the other hand, provide a basis for a far more sweeping range of possibilities. All such possibilities are self-similar, rather than self-same.

Consequently, principles are capable of being receptive to, as well as of responding to, nuances and variations that fall beyond the largely linear horizons of a rule. Nonetheless, despite such variability, all these self-similar possibilities fall within the structural parameters of the chaotic attractor to which they give expression.

The principle(s) inherent in a given biological clock form an attractor basin that is sensitive to, and shaped by, certain kinds of phase information being relayed to the basin(s) as a result of the organism's engagement of, and engagement by, different aspects of the environment. In other words, the presence of certain kinds of phase relationships induces shifts or transitions in the way the attractor basin/principle gives expression to itself. As a result, the principle, in this case a biological clock, is activated.

Subsequent behavior that is generated in, or that is colored by, such an attractor basin, will conform to the parameters of constraints and degrees of freedom that have been established by means of the activated principle/attractor basin. Moreover, since the activated attractor basin/principle is sensitive to, and shaped by, the changing character of the phase relationships in the dialectic between organism and the environment, those behavioral patterns that are influenced by such an attractor will reflect the shifts in phase relationship information.

In short, certain aspects of the organism's behavior become entrained by transitions in phase relationship. Thus, although no rules have been internalized, principles have been set in motion and behavior has been affected as a result of the dialectical engagement between organism and environment.

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In the early 1970s, a certain amount of excitement was generated when a number of biologists believed they had discovered a master biological clock. Such a clock is supposed to be autonomous and independent of all external, temporal cues. In addition, a master biological clock is theorized to be responsible for generating all the different rhythms of the body.

The would-be master clock discovered in the 1970s is located in the frontal portion of the hypothalamus. It consists of several clusters of cell groups that have become linked during the course of development. The technical term for these coupled cell clusters is suprachiasmatic nucleus -- or, SCN, for short.

Two properties, in particular, of the SCN seemed to enhance its attractiveness as a candidate for the master clock. First of all, the coupled nuclei of the SCN display a great deal of oscillatory activity. Oscillatory behavior is something one would expect to observe in any candidate for a master clock since the clock is responsible for regulating a wide variety of rhythmic patterns.

Secondly, the suprachiasmatic nuclei are connected, via a nerve tract, to the retina in each eye. One obvious implication of this link is that the SCN would be able to receive important data concerning temporal rhythms in the external world. Especially important in this regard would be those rhythms involving the changing pattern of the ratio of daylight to nighttime as one progressed through the year.

Subsequent experiments, in which the SCN were removed, indicated the master clock had not been found. These experiments showed that although the temporal identity of an organism is significantly altered when the SCN are removed, nevertheless, temporal identity was not destroyed. In other words, while the SCN seemed to play a fundamental role in synchronizing various biological rhythms, they were not responsible for generating these other rhythms. Consequently, there must be other biological sources that are underwriting temporal identity.

Although the suprachiasmatic nuclei do not constitute ' the' master biological clock, they are believed to be the locus within which one of two master clocks can be found. Together, these two clocks are considered, by many chronobiologists to be responsible for regulating the vast majority, if not all, of the biological rhythms in the human body. These rhythms range from: the secretion of growth hormone, to cycles of activity and inactivity, to establishing the point in the sleep cycle when vivid dreams are most likely to occur, to the rise and fall of core body temperature, and so on.

The location of the second master clock has not yet been established. However, this second clock is thought to be the more stable, as well as the more powerful, of the two clocks.

Nevertheless, this second, more stable and powerful, master clock is believed not to have any direct contact with the changing patterns of light to darkness ratios. Therefore, this second clock might be entrained by the so-called master clock thought to be located in the suprachiasmatic nuclei, since this latter "master" clock is in contact, via nerve tracts extending to the retina, with external data concerning the changing ratio of light to darkness.

There are some chronobiologists who do not accept the 'two master-clock hypothesis'. They believe there might be a number of other "master" clocks in addition to the two already mentioned.

For example, there is considerable evidence pointing toward the adrenal gland as the locus for, yet, another clock of sorts. More specifically, one of the hormones secreted from the outer cortex of the adrenal glands is cortisol.

Cortisol plays a fundamental role in the way the body responds to stressful situations. Fluctuations in the level of cortisol secretion appear to follow cyclical rhythms during the course of the day.

The adrenal-clock, however, is not necessarily a master clock. Quite frequently, a given biological system will have an intrinsic periodicity that characterizes its biological activity. This innate periodicity is not, in and of itself, a master clock. Such inherently periodic systems are known as a tau.

The structural character of a tau gives expression to certain aspects of an underlying genetic blueprint. Although a tau's general structural character is species specific, the individual members of a species will display a tau that is similar to, but not precisely the same as, the average value for the species with respect to that tau.

Human beings, along with a variety of other species, are capable of being entrained, simultaneously, to a variety of different biological clocks. On the other hand, human beings are also capable of having some of their biological rhythms synchronized with others with whom they live in close contact over a period of time.

Some hormones play a role in communicating, to various systems in the body, information concerning the temporal phase of external rhythms. These hormones are referred to as temporally active hormones.

These sorts of hormones are believed to keep different circadian systems in touch with the fluctuations occurring in various rhythmic patterns in the external world that are relevant to the body's circadian rhythms. In human beings, there are a variety of temporally active hormones providing humans with a number of different sources of temporal information.

As a result, such hormones help establish a spectrum of ratios of constraints and degrees of freedom with respect to the way a human being can engage the environment in a temporal dialectic. Furthermore, although the general number and structure of biological clocks is pretty much the same from one human being to the next, there can be a great deal of variance in how these different clocks are linked together in different individuals. In other words, different individuals will exhibit different patterns of synchronization with respect to how the clocks will be linked to one another.

Sometimes these differences are a result of genetic inheritances. Sometimes the differences in patterns of synchronization are due to the kind of life the individual leads. Finally, sometimes a combination of the two foregoing factors will lead to differences in patterns of synchronization from individual to individual.

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Modern high-speed computers have taken on a function, with respect to biological rhythms, somewhat similar to the role that a prism played with respect to light waves. Just as a prism is able to show visible light is an aggregate of a number of different wavelengths of light, so too, modern computers have been able to show there is a spectrum of biological rhythms underlying an organism's activity.

Through the application of computer and inferential statistical techniques, approximately seven to eight basic types of rhythms have been discovered so far. They are: ultradian (less than 20 hours); circadian (between 20-28 hours); circasemiseptan (31/2 days); circaseptan (7 days, plus or minus 3); circadiseptan (14 days, plus or minus 3); circavigintan (21 days, plus or minus 3); and, circannual (1 year, plus or minus 2 months). The term infradian is used to refer to cycles lasting longer than 24 hours.

Circaseptan rhythms (which have a period of approximately 7 days) are showing up in a variety of biological processes. Generally speaking, these rhythms are of low amplitude and, therefore, are hard to detect amidst the higher amplitude, more prevalent circadian rhythms. However, although, on an individual basis, the circaseptan rhythms are weaker than the circadian rhythms, over the course of a week, the aggregate collection of circaseptan rhythms has a large amplitude.

While circaseptan and circasemiseptan rhythms do not appear to reflect any external temporal rhythm, these rhythms are not arbitrary. They have a harmonic relationship with such external rhythms as the cycle of day and night, as well as the lunar cycle.

Thus, the rhythms associated with various biological functions (such as growth, maturation, cell maintenance, reproduction, immune responses, and so on) will be a complex harmonic function of the way entrainment properties of external rhythms dialectically interact with the vectoring properties of innate biological currents such as the circaseptan and circasemiseptan rhythms. However, nobody in the field of chronobiology knows, yet, what the structural character of this dialectic is or what the harmonic laws are that govern that dialectic.

One can differentiate between music and noise by noting how the former consists of a set of sound waves that have an ordered, structured relationship with one another. In the case of noise, the aspect of orderly relationship is missing.

In music, a given complex sound is a function of a set of simple waves that are whole-number multiples of some fundamental, lowest frequency, wave component inherent in the given complex sound. This lowest frequency wave component is known as the first harmonic. Depending on the sort of whole-number multiple a given wave component has relative to the frequency of the first harmonic, the other wave components of a complex musical sound will be referred to as harmonics of the second, third, fourth, etc. order.

Some of the more complex temporal rhythms (e.g., circannual or circavigintan , etc.) might be whole-number multiples of some of the simpler rhythms such as the ultradian or the circadian. Thus, the more complex biological rhythms could be seen to be higher order harmonics of the basic temporal units.

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Just as light plays a fundamental role in Einstein's special theory of relativity, light also plays a fundamental role in chronobiology. Light is the standard to which the body refers in order to re-gauge its biological rhythms so they can be synchronized with, among other things, the primary circadian rhythms generated by the alternating cycle of night and day.

Although most of the light impinging on the individual's eye is transduced into visual signals, a certain amount of the light serves as a source of temporal information concerning the external rhythm of the cycle of day and night. This information is passed on to the suprachiasmatic nuclei in the hypothalamus. These nuclei are linked with a variety of other biological clocks and taus. The end result of this dialectic is to permit the organism to get into an appropriate phase relationship with external rhythms.

The pineal gland is known as a neuroendocrine transducer. This means it is capable of converting or translating the action potentials of the nervous system into the secretion of various kinds of hormones. One of the hormones transduced by the pineal gland in this fashion is melatonin.

The suprachiasmatic nuclei are connected to the pineal gland by means of a nerve tract. By sending certain messages along this nerve tract to the pineal gland, the SCN is able to control the quantities, and, therefore, activity, of a particular enzyme in the pineal gland. The enzyme regulated by the SCN plays a role in synthesizing melatonin from a precursor neurotransmitter, serotonin.

Although the precise role of melatonin is not presently known, it is deeply implicated in the body's circadian system that is hooked into external rhythms of night and day. The levels of melatonin secretion are highest between the hours of 11 at night and 7 in the morning. Alternatively, the levels of melatonin secretion are lowest during the hours of waking activity.

Apparently, light serves as a signal for the suppression of melatonin secretion, whereas nighttime acts as a stimulus leading to the synthesis of melatonin. The rhythmic rise and fall of melatonin levels is a waveform that is propagated throughout the body.

This cyclical waveform plays a role in the synchronization and harmonious interaction of a variety of biological rhythms. Furthermore, while the amplitude, frequency and phase of this wave can be affected by altering the timing and/or intensity of the organism's engagement with light stimuli, each species has its own characteristic way of responding to such alterations in the character of light stimuli.

Almost all vertebrates come equipped with a pineal gland. Although the function and the size of the pineal gland varies from species to species, generally speaking, the more critical the role(s) that is(are) played by temporal rhythms in a given vertebrate species, the larger will be the size of that species pineal gland. In addition, in many of, if not most of these vertebrate species, fluctuations in the level of melatonin synthesis and suppression in the pineal gland are linked to the way the organism establishes phase relationships with external cyclical patterns such as day and night, as well as summer and winter.

In the latter case, the nervous system might have some sort of mechanism for both: (a) keeping running totals of the ratio of melatonin synthesis to melatonin suppression and, then, (b) coupling (a) with a process that compares the latter ratio against some innate or learned (such as through critical periods) standard. This mechanism allows the organism to make fairly complex preparations for forthcoming seasonal changes.

The suprachiasmatic nuclei are also linked with the lateral geniculate nucleus. The primary neurotransmitter propagated along the nerve tract connecting the SCN and the LGN is known as neuropeptide Y.

In experiments in which neuropeptide Y has been introduced directly into the SCN, this neurotransmitter appears to have the effect of resetting the circadian clock of the suprachiasmatic nuclei in the same manner as if the organism had encountered the darkness of night. One of the implications of this kind of experiment is as follows. Just as there are biochemical components that act as carriers of the temporal information of light, there also might be systems responsible for the generation and regulation of carriers of the temporal information of darkness.

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All species exhibit a mixture of constraints and degrees of freedom in relation to the temporal dimension. In other words, for every species there are some aspects of functioning in which temporal relationships are central or critical, whereas there will be other aspects of functioning in which temporal relationships play only a very minor, if not non-existent, role.

The ratio between these two possibilities (i.e., instances in which temporality is important and instances when temporality is relatively unimportant) establishes a given species' temporal identity. Temporal identity sets the tone, orientation and so on with which a given organism will interact with different patterns of external rhythms under various circumstances.

The phenomenon of critical periods is one of the modes through which the temporal identity of a given species or individual is given expression More specifically, for a large number of species, there seem to be temporal phase windows, of varying lengths of time, within which the learning of various kinds of behavior or the development of certain kinds of capabilities must take place. Vision in kittens, social behavior in monkeys, the singing of songs in different species of birds, identification of the mothering-one in geese, and language in human beings, are all examples of learned behaviors that appear to be shaped by the structural character of the temporal windows that seem to form integral aspects of the temporal identity of the respective species.

Other kinds of learning also exhibit a rootedness in the ratio of temporal constraints and temporal degrees of freedom. Honeybees, for example, are able to learn certain information concerning the scent, color, location, and distance of a source of nectar. However, each segment of information can be learned only at certain phase states during the bee’s interaction with the nectar source.

More specifically, the honeybee only can learn the color of a flower in the two second period just prior to landing on the flower. Secondly, the honeybee only can learn the scent of a flower when it has actually landed on the plant. Thirdly, the honeybee is able to learn the location of the nectar source only as it leaves the flower on which it has landed. Finally, the honeybee can learn the location of the hive entrance only when it leaves the hive as it goes in search of food sources.

In all of these cases, the temporal phase linking the honeybee to the learning cycle assumes a fundamental importance. If anything disrupts the temporal window within which, and through which, certain kinds of data must be stored in the honeybee's memory, then, learning of the requisite sort will not take place.

The fact that in some species there are critical temporal windows or critical phase relationships that must exist in order for certain kinds of learning to occur raises the question of whether there are similar sorts of temporal windows of learning in human beings. This is an issue of some importance.

For example, the network of phase relationships that arises as a result of the dialectic between a given individual's temporal identity and the way in which a given curriculum program allows a topic to unfold over time might play a fundamental role in determining the way in which the individual engages, and is engaged by, the subject matter. The structural character of such an engagement process might affect, in turn, both the quality and quantity of learning that occurs in relation to a given subject matter.

Some curriculum programs might enhance an individual's likelihood of learning because such a program is conducive to the individual's mode of temporal identity. As a result, a resonance process arises that permits heuristic transitions in some of the ratios of constraints and degrees of freedom governing an individual's understanding.

On the other hand, other curriculum programs might diminish an individual's likelihood of learning since such a program is not compatible with the structural character of the individual's temporal identity. In other words, the dialectic between individual and curriculum does not permit a resonance process to be established that is conducive to heuristic transitions in the ratios of constraints and degrees of freedom governing that individual's understanding.

Sometimes a curriculum program might need to expand the character and quantity of constraints surrounding the unfolding of a given subject matter in relation to an individual of a given temporal identity. At other times, one might need to decrease the character and quantity of such constraints for a given individual.

Similarly, sometimes one might need to expand the character and quantity of the degrees of freedom surrounding the unfolding of a given subject in relation to an individual of a certain temporal identity. At other times, such degrees of freedom might need to be decreased.

Phase relationships might play an important role in, yet, another aspect of the manner in which temporal identity is linked to the process of learning. This further possibility concerns some of the techniques associated with super-learning or suggestopedia.

One of the reasons why baroque music of a particular time signature has proven to be so integral an aspect of super-learning programs seems to be because the temporal identity of human beings as a species finds such a tempo to be compatible with enhanced learning opportunities. Alternatively, perhaps one of the reasons why some people have experienced only limited success with the super-learning program is because different individuals might require music with slightly different time signatures that might, or might not, be harmonically related to the baroque music time signature.

Moreover, the visualization techniques, together with the practice of positive self-regard and relaxation exercises, used in conjunction with the super-learning program, might all help to focus, and/or heuristically orient, the network of phase relationships through which one engages, and is engaged by, learning material. The combined effect of all these processes might help to create chreods or canalized pathways that make learning easier and more efficient.

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In experiments involving human beings, in which all time cues were removed from the experimental situation and people were allowed to set their own routine with respect to sleeping, eating, working, and so on, scientists found a number of themes that, on average, seemed to be characteristic of human sleep. Apparently, sleep patterns are shaped by several distinct components.

One of the components shaping the sleep cycle is innate. The other component shaping the sleep cycle is a function of the way an individual interacts with on-going environmental contingencies involving work, recreation, social relationships, and so on.

Part of the innate component of sleep has to do with how long, in general, any given period of sleep lasts. This component is strongly influenced by a biological clock intrinsic to the genetic blueprints that lay down the spectrum of ratios of constraints and degrees of freedom that shape biological patterns.

Moreover, the onset of sleep is also affected by an innate biological clock since, on average, people tend to seek out sleep a short time after the core temperature of the body has reached its lowest level. As indicated previously, the cyclical character of deep body temperature is regulated by a biological clock.

The structural character of the sleep cycle has four or five fundamental stages that run in sequence throughout a 'normal' period of sleep. These stages are differentiated from one another by, among other things, the frequency signature of the brain waves that occur during a given stage of sleep, as well as, at least in some stages of sleep, the level of synthesis activity of certain neurotransmitters (namely, acetylcholine, norepinephrine and serotonin).

At various, relatively regular, intervals (approximately every 90 minutes) during the running of the sleep sequence, the REM phenomenon occurs. REM sleep is characterized by a paralysis of the muscles of the body, a heightened level of activity of the nervous system, and vivid dreaming. Usually, REM sleep occurs after, or in conjunction with, stage 2 sleep, once the sleep sequence has completed the following sequence of stages: 1,2,3,4,3,2.

With the exception of stage 1, this pattern is repeated a number of times throughout the period of sleep. Finally, the amount of time that any given individual spends in REM sleep tends to be both characteristic of the individual, as well as relatively stable over the course of the individual's life.

Allan Hobson and Robert McCarley have studied the aminergic and cholinergic components of the biological clocks that help regulate and shape not only the waking-sleep cycle, but the sleep-dream cycle as well. The aminergic component, which is located in a specialized group of cells in the brainstem, gives expression to the so-called amine force. This 'force' is responsible for the synthesis and release of the neurotransmitters, serotonin and norepinephrine.

There is second group of specialized cells in the pons that gives expression to the cholinergic force. This 'force' controls the synthesis and release of acetylcholine.

According to Hobson and McCarley, the aminergic system plays a fundamental role in bringing about and sustaining the waking portion of the wake-sleep cycle. All throughout the waking state, serotonin and norepineprhine are synthesized and released in a regular, clock-like fashion. The effect of these manifestations of the aminergic force is, among other things, to inhibit the activity of the giant pons cells that are the locus of synthesis of acetylcholine.

During the sleep segment of the wake-sleep cycle, the activity of the aminergic system is suppressed. This results in the disinhibition of the cholinergic system. Once disinhibited, this system proceeds to synthesize and release acetylcholine.

The combined effect of the gradual suppression of the activity of the aminergic system, together with the disinhibition of the cholinergic system, permits a variety of systems of the nervous system to become activated. One of the systems activated in this manner begins synthesizing a neurotransmitter that is conveyed to the voluntary muscle system.

When this neurotransmitter arrives at the site of the voluntary muscle motor plates, it takes on the function of a blocking agent with respect to motor nerve impulses, thereby, preventing movement of arms, legs and so on. In addition, Hobson and McCarley believe the combined effect of the suppression of the aminergic system, along with the disinhibition of the cholinergic system, leads to the increased level of activity of the nervous system out of which REM sleep arises. REM sleep activity is specifically stimulated by the presence of acetylcholine.

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In broad, general terms, one can categorize brain circuitry in two ways. On the one hand, there are circuits that are dominated by fast-acting but short-lived neurotransmitters such as acetylcholine (which excites cellular activity in the nervous system) and GABA (gamma amine butyric acid) (which inhibits cellular activity in the nervous system). These neurotransmitters are generally found in motor and sensory circuits where speed of response is important.

On the other hand, there are brain circuits that are dominated by relatively slow-acting but long-lived neurotransmitters like serotonin and norepinephrine. These neurotransmitters are generally associated with activities of learning and attention.

Although the roles of acetylcholine and GABA have been mapped out fairly precisely in relation to sensory and motor activity, such is not the case with respect to the roles of serotonin and norepinephrine in relation to learning and attention activities. In other words, although serotonin and norepinephrine might be implicated in conscious, intelligent activities, just how they bring about such activities, or how they sustain them, or how they underwrite a system that permits differential attention is not known.

Surely, any attempt to reduce the extremely diverse and complicated possibilities surrounding learning/intentional activity to being a function of biogenic amine neurotransmitters, will encounter theoretical difficulties. For example, even if there were 25 or 30 of these sort of neurotransmitters (i.e., enough for a complex alphabet of sorts), one still would be faced with the following problem: biogenic amine neurotransmitters, such as serotonin and norepinephrine, do not control their own levels or rates of synthesis. Nor do they control where in the nervous system they will be sent or when they will be released for propagation. Thus, even if one were to suppose that learning and attention are somehow reducible to being a function of various combinations of biogenic amine neurotransmitters, one needs to uncover the structural character of the system that is responsible for organizing, shaping, regulating and directing the components of the biogenic amine code to form the complex, diverse structural properties characteristic of both learning and intentional activity.

In a sense, the problem facing the biogenic amine neurotransmitter theory of learning and attention is, at best, like that of a person who is trying to decode an alien language. When a language is radically dissimilar from any with which one is familiar, one might not be able to apply the normal mathematical rules of decryption.

If the problems facing the biogenic amine neurotransmitter theory of learning and attention are comparable to those facing the decryption of an alien language, then, all that the biological cryptologist has to go on is, at most, a few letters of the alien alphabet (i.e., the known neurotransmitters). Knowledge of these letters, however, is not accompanied by any understanding of how the letters are organized to give expression to the sort of syntactical or semantic processes that are capable of giving expression to learning and attention.

There are further problems that arise if the biogenic amine neurotransmitter system of learning and attention does not operate like a language. If this is the case, then, biogenic amines such as serotonin and norepinephrine are not analogs for letters or words and have some entirely different functional role that they fulfill. What this role might be, no one presently knows.

However, irrespective of what their role might be, the underlying problem that needs to be solved remains the same. In each case, one needs to discover the identity of the structural character of the process or mechanism responsible for the organizational capacities that establish the spectrum of ratios of constraints and degrees of freedom that give expression to the learning and attentional pathways.

These pathways could be characterized by waveforms of synthesis activity that have varying frequencies, amplitudes and wavelengths involving different biogenic amines or different combinations of such amines. In fact, to a certain extent, various biogenic amine neurotransmitters might be just a medium of transmission for some underlying source of information, order, communication or organization. If so, one should pay more attention to the shape and character of the wave being propagated by the amine medium than one pays to the medium itself.

If the foregoing were the case, then, the idea of wavelength might have something to do with the duration of the burst of synthesis activity of a particular biogenic amine, whereas frequency might have something to do with how often such a wavelength is generated per unit of time greater than the duration period. Furthermore, amplitude might have to do with the level of intensity of the synthesis activity surrounding a given biogenic amine.

Then, one would have to work out a functional relation between different waveform properties and various kinds of learning and attentional behavior. In addition, an extra dimension of vectored shaping might be introduced if one were to assume that the same waveform propagated through different biogenic amine mediums might mean quite different things or have quite different functions in different circumstances.

Throughout the aforementioned sort of waveform activity, the property of phase relationships would play an extremely important role of shaping and communicating various aspects of understanding. Indeed, in light of the fact that more and more aspects of biological functioning are being construed in terms of periodic, cyclical, or rhythmic patterns of activity, the need to map out phase relationships within, and among, such cyclical patterns of activity, as well as to map out the character of phase transitions under various circumstances of learning and attention becomes increasingly pressing.

In this sense, the brain or nervous system would become like an amalgamation of dialectically interacting phase states. Such states might be extremely receptive to sympathetic vibrations (i.e., the phenomenon of resonance) from a variety of other dimensions that are in a compatible or synchronous phase state.

The foregoing suggests the temporal dimension might serve as an ideal medium through which information about phase state, phase relationship and phase quanta could be exchanged among a variety of quite different (in terms of the spectrum of ratios of constraints and degrees of freedom that characterize them) dimensional mediums. In other words, given that the temporal dimension can be conceived of as sharing a common boundary (in the form of a set of phase relationships) with virtually every other dimensional structure, one easily could suppose that a great deal of information concerning the phase states of different dimensions might be transmitted via the temporal dimension. One could further suppose that such transmitted phase information might become entangled with whatever dimensional dialectic activity exhibited an organizational or structural or ordered resonance.

If the foregoing suppositions are true, then, one of the common currencies of communication of information in the universe might be phase quanta, phase relationships and phase states. All of these phase modes are manifestations of the sort of constraints and degrees of freedom to which the temporal dimension helps give expression during its dialectic with other dimensions.

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Daniel Kripke and David Sonnenschein have run a series of studies indicating that many people seem to go through waking cycles, lasting approximately 90 minutes, in which they have reverie or fantasy experiences of a spontaneous nature at the beginning and/or end of such cycles. While these reverie episodes exhibited some degree of resemblance to REM-stage dreaming, they were not accompanied by the characteristic rapid eye movements of REM-sleep. Therefore, these reverie rhythms are not considered to be waking counterparts to REM-stage dreaming.

Both REM-stage dreaming, as well as the waking reverie cycles, are examples of ultradian rhythms. These are rhythms lasting less than the 24 hour period of the more easily detectable circadian rhythms. A number of chronobiologists believe there are a number of ultradian rhythms occurring in human beings. Moreover, these chronobiologists believe such ultradian phenomena might form a number of related and interacting, rhythmic families.

Another example of an ultradian rhythm involves the idea of 'sleepability'. Sleepability refers to the ability of a person to go to sleep at a given time. Researchers have discovered there are temporal windows opening up on a regular basis.

An individual can go to sleep more easily when these windows are open than when they are closed. Generally speaking, these temporal windows open approximately every 90 minutes.

There also appear to be temporal windows of wakeability. These are periods of time during the sleep cycle when the individual can awaken more easily relative to other periods of the sleep cycle. One example of a wakeability window occurs during the REM-stage of sleep. Wakeability appears to be another example of an ultradian rhythm.

Despite the fact the foregoing examples of ultradian rhythms, along with a number of other instances of such rhythms, have cycles lasting approximately 90 minutes, there does not seem to be any master biological clock synchronizing all of these oscillating systems. In other words, the similarity of cycle length notwithstanding, all of these ultradian rhythms appear to be independent of one another.

Another example of how ultradian rhythms might play an important role in shaping the structural character of human behavior concerns evidence that suggests there are significant differences in the storage-efficiency of short-term and long-term memory. This evidence indicates memory storage-efficiency is dependent on the time of day one is given certain kinds of memory tasks.

Apparently, short-term memory reaches a peak of efficiency somewhere between 10-11 A. M.. Long-term memory, on the other hand, seems to reach a peak of efficiency later in the day.

For instance, children who were read a story at 9:00 A.M. were able to recall fewer details of that story than were children who were read the same story at 3:00 P.M.. The data seems to indicate there is a 15 % difference in storage-efficiency.

If the foregoing finding holds across the board, then, it might have fairly substantial implications for how one structures the school day. For example, although teachers obviously would like students to remember everything being taught, some material might be more essential or critical than other course material. The experimental data alluded to above indicate the more essential course material might be saved for the latter portion of the afternoon when it has a better chance of staying in long-term memory.

The foregoing data concerning memory storage-efficiency, however, might have to be modulated somewhat by other kinds of experimental findings. A certain amount of evidence has been uncovered that differentiates between two broad categories of temporal identity in human beings.

The members of one group have been labeled "owls". The individuals in the other group are referred to as "larks". As the respective names suggest, owls tend to have their period of peak activity late in the day, whereas larks manifest a period of peak activity during the early part of the day.

Interestingly enough, a major biochemical difference between the two groups has to do with the amount of epinephrine secreted by individuals in each group during the morning hours. Epinephrine, that is associated with biological stimulation, is secreted in greater quantities, during the morning hours, by the larks.

One wonders if there is a way for the two experimental results outlined above to be combined so that all categories of individuals could gain the greatest benefit from the effect such rhythms have on the potential for learning, alertness and so on? For instance, should one assign students to classes according to the character of their temporal identity?

One also wonders if larks will learn more efficiently in the afternoon as the first study cited above suggests, or whether their temporal identity will overshadow the apparent enhancement of memory efficiency associated with mid-afternoon learning. Or, could one explain the apparent enhancement of memory efficiency in mid-afternoon learning by the presence of a larger number of owls, relative to larks, in the sample subjects? Whatever the answer to these questions might be, biological rhythms, together with their complex expression in the form of temporal identity, would seem to be important areas to explore in relation to the educational process.

While the biological rhythms occurring in humans are innate, their structural character is not instinctual in any narrow sense. There is some degree of flexibility inherent in these rhythms.

Therefore, although they play a significant role in shaping various aspects of behavior, they do not rigidly control behavior. Quite frequently, the manner in which biological rhythms manifest themselves is itself susceptible to being shaped, to a certain extent, by directed awareness.

For example, experimental work has established that when human beings undertake a task requiring some degree of concentration for an extended period of time, they go through a cycle of, first, enhanced efficiency, which is, then, followed by a deterioration of efficient engagement of the given task. Then, this cycle repeats itself.

The length of each cycle is approximately 90 minutes. Thus, such a cycle is an ultradian rhythm.

Apparently, the cycle is set in motion by an individual's decision to engage some task requiring conscious attention. Within certain limits, each new engagement decision resets the ultradian efficiency clock so that another cycle is initiated.

Obviously, if a change in the direction of conscious attention is made too frequently, this, presumably, would have a dampening effect on the efficiency cycle. In other words, one would never be able to get far enough into the task in order to make the heightened awareness payoff. Consequently, there would seem to be some minimal amount of time that would have to be spent in the cycle to get the most out of it.

Furthermore, under some circumstances, there might be other sorts of forces shaping the ultradian cycle of efficiency. For instance, there are cases in which one becomes deeply engrossed in what one is doing because one finds a given issue or task extremely intriguing, interesting, challenging, stimulating, rewarding, and so on.

Under these sorts of circumstances, the 90 minute cycle might not be in effect. In other words, there might be thresholds involving interest/reward/challenge that, in being exceeded, lead to the shutting down of the aforementioned ultradian cycle that normally governs mental alertness.

Alternatively, if the ultradian rhythm concerning mental alertness is in effect (i.e., not shut down or switched off), the down aspect of the cycle might be greatly attenuated as it is swamped by other, more powerful cycles. As a result, there might not be much deterioration of mental alertness during such circumstances.

A further possibility is the following consideration. Within the context of the task, work or issue being engaged, there might be a number of new, interesting twists and turns, each of which resets the efficiency cycle.

However, because all of the twists and turns are bound together within the framework of a thematically directed latticework of interest/reward/challenge, the change in focus does not become disruptive to, or interfere with, or act as a suppressor of, efficient engagement as would be the case if the twists and turns were unrelated to one another. Indeed, such a latticework might operate as a strange or chaotic attractor in which the various re-settings of the ultradian mental alertness cycle give expression to a self-similar (and, therefore, linked) series of rhythms.

This latter point concerning the possibility of the synergetic effect of introducing twists and turns within a given task framework has some potentially interesting implications for educational theory and the planning of classes, homework, assignments and so on. Possibly, if one can find the right kind of twists and turns within the context of a certain task framework, one might be able to provide the individual with a means to reset the ultradian efficiency clock on a regular basis, and, thereby, within certain limits, keep the individual at peak efficiency for a longer period of time.

The foregoing considerations seem to suggest that not only are there biological rhythms, but there also are what might be referred to as epistemological and/or hermeneutical rhythms. Furthermore, these biological rhythms and epistemological/hermeneutical rhythms dialectically interact with one another in a process of mutual vectoring or tensoring.

In the light of the foregoing considerations, when something is learned might be as important as what is learned. The phase orientation one has as one begins to engage a given topic, issue, task, and so on, might significantly affect the structural character of the outcome of such an engagement. In other words, certain phase relationships, which play central roles in shaping learning and understanding, might be more amenable to heuristically valuable phase shifts or transitions during some phase states than during other phase states.

Each individual might be shaped by a variety of temporal windows affecting the efficiency with which, and way in which, learning and understanding occur. These temporal windows are a function of the dialectic among a variety of biological and epistemological/hermeneutical rhythms. If course material is engaged by an individual when a propitious ratio of such temporal windows is open, learning might be easier and more is not conducive to learning and understanding.

Similarly, before one can understand certain aspects of an issue, one might have to acquire the right sort of phase orientation with respect to such an issue. That is, one might have to get into, or be brought into, phase with the material as well as the educational setting through which the material is being introduced. Consequently, an important part of the educational process might be to assist the individual in constructing the right sort of phase state or phase orientation through which a constructive exchange of phase quanta (i.e., learning, understanding, etc.) is more likely to occur.

In short, an individual's temporal identity gives expression to both biological rhythms, as well as, hermeneutical rhythms. Indeed, temporal identity is a manifestation of the structural character that is generated, in part, by the dialectic of biological and hermeneutical rhythms. In addition, temporal identity consists of oscillating ratios of constraints and degrees of freedom. These oscillating ratios are generated by the different levels of scale of dimensional dialectics that give expression to a human being.

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One of the interesting things about an oscillator is the way it, simultaneously, can serve as a clock as well as a source of signals, information or messages. In this respect, there might be a sense in which both biological and epistemological/hermeneutical rhythms form oscillating systems that are somewhat like the clocks of Einstein's special theory of relativity.

In other words, they often give measured versions of rhythms, time, synchronization, signals and so on which are influenced by local conditions instead of being reflections of temporal absolutes that are unaffected by methodological considerations. At the same time, just as is the case in special relativity, there are elements of universal laws (involving rhythmic structures in the present case) which are being preserved during the process of methodological engagement. Thus, aspects of both variability and invariance are manifested in the chemical and hermeneutical oscillating systems that characterize human beings.

Although chemical clocks or chemical oscillators were first discovered in 1921 by William Bray, they were not systematically studied until the late 1950s and early 1960s by A. M. Zhabotinsky and B. P. Belousov of the Soviet Union. Essentially, a chemical oscillator (sometimes referred to as a Belousov-Zhabotinsky reaction) will, if left to itself, spontaneously shift between several states in a periodic fashion. Usually, the periodicity of a chemical clock is noticeable because that periodicity is visually manifested as a color transition in the chemical system that is oscillating.

As is the case for any oscillating system, a chemical clock is sustained by a process of energy flow that enables the energy to: (a) be stored, at least temporarily, as potential energy, and (b) be converted from a potential form to an active or kinetic form of energy. One of the ways in which this process of energy flow occurs in chemical systems is by means of a series of cyclical transitions between the oxidized and reduced states of certain molecules in such systems.

Chemical oscillators are capable of producing a wide range of effects, including complex phenomena of communication. In other words, some networks of chemical/biochemical processes exhibiting various sorts of oscillating properties are capable of giving rise to a variety of systems that generate, store and transfer information.

The Acrasiales fungi or slime mold is, relative to human beings, a simple example of a chemical/biochemical clock that, under the right sort of circumstances, manifests many of the characteristics of a system of communication. Under environmentally favorable conditions, the slime mold exists as an single-celled amoeba.

However, when environmental contingencies become problematic (such as when food becomes scarce), the formerly independent slime molds begin to draw together and become transformed into a stalk. In time, this stalk yields spores that, eventually, break off and are dispersed by wind currents to more favorable environmental circumstances. When these more favorable conditions are reached, the spores undergo reproduction. This results in a new colony of slime molds being established.

The series of transformations and transitions undergone by slime molds is driven by a chemical oscillatory system in which cyclic adenosine monophosphate (cyclic AMP) plays a leading role. For unknown reasons, one of the slime molds in the colony begins to secrete cyclic AMP in rhythmic pulses. These pulses have the effect of entraining the other slime molds' production and secretion of cyclic AMP so that all of the members of the colony begin to secrete cyclic AMP in unison.

The over-all effect of the community production of cyclic AMP is to lead all of the individual cells to congregate around the initial cyclic-AMP-secreting- amoeba cell. The congregated colony, then, undergoes the series of transformations outlined previously in which there is a sequential expression of the base, stalk and spores stages of the slime mold.

Cyclic AMP is referred to as the 'second messenger'. It has this label because of its role of interacting with neurotransmitters that are considered to be the first-line messengers.

Generally speaking, when a given neurotransmitter attaches to a receptor site, one of the effects ensuing from this is the synthesis of cyclic AMP inside of the target cell. Cyclic AMP is, then, distributed throughout the cell. Apparently, its presence helps to communicate some of the message that has come to the cell in the form of a given neurotransmitter.

Among other things, cyclic AMP seems to help amplify, by an order of quite a few magnitudes, the relatively weak signal of the first messenger neurotransmitter. In addition, cyclic AMP tends to extend the period of duration during which the message conveyed by the first messenger is actively propagated. In other words, even though the neurotransmitter might have departed from the receptor site that initiated the synthesis of cyclic AMP, nonetheless, the cyclic AMP continues to serve as a sort of proxy for the message/signal carried by the neurotransmitter.

The second messenger, cyclic AMP, operates more slowly, relative to the pace at which many other neural processes take place. Consequently, the activity rate of cyclic AMP might lend itself to helping to maintain those mental states that are more enduring such as memory, learning and consciousness.

In 1955, M. Calvin and A. T. Wilson detected, for the first time, an instance of a biochemical oscillator. The oscillator forms part of the process of photosynthesis. More specifically, the oscillator is located in the portion of the cycle known as the dark reactions.

Approximately ten years later, another example of a biochemical oscillator was discovered. During the process of glycolysis, the primary means by which cells in many different organisms catabolically degrade glycogen, there are several enzymes involved in the breakdown of glucose that form an oscillating system.

Cyclic AMP and its associated catabolic enzyme, phosphodiesterase, might form an oscillating system somewhat comparable to the systems existing in glycolysis and the dark reaction of photosynthesis. Moreover, cyclic AMP might play a fundamental role in entraining a variety of biological rhythms of the body and mind. This possible role emerges in the light of its pervasive, almost ubiquitous, rhythmic activity in so many parts of the body.

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There is substantial evidence (and chronobiology is but one part of this evidence) to indicate there are underlying sets of oscillating systems in the form of various kinds of ratios of constraints and degrees of freedom that leave their imprint on the structural character of behavior. The ebb and flow of concentration gradients for cyclic AMP might form a part of some of these systems.

In many cases, the underlying oscillatory activity seems to be in the form of chaotic attractors. This is so since the behavior associated with such oscillatory activity often tends to be self-similar rather than self-same.

Various kinds of biological and hermeneutical oscillating systems in human beings might form a series of horizonal (pertaining to the horizons of experience that shift in relation to one's focus) attractor basins that engage, and are engaged by, the self-similar activity of focal attractor basins. Sometimes this dialectic is dominated by one or more horizonal attractor basins that simultaneously bring focal activity into their sphere of influence.

The effect of such influence would be to color, orient and shape that focal activity from a number of different vectored directions. At other times, the activity of the focal attractor basin dominates and selects the horizonal attractor basin or basins that it wishes to interact with, be colored by, be oriented by, and so on.

In both cases, however (that is, irrespective of whether the activity of the focal attractor plays an active/shaping role or passive/malleable role), the activity of the focal attractor basin has the capacity, within certain limits, to fine-tune the way it is engaged by, or engages, the different horizonal attractor basins. In other words, the activity of the focal attractor basin has the capacity, within certain limits, to make adjustments in the manner in which it is being modulated by the different attractor basins. Moreover, the activity of the focal attractor basin has the capacity, within certain limits, to make adjustments in: (a) the manner in which it is oriented toward horizonal attractor basis; as well as (b) the extent to which it wishes to open itself up to the influence of a given horizonal attractor basin.

In the light of the foregoing comments, one way to construe brain activity is in terms of the way such activity helps generate a variety of horizonal attractor basins of varying biological rhythms. These biologically dominated horizonal attractor basins are capable of shaping and modulating behavioral currents involving motivations, emotions, sensations, dreams and so on. Indeed, early in life, innate biological horizonal attractor basins dominate focal activity and form the primary components of the horizon of focus.

As the individual develops, the activity of the focal attractor basin begins to take on an increasingly active role across a wide range of issues and situations. As a result, the hermeneutical operator begins to pick up steam and generate a variety of hermeneutical themes, attractor basins, and so on, that might become increasingly independent of, though not necessarily entirely unrelated to, purely biologically driven attractor basins. These hermeneutical attractor basins also become part of the horizon.

Consequently, part of the maturational process shows a change in the ratio of purely biological rhythms to hermeneutical rhythms. This change in the ratio of hermeneutical to biological rhythms might be reflected, to some extent, in various stages of development.

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At this juncture, a useful exercise might be to pursue a discussion concerning some of the differences, with respect to developmental issues, that exist between the perspective being advanced in the present dissertation and some of the views of Jean Piaget who has had a considerable impact on certain aspects of educational theory. Hopefully, such an exercise will help to develop, somewhat, different facets of the position being advocated in this article, as well as lay down a foundation for the sections following this one.

The following discussion is not intended to be exhaustive. It is intended to be illustrative of some of the differences in perspective that exist between Piaget and myself.

Piaget believed the intelligence of an organism is rooted in a set of structures that had the potential capacity for unfolding or developing under appropriate circumstances of interaction between the organism and the environment. However, he did not believe the organism was merely a passive entity in this developmental process. He maintained, instead, that development was a complex activity involving a tension between assimilation and accommodation as the organism sought to restore equilibrium. (see the note following the source entry)

Piaget collectively referred to the developmental dialectic outlined above by means of the term action. Action encompasses all the variations on one, fundamental theme - namely, the way in which the organism both restructures and is restructured by its interaction with the environment.

Piaget considers action to be inherently intelligent activity. Piaget also maintains, however, that action is inherently stage-governed. This latter characteristic means action gives expression to intelligent activity with qualitatively different operational or structural characteristics at various points of development.

Moreover, for Piaget, the idea of stage incorporates a sequential element in which some stages precede other stages in a fixed, biologically given order of development. Thus, according to Piaget, stage 3 operations will not begin to establish themselves until stage 2 operations have been mastered. Similarly, stage 2 operations will not begin to emerge in any consistent, pervasive sense until stage 1 operations have been established.

During the sensorimotor stage of operations, the child physically interacts with the world through various parts of the body, such as mouth, hands, eyes, ears and so on. This interaction results in a series of schemata being formed that constitute, in a sense, action mappings linking the child with his or her world.

These schemata become progressively more sophisticated and integrated with the passage of time. Out of these mappings emerge the child's initial conceptions of space, time, objects, causality and so on.

The next stage of development is referred to as the concrete stage of operations. During this stage, the individual gradually acquires an understanding of certain principles of conservation and operational reversibility. During this stage there is also a further consolidating and expanding of various themes that had been introduced in the sensorimotor stage.

Moreover, although the individual's action is still very much focused on concrete, physical aspects of interaction with the environment, there is an emerging theme of interiorization of action. In other words, objects are mentally operated on, not just physically operated on. Acquisition of, and utilization of, the idea of operational reversibility, for example, is one expression of the increasing tendency toward the interiorization of action.

The final stage of development, known as the formal stage of operations gives expression to the transition from a largely concrete mode of interacting with the environment to a largely formal or symbolic way of dealing with the environment. This stage of development also marks the continuation of the trend toward the interiorization of action that began to play a substantial role during the concrete stage of operations. In the formal stage, the individual becomes increasingly able (a) to operate on symbolic and/or linguistic representations of the physical world, as well as (b) to pose purely hypothetical if-then, questions in an attempt to grasp the structural character of the world.

Piaget stipulates, however, that one cannot bifurcate these various stages into isolated, independent units. There is a certain amount of overlap from one stage to another. As a result, harbingers of themes assuming more focal prominence in later stages will make appearances in earlier stages.

Thus, for example, one sees remnants of the formal stage of operations in the emergence of various aspects of language functioning during late sensorimotor/early concrete operational stages. Or, one sees the introduction of operational reversibility during the concrete operational stage, despite the fact that operational reversibility does not reach its full potential until the formal stage of operations is in full bloom.

According to Piaget, there is a further theme of development running parallel to the intellectual side of action. This further theme concerns the issue of egocentrism. Egocentrism refers to the way, and extent to which, the individual tends to see, feel and understand things strictly from his or her own perspective.

However, Piaget indicates egocentrism is not a matter of selfishness. He attributes it, instead, to the individual's assumption that everyone else sees, feels and understands things pretty much in the same way as he or she does.

Piaget believes this assumption is rooted in the individual's inability to differentiate self from environment. However, as the individual begins to grasp (and apply) the structural character of reversible operations in (to) a wider and wider variety of contexts, the influence of egocentrism gradually diminishes until it reaches its lowest point in the formal stage of operations.

There are three major trends in Piaget's stage theory of development. One trend concerns the aforementioned tendency away from egocentrism as one proceeds through the various operational stages. A second trend involves the manner in which there is an increase of interiorization of action schemata over time, as one moves from purely surface, immediate physical modes of interacting with the world, to interiorized modes of interacting with the world. These latter modes take the form of various kinds of mental schemata. Mental schemata place distance or buffers between the individual and his or her environment. Finally, there is a trend that moves from reliance on overt, concrete activity to a reliance on formal, symbolic operational activity when interacting with the world, both social and physical.

All three of the thematic trends outlined above need to be examined critically. For instance, one might disagree with Piaget's contention that there is a tendency toward increasing interiorization of action schemata. One might just as easily argue such interiorization is present from day one and that the generation of action schemata of whatever stage presupposes such a capability.

In fact, if one does not make the foregoing sort of assumption concerning the presence of interiorized, mental activity from the very beginning, one is faced with a problem. One must provide an account of how purely physical/biological action schemata become transformed into interiorized phenomenological schemata.

Either one has this capacity from the very beginning, or one has to explain its emergence as a function of processes that do not seem capable of accounting for its emergence or its existence. This is a problem Piaget never adequately resolves in any clear-cut fashion.

A second trend of development in Piaget's perspective, concerning the alleged movement away from egocentrism as one increasingly comes under the influence of formal stage operations, also seems rather argumentative. For example, all through the history of ideas, as well as in the midst of everyday life, one repeatedly comes across cases of people who appear to be operating at extremely sophisticated levels of formal operations, yet, these people either: (a) cannot comprehend why everyone doesn't see things the way they do, or (b) insist everyone must accept their point of view as being the only correct way of thinking about a particular issue.

Both (a) and (b) seem to be obvious expressions of, or variations on, the egocentric theme. Consequently, the fact that an individual is thoroughly entrenched in the formal stage of operations does not necessarily serve as a guarantee that such an individual won't also manifest considerable egocentric behavior. Indeed, egocentric tendencies tend to be imbued with emotional and motivational currents that often prove intractable to rational efforts to transform or constrain them.

One could take exception, as well, with a third trend of development emphasized by Piaget. In this third trend there is, supposedly, a progressive move away from the immediacy of physical operations on the objects of experience, and toward a more symbolic mode of operations with respect to the objects of experience.

From the perspective of the present article, the core feature of thinking is rooted in the hermeneutical operator (which gives expression to the dialectic of: reflexive awareness, identifying reference, characterization, interrogative imperative, inferential mapping, and congruence functions). This operator is present in thinking from the very beginning of post-uterine existence (and, quite possibly, much earlier than this). It is responsible for the generating, shaping, transforming, and organizing of the structural character of the individual's understanding of various aspects of the phenomenology of the experiential field.

All components of the hermeneutical operator are present from the beginning of life outside the womb (and, perhaps, even in the womb). Nonetheless, the passage of time is required for the individual to develop facility with the use and application of that operator system.

As a result, in the beginning, identifying reference might be vague, rather than refined. Reflexive awareness might be sporadic and fleeting. Characterization might be distorted, rather than accurate.

In addition, certain kinds of questions might not be asked, or the wrong kinds of questions might be asked, or questions might be asked that are in the service of self-interest rather than a desire to understand. Furthermore, inferential mappings might be more a matter of imaginative projections or speculations, rather than a matter of entailment. Finally, congruence functions might be limited to localized, narrow, analog reflections rather than be allowed to develop, and be extended to, latticework analog relationships.

In any event, formal, symbolic operations of the sort Piaget has in mind constitute only one mode of utilizing or approaching the hermeneutical operator. Indeed, there are an indefinite number of possibilities for combining different components of the hermeneutical operator to generate a latticework of phase relationships intended to reflect, in analog form, different aspects of the structural character of various facets of reality on different levels of scale.

Mathematical/logical systems of symbolic operations are extremely limited in the sorts of problems with which they are capable of dealing. Morality, religion, art, meaning, mysticism, historiography, purpose, interpretation, and so on, all appear to fall beyond the horizons of Piaget's brand of formal operations.

Piaget also speaks of three different kinds of fallacy that are manifest in the thinking of children in the first stage of operations. He calls these fallacies: realism, artificialism and animism.

The fallacy of realism comes in three varieties. One form of this fallacy is when the child confuses a mental state, such as a thought or dream, with the thing for which the mental state is a representation.

A second form of the fallacy of realism is manifested when there is a confusion in the child between internal and external. For example, children go through a stage when they think that a dream is external to themselves. Only later do they believe the dream comes from within them.

The third form of realism fallacy is when the child attributes substantive reality to a thought or dream. In other words, rather than maintain that thoughts and dreams are insubstantial in nature, they suppose thoughts and dreams are made of some sort of substantive material or substance.

There are several considerations that emerge when reflecting on the foregoing fallacy of realism. First of all, one might argue that many scientists and mathematicians are guilty of the version of the fallacy of realism in which there is confusion between the individual's idea of something and the thing that is being represented through that idea.

The model is not the thing (or event, process, state, condition, etc.) being modeled. Yet, one often hears from scientists and mathematicians that if the model has a certain property, then, reality also must have such a property.

As far as the second fallacy of realism is concerned, one needs to raise the following question. Where, in fact, do dreams occur?

Of course, the prevailing, generally accepted position on this issue is to contend dreams occur in the head and are a function of neurobiological activity. However, there is absolutely no evidence demonstrating this to be the case.

In fact, whatever data exists with respect to this point could be interpreted in a variety of ways. To be sure, there is a strong correlation between dream activity and certain neurophysiological states, but there is nothing to indicate the neurophysiological states are the cause of the dreams, rather than vice versa, or rather than both being caused by some further factor not yet understood.

Finally, the third fallacy of realism concerns the way a child mistakenly, according to Piaget, attributes some sort of substantive reality to dreams when, according to the prevalent belief system of modern civilization, dreams are insubstantial in character. As was true in connection with the second fallacy of realism, Piaget's biases are clearly in evidence in the third fallacy of realism.

Many cultures (that of the Oglala Sioux Indians being one that comes readily to mind) believe dreams have a substantive reality that extends beyond the individual's experience of that dream. Only because of his scientific prejudices, could Piaget attempt to maintain that the insubstantial nature of dreams is beyond question and that anyone who thinks otherwise is committing a fallacy.

The fallacy of artificialism refers to the tendency of children in a certain stage of development to maintain that everything in existence is an artifact that has been made for a specific purpose. Thus, nature is invested with purposeful activity in which all things are inclined to seek out some goal or purpose.

The idea that something could happen just as a result of random occurrences or as the result of purely mechanical cause and effect sorts of events does not seem to enter the mind of children who commit the "fallacy" of artificialism. Moreover, this sort of fallacy involves a confusion between physical events and moral events such that the former are often seen as serving, or giving expression to, some underlying moral purpose.

Again, Piaget might be letting his own biases influence him in his interpretation of things. Although the child's understanding of the precise manner in which everything is purposeful might not be correct, the principle that purpose (as is reflected in the teachings of, say, most religions and mysticisms) is central to the character of the universe cannot be rejected out of hand as Piaget seems to be doing.

Randomness is not a fact. It is an interpretation of events.

Furthermore, to assume certain events can be reduced to a purely mechanical and/or biological set of forces, is, again, to impose an interpretation onto those events. Piaget is presuming that the child's account of things is very primitive and unsophisticated, when, in point of fact, it might very well not be mistaken - at least, in principle, although the details of the child's interpretation of that principle might be erroneous.

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According to Piaget, the newborn infant begins life with a set of reflexes (such as crying, sucking, swallowing and so on) which are, within certain limits, capable of adapting themselves to current circumstances. Piaget uses the term accommodation to refer to this capacity for, and process of, modifying biological or psychological structures in order to adjust to a situation.

Assimilation, on the other hand, is Piaget's term for referring to those manifestations of an organism's action schemata which operate on some aspect of the environment or the phenomenology of the experiential field. These schemata are employed in order to modify aspects of the environment for the organism's own purposes, ends or goals.

For example, initially, the sucking reflex accommodates itself to the situation presented to it, namely the mother's breast. Within a short time, however, the infant introduces a number of variations on the initial sucking theme.

These new variations are the result of the infant's operations on, and modifications of, the sucking reflex. Such constructed variations on any biologically given issue are instances of assimilation in action.

According to Piaget, an action schemata -- in this case, the sucking scheme - is not a matter of any particular instance of sucking activity. An action schemata encompasses the stable elements that persist across a wide variety of sucking activities. In a sense, these stable elements define or characterize, the fundamental components that all sucking activities have in common, their individual differences notwithstanding.

The next step up the developmental ladder occurs when primary circular reactions begin to emerge. These represent systematic co-ordinations of different action schemata or behavioral patterns into a unified whole.

At first, of course, the co-ordinations are very rough. Subsequently, however, they become refined and the integration of action patterns is mastered by the individual.

Primary circular reactions are supplemented by secondary circular reactions. In this latter kind of activity, the infant begins to use (although not necessarily in any self-conscious or intentionally purposeful way) the structures generated through primary circular reactions. These structures are used to probe various aspects of the environment.

Over time, the results and consequences of such probing activity begin to register with the child. Thus, secondary circular reactions build up a sort of action-schemata-network that is made up of: (a) primary circular reactions, (b) the use of circular reactions as probes in relation to experience, and (c) a gradual awareness of the results ensuing from such probing.

Tertiary circular reactions tend to arise in contexts in which the individual is exploring aspects of experience that are not easily assimilable, if at all, to already established action schemata that usually deal with, or handle, similar situations. For example, activity of the individual that is directed toward finding a way of resolving problems involving existing action-schemata tend to be subsumed under the heading of tertiary circular reactions.

Eventually, toward the end of the child's second year of life, the child will show signs of employing tertiary circular reactions that do not depend on a preliminary period of trial and error as a prelude to solving a problem. In these instances, a solution to a problem appears to emerge from the performance of purely mental operations, without any mediating physical activity.

Consequently, by the end of the sensorimotor period or stage of development, the child has begun to exhibit the essential feature of operational thinking. This essential feature is the capacity to manipulate and modify action schemata without necessarily having to resort to overt, physical activity.

The emergence of operational thinking in the child, according to Piaget, marks a major transition in the character of the way the child engages experience. On the one hand, the child is no longer restricted to thinking about events strictly in terms of what has been observed to be the case with respect to such events.

The child can begin to think about objects and events in terms of their potential for being other than they have been observed to be. In other words, the potential for manipulating and modifying a situation (through the intervention of the child's mentally operating on that situation and, thereby, conceptually constructing something different than what had been the case) assumes increasing importance in the thinking of the child.

A second facet of the transition in thinking brought about by operational activity is the child's growing capacity to think about the world in an integrated, unified and connected way. Piaget believes that prior to operational thinking, the child treats experience as a sort of loosely connected sum of events.

After operational thinking makes its appearance, however, the child develops a set of concepts involving object permanence, space, time, causality, and so on. These new concepts form the basis of the individual's understanding of, and interaction with, the world.

One of the formative influences on Piaget's thinking was Jules Henri Poincare. Among other things, Poincare held that the idea of space was an innate part of human thinking. Moreover, he believed our innate sense of space exhibited the properties of a mathematical group.

Piaget assimilated Poincare's approach to space to his own way of thinking about things. Thus, rather than treating space as an a priori concept, as Poincare had, Piaget maintained that the individual's concept of space was a construct that was the integrated result of a whole series of physical and interiorized activities involving the child's interaction with the surrounding environment.

Piaget not only modified Poincare's position concerning the a priori nature of space, he was interested in extending his idea concerning the individual's construction of reality to a whole set of basic concepts previously considered to have a priori origins. In other words, Piaget's proposal, if accepted, would overturn Kant's position concerning, in addition to the idea of space, the a priori nature of concepts such as time, causality, and so on.

Piaget referred to these constructed concepts as practical groups. In fact, one of his ways of determining if an individual had attained a given concept is whether or not one could show that the individual's manipulation of a given concept was isomorphic with a group representation of that same concept.

Most of Piaget's research concerns: (a) an account of the emergence (around the age of 7-8 years) of concrete operational thinking in the child, together with (b) an account of how such thinking is different from pre-operational thinking activity. Essentially, for Piaget, the attainment of the stage of concrete operational thinking is marked by a consistent (as opposed to sporadic) capacity to exhibit certain kinds of operational activities while physically and mentally manipulating various aspects of reality. Among these operations, Piaget gives special attention to the properties of identity, reversibility and compensation.

Identity refers to the way in which the quantitative character of some substance remains exactly the same despite superficial changes of appearance undergone by that substance as the result of some sort of manipulation. Thus, when a certain quantity of liquid is poured from a short, fat beaker to a tall, thin beaker, the quantities' identity remains the same despite the apparent differences in appearance of the two beakers.

Reversibility concerns instances in which a process can be reversed without changing the basic identity of that which is being subjected to the reversal process. For example, if one pours from beaker A into beaker B, and, then,, one pours from beaker B back into beaker A, this is an instance of reversibility since the basic quantitative character of the liquid has not changed.

Finally, compensation is an operation involving two or more actions that have the effect of canceling one another, or compensating for one another. If, for instance, one pours a liquid from a wide, but not very tall, beaker into a tall, but not very wide, beaker, the effect of the height of the second beaker compensates for, or cancels out the effect of, the width of the first beaker. If one is able to grasp the character of this relationship, then, according to Piaget, one has performed - either physically or mentally, the operation of compensation

Essentially, Piaget's concept of thinking consists of a set of transformations or operations. This set of operations is applied to a certain aspect of on-going experience in order to bring about a modification of some sort.

Piaget maintains one's knowledge of a given situation or aspect of on-going experience is a function of the kinds of transformations that one applies to that situation or aspect of experience. In other words, if one understands the structural character of the series of transformations responsible for shaping a given experiential state, then, one knows the nature of that state. Consequently, for Piaget, having an understanding of the transformational history of the genesis of a given structure is the key to acquiring knowledge of that structure.

When one speaks of the construction of reality, as Piaget frequently does, this does not necessarily mean one generates the character of reality or that one is transforming reality. There are two broad possibilities here.

In one case, the individual does, literally, construct or invent 'reality' since the structural character of his/her construction is a deviation from, or distortion of, the nature of reality. As a result, the individual has imposed something alien onto reality.

The other kind of construction process, however, does not involve inventing, in any distortive or deviant sense. On the other hand, this sort of construction process might involve the development of some form of analog stand-in for the original aspect of reality that is being represented by the construction.

In this latter sense of construction, the individual is working toward developing a set of congruence functions. Ideally, these congruence functions will generate structures of understanding capable of accurately reflecting the structural character with respect to some aspect of reality and to which identifying reference is being made through means of the construction. In this sense of construction, the individual is taking reality as the set of blueprint guidelines that is to become the basis for constructing his/her own analog model of those ontological blueprints.

Although both senses of construction seem to be implicit in Piaget, the distinction is not always clear cut. Often times, one gets the impression his use of the idea of 'constructing reality' is as if reality were being invented anew. As a result, one tends to lose sight of the way in which reality can be mirror imaged in the form of an analog or representational model through which the individual actually grasps, on some level of scale, the structural character of a certain aspect of reality.

Central to Piaget's notion of intellectual development is the individual's active engagement of, and operating on, different aspects of the 'world'. A second key factor in Piaget's conception of intellectual development revolves around the capacity to coordinate such activity into patterns or schemata or action structures.

However, Piaget does not account for the origins of this capacity to coordinate. Furthermore, Piaget fails to account for how the individual is able to progress from one kind of coordinating activity at a given stage of intellectual development, to another, qualitatively different kind of coordinating activity at some other stage of intellectual development.

Piaget does speak of a "tertium quid" process that is claimed to be an expression of: genesis without structure and structure without genesis. Unfortunately, this process remains something of a black box mechanism since its inner workings remain elusive throughout Piaget's writings.

From the perspective of the present article, a given stage of development consists in a preoccupation with, or dominance by, one or more attractor basins. Some of these attractor basis might be indigenous to biological givens. Other such attractor basins might be generated as a function of the way the individual engages, and is engaged by, a variety of cultural and social themes. In both cases, the attractor basins shape, color, orient, and help organize focal activity and its accompanying hermeneutical operator.

The transition to a new stage of development is characterized by the spontaneous or induced emergence of a new category of attractor basin(s) that begins to replace the sphere of influence of the previously established basin(s). However, one need not suppose this transition occurs because of any innate sequence of stages that unfold over time. Or, if there are such innate, sequential influences, they might not always play a dominant role, or they might be capable of being modulated by other non-sequence oriented systems.

From the very beginning there might be a spectrum of ratios of constraints and degrees of freedom for focal activity to select from, as well as by which to be influenced. However, from a point of view of information processing, theory building, issues of simplicity, perceived priority of needs, and so on, certain ratios might come to form the germ of attractor basins more readily than do other ratios of constraints and degrees of freedom during the early stages of development.

Thus, for example, one might expect that - on the basis of both priority of needs, as well as ease of access and manipulation - sensorimotor interests and inclinations might precede either concrete or formal operations, even though the capacity for, and inclinations toward, both of the latter sort of operations already are present in the infant. Using similar reasoning, one might suppose that an individual's concrete interests and inclinations would tend to precede or marginalize the individual's tendencies toward formal operations, until sufficient experiences of a formal kind had been acquired, processed, and used.

If so, then, stockpiling of experiences, processing time, and level of difficulty or ease of access with respect to various kinds of operational thinking might be the dominant themes in determining the sequence in which cognitive stages of thinking are encountered. Biological maturation also, of course, plays a role here, but not necessarily in the sense that the sequence of cognitive stages are inherently pre-established in the way that Piaget argues is the case.

In addition, once under the sphere of influence of a given biological and/or hermeneutical attractor basin, the individual gets use to seeing, understanding and being oriented to things in particular ways. Thus, there is a sort of inertial property associated with such attractor systems.

Over time, the individual builds up a backlog of experience with, and sophistication in developing and using, properties and features such as information processing, hermeneutical dialectics, conceptual models, and so on. As a result of building up a backlog of experience, the individual has an opportunity to explore some of the other ratios of constraints and degrees of freedom that are available to the individual. As these other ratios are explored, tried out, constructed, refined and so on, they form the germs of new attractor basins.

By and large, however, these later emerging, attractor basins often are over-shadowed by already existing attractor basins that have associated with them a hefty amount of inertia. Therefore, for a period of time, sensorimotor activity tends to dominate both concrete and formal operations - though there are traces of the latter two sort of operational activity that continue to emerge, just as, for a time, concrete operational activity tends to dominate formal operational activity, although, nonetheless, there are episodic instances of formal operational activity manifesting itself despite concrete operational domination.

On the other hand, the new attractor basins often have the advantage of improving the quality of the individual's dialectical interaction with the environment. This is accomplished through extending and deepening the individual's range of competent interaction with the environment, as well as by providing a series of strategies providing better, faster as well as more satisfying ways of approaching and resolving a whole host of issues and problems.

Consequently, the old and new attractors compete, in a sense, for the attention of focal activity. The gradual process of transition from one stage to another reflects this competition.

In addition, the process of transition reflects the changing character of the way focal activity orients itself toward, as well as permits itself to be influenced by, different attractor basins. This changing nature in the qualitative character of focal engagement activity might be as much a function of having the time to sift through incoming data and information, as well as the time to develop models and strategies for handling such data, as it reflects motivational, emotional, and intellectual inclinations that are inherent in the individual.

Ideally, the attractor basins that are most efficient, most heuristically valuable, and most far-reaching in their capacities to solve problems or deal with the world in an effective manner would come to dominance. However, the inertia of already existing attractor systems must be overcome in the process, and this does not always occur, for any number of reasons.

Thus, the developmental history of an individual will reflect the manner in which the dialectic involving biological givens, the hermeneutical operator, and cultural/social vectors is given expression. Some of the themes of such dialectic will be shared universally by all people. Some of the themes of the aforementioned dialectic will be shared by the members of a given culture or community. On the other hand, some of the themes of the dialectic will be unique to a given individual.

In short, the point of view taken in this article argues that the hermeneutical operator is at the heart of many kinds of intellectual activity on many different levels of scale. Moreover, such an operator is present from the very beginning of life - although experience, language, education and various kinds of intellectual/emotional challenge are required to act as catalytic agents to permit the operator to generate structures of differential character, over time, through the operator's dialectic with various facets of ontology. Finally, the apparent stages of intellectual development might be as much a reflection of the problems surrounding the processing of information and the purely procedural or methodological need to grasp some steps before others, as it is a reflection of biologically indigenous features in the character of intellectual development.

According to Piaget, neither biological nor environmental factors, in and of themselves, can lead to the emergence of the formal stage of operations. What is required, in addition, is for thought to reflexively operate on itself. When this occurs, the individual sets in motion a process that works toward a final, stable equilibrium.

This sort of equilibrium is final for Piaget because he believes formal operations constitute the highest and most powerful kind of thinking that is available to the individual. Moreover, this stage, once it is acquired, is fully in equilibrium since, according to Piaget, whenever any event serves to disturb such a system, then, spontaneous, compensating, operational activity is set in motion in order to resolve the problems generated by the disturbance.

One of the problems with Piaget's conception of the formal stage of operational thinking is his assumption that it constitutes the final and highest form of equilibrium that is possible for human beings. Carl Jung, to name but one individual, was of the opinion that during the second half of life there was a crisis faced by the individual in which there was a major need to integrate the shadow aspect into one's personality.

This crisis manifests itself as a fundamental disturbance of equilibrium. Moreover, the crisis required the individual to seek solutions through the process of individuation. This does not easily fit in, if it does at all, with Piaget's belief that the logical-mathematical operational mode of thinking constitutes the final word in the equilibration process.

Furthermore, virtually every mystical tradition points in the direction of an essential disequilibrium that distorts all understanding and thinking. Such a state of imbalance will persist until it is resolved through the development of supra-rational capabilities involving insight, intuition, patience, compassion, forbearance, trust, sincerity, gratitude and, most importantly, love.

According to the mystics, true equilibrium is only achieved when these other modes of operational activity are fully developed. Although discursive thinking of a logical sort does have a role to play in all of this, it is hardly the dominant, or the central, consideration.

Finally, once again, one needs to raise the fact there are purely rational modes of operational activity that are every bit as important as are formal logical/mathematical modes of operational thinking but that cannot be reduced to these latter forms of thinking. Hermeneutical thinking, for instance, neither needs to conform to, nor does it need to reflect, systems of formal logic or mathematics.

It can have a structural character that is quite different from these latter systems of thinking, yet, such non-formal thinking cannot be said to be, in any way, inferior to formal mathematical-logical thinking. In fact, non-formal modes of thinking are capable of engaging a whole variety of moral, religious, political, artistic, historical, legal, philosophical, literary, and interpersonal issues, while still producing heuristically valuable results. However, formal logic and mathematics haven't been able to make the slightest, plausible dent in such issues.

Piaget does emphasize that all levels of operational thinking exhibit the property of being able to manipulate mental structures in a purely mental manner, without any sort of physical activity serving as intermediary. Moreover, part of such mental manipulation involves the capacity to think in terms of the possibility and potential inherent in some given structure, rather than being restricted only to what has been observed.

Nonetheless, Piaget maintains that the primary means of exploring and exploiting such possibility and potential is through the hypothetical-deductive method as expressed in terms of systems of formal logic and mathematics. Very little, if any, credence is given to the possibility there might be equally viable, if not more productive, alternative means of exploring and exploiting the possibilities encompassed by various ontological and experiential structures.

Piaget draws a distinction between wisdom and knowledge. According to Piaget, wisdom refers to that which results when there is a dialectic between personal values and objective knowledge. Such results are thought of by him as largely philosophical in nature. Knowledge, on the other hand, presupposes determinate criteria of truth and rigorous standards of methodology. The end result of the combined effect of these criteria of truth and standards of methodology is science.

Piaget's characterization of wisdom is rather arbitrary, if not biased. Traditionally, wisdom has meant having a certain orientation to the truth - namely, one that permitted the individual to be able to successfully apply the truth to the problems of everyday life.

Wisdom was not just a matter of having a certain kind of understanding, it also was the ability to implement that understanding in ways that had great heuristic value in resolving moral, political, philosophical and interpersonal difficulties. As such, wisdom is not just a matter of the combining of personal values with objective knowledge. It represents the penetration of insight into the very soul of knowledge and the drawing of practical value from that insight.

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According to Francois Jacob, a biologist, organisms generate a biological, space-time analog of reality. The structural character of this analog will depend on a variety of factors such as: the way in which an organism is sensorially hooked into the environment, as well as the manner in which such information is processed, transformed, organized, shaped, stored, oriented, and so on, once the sensory data has gone through the initial process of transduction.

Depending on the species and the circumstances, and, depending on what sort of sensory modalities an organism has available to it, an organism might generate a variety of spatial analogs of external reality. Thus, for example, one can speak in terms of acoustic space and aromatic space, as well as visual space or proprioceptive space.

Furthermore, temporal cues often shape the structural character and orientation of such spaces. For example, in the superior olivary complex, fairly subtle comparisons are made concerning time differentials for a given sound reaching each ear. These temporal differences are used to help construct acoustic space.

Each kind of sensory process will give expression to a characteristic ratio of temporal and spatial vectored currents. All of these currents are woven together to produce a complex analog representation of external reality.

Acoustic space, visual space, proprioceptive space, and so on, are fundamental currents that shape and orient an organism's mode of analogically representing various aspects of reality. However, in human beings, one cannot reduce reality to a set of sensory analogs. In fact, sensory analogs become incorporated into even more complex hermeneutical analogs of reality.

Hermeneutical analogs are representations emphasizing various modes of valuation, signification, purposefulness, meaning, interpretation and understanding. Each mode of conceptualizing, understanding, theorizing or methodology gives expression to a characteristic ratio of hermeneutical constraints and degrees of freedom that feature, but are not reducible to being functions of, a variety of sensory modalities.

The spatial-temporal structures derived from sensory modalities constitute an important source of both constraints and degrees of freedom for the generation and construction of hermeneutical analogs. They are a source of constraints in as much as one has to be able to reconcile various aspects of one's hermeneutical analog with the structural character of various spatial-temporal analogs.

If one cannot produce such a re-conciliation on some level of scale, then, one has to begin questioning the tenability of either the sensory analog or the hermeneutical analog or both. On the other hand, the spatial-temporal analogs constitute a source of degrees of freedom since they are starting points for exploration, inquiry, experimentation, analysis, reflection and so on.

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One of the most fundamental vectors shaping temporal identity is memory. Psychologists have distinguished two broad categories of memory: namely, short-term and long-term memory.

In human beings, short term memory last for about 10-15 seconds. In other species, short-term memory can cover a longer time period. For instance, the fruit fly has a short term memory of approximately 45 minutes, and the bee has a short-term memory of about five minutes.

In each of these cases, if what is stored in short-term memory is not converted into a long-term memory format, then, the data is lost to the organism. Moreover, short-term memory is quite vulnerable to various kinds of interference, and such interference disrupts the contents of short-term memory so that they are either permanently lost or they become garbled.

Just as there is a temporal set of constraints that characterize short-term memory, there also is a sort of quantitative constraint on the amount of data that can be stored in short-term memory. This is George Miller's magic number of 7 plus or minus 2.

In other words, approximately seven units of information -- give or take a few such units -- can be stored in the temporary buffer constituting short-term memory. However, depending on the meaningfulness of what is being stored in short-term memory, and depending on the kind of mnemonic strategy one employs, a unit of information can vary, to some extent, with respect to its size.

One other facet of short-term memory has a significance that is relevant to the discussion of temporal issues. This aspect concerns the way in which short-term memory retains the temporal character of the sequence in which events transpire.

Although there is considerable debate in the psychological literature, the currently prevailing view suggests there are three kinds of long-term memory. These categories of long-term memory are referred to as: semantic, episodic and procedural.

Semantic memory appears to be somewhat time-independent in the sense that it is concerned largely, if not exclusively, with the sort of data that gives expression to facts relating to numbers, mathematical expressions, formulas, addresses, laws, rules, dates, and so on. Moreover, semantic memory often has a symbolic form that can be divorced from temporal contingencies.

Episodic memory is quite different from semantic memory in this latter respect. In episodic memory, temporal relationships play an important role. The contents of this kind of long-term memory revolve around biographical events that occur in the life of the individual. What one did, where one did it, when one did it, who one did it with, what was done to one, and so on are all instances of the kind of material stored in episodic memory.

Episodic material plays a fundamental role in the individual's development of a sense of temporal identity. As the evidence concerning patients who suffer from, for example, retrograde amnesia indicates, the loss of episodic memory tremendously alters the way the individual interacts with the surrounding environment.

In addition, there can be tremendous flexibility, from individual to individual, surrounding the formation of this aspect of temporal identity. Each individual generates and establishes his or her own set of phase relationships with a given event or episode. Therefore, even though one-and-the-same event might be engaged by two, or more, individuals, the arrangement, number, shape, orientation and so on, of the set of phase relationships formed in each case, can vary greatly.

In a sense, the foregoing considerations are reminiscent of the methodology of Einstein's special theory of relativity. In that theory, observers in different inertial frameworks engage one-and-the-same event, arriving at different values for times, velocities, lengths, mass, and so on, as a result of the variable character of the phase relationships that their respective methodologies generate during the event-engagement process.

Procedural memory revolves about skill learning sorts of issues in which one has to acquire certain steps or procedures in order to gain mastery over a variety of physical, mental or social activities. Driving a car, rules of etiquette, playing a game, learning a new language, and so on, are all examples of skills requiring a substantial amount of procedural memory if they are to be mastered with any degree of competence or expertise.

This category of memory is somewhat like semantic memory in as much as one does not have to remember the context in which one learned a skill in order to have mastery of that skill. All that matters is retaining certain facts or data about how to do something.

On the other hand, there is a sense in which procedural memory is somewhat like episodic memory since the temporal sequence of the steps or procedures is important to retain. If one does not learn the correct sequence of steps for a given technique, if one does not grasp the rhythmic character(s) of a given procedure, if one does not develop the requisite set of phase relationships concerning a given skill , then, one will not be able to acquire either competency or expertise in the performance of the associated procedures, techniques or skills.

Procedural memory might be considered to be a sort of subcategory of semantic memory in which temporal issues assume a certain degree of ascendancy. Procedural memory also might be considered to be a sub-category of episodic memory in which biographical features become largely horizonal, with little focal importance. In either case, there would be two sorts of long-term memory rather than the three categories that are currently favored in many psychological circles.

A further possibility is as follows. There is a sense in which only one kind of long-term memory exists, but it consists of a ratio of time-relevant to time-irrelevant factors. However, because there can be different ratios of these factors, this gives the appearance of different categories of memories under different circumstances.

On the view being put forth here, semantic memory would be characterized by a ratio with a, relatively speaking, low time-relevant component and a high time-irrelevant component. Episodic memory, however, would have a ratio with a high time-relevant component but, relatively speaking, a low time-irrelevant component.

In neither of the above cases can one suppose a given component of the ratio is zero. There always will be a certain number of time-irrelevant themes present in memories that are largely time-dependent, just as there will always be a certain number of time-relevant themes present in memories that are largely time-irrelevant in character.

Finally as previously indicated, procedural memory constitutes a case combining elements of both episodic as well as semantic memory. Therefore, the temporal ratio for procedural memory will exhibit aspects of both time-relevancy as well as time-irrelevancy.

One advantage of conceptualizing things in the foregoing manner, is that instead of having to come up with experimental evidence supporting the existence of three mechanisms of memory, one only has to come up with evidence for one mechanism of memory. Moreover, the character of the mechanism one is looking for is, at least in general terms, fairly well specified.

In other words, the mechanism being sought must provide for a set of ratios of constraints and degrees of freedom capable of varying with respect to themes of time-relevancy and time-irrelevancy. Another feature of this mode of conceptualizing things is the way in which it places temporal phase relationships squarely in the picture of all manifestations of memory, whether short-term or long-term.

A further possibility that might follow from the foregoing conceptualization of the structural character of memory has potential implications for educational issues. More specifically, phase relationships become very important to the efficiency with which things are learned and remembered.

For example, one possibility why suggestopedia or super-learning works, when it does work, is because of the emphasis laid -- albeit, perhaps, unconsciously -- on temporal phase relationships as a means of unifying the different components of the learning situation. When everything is in phase, then, memory or learning becomes more efficient both in terms of coding as well as in terms of decoding.

In any event, one might think about the possibility of seeking to improve the efficiency with which learning occurs by trying to alter the character of the time-relevancy to time irrelevancy ratio. This could be done by manipulating the set of phase relationships linking an individual with the learning situation.

Some phase relationships might be more conducive to the fixing of a memory than are other sorts of phase relationship. If so, the former kind of phase relationships will form the currents that will have to be manipulated through amplification, or by suppressing other kinds of phase relationship that might prove to be a source of interference.

People who suffer from Korsakoff's syndrome or from some other cause of anterograde amnesia might represent something of a problem for the theory of structural memory as a ratio of time-relevant to time-irrelevant components introduced earlier. People who suffer from some form of anterograde amnesia would seem to suggest cases in which the aforementioned ratio is zero since short-term memory apparently cannot be converted into either semantic memory or episodic memory.

On the other hand, people who suffer from Korsakoff's syndrome are able to learn certain kinds of new skills such as how to do a puzzle, although they will not remember how they came to learn to do the puzzle. This suggests procedural memory is, to some extent, still intact in such people.

Given that sufferers of Korsakoff's syndrome still have some degree of procedural memory, the existence of such memory capabilities could be seen as being consistent with the aforementioned ratio theory concerning the structural character of memory. In fact, the existence of such memory capabilities in the sufferers of Korsakoff's syndrome would seem to suggest the importance of phase relationships in helping to fix memory.

Procedural memory is required when a task has, relatively speaking, a time-relevant component and a time-irrelevant component that are roughly equivalent. The source of the time-relevant component is the phase relationships that establish the sequence of the steps that are necessary to solve a given puzzle. The source of the time-irrelevant component is the contents of the steps or procedures, taken individually and apart from the role that they play in a set of steps or procedures.

This fixing of a sequence in long-term memory would not have to involve an understanding of the relationship of the sequence of steps to the solution of the puzzle (i.e., a means-ends relationship). Quite possibly, the individual would have no recollection of having solved the puzzle before.

On the other hand, the increased speed with which the puzzle is solved over a number of trials would indicate a learning curve is present. This learning curve would be a function of: (a) the individual's capacity to transfer the phase relationships of short-term memory into long-term, procedural memory, and (b) the individual's capacity to transfer the content of individual steps, apart from their role in a sequence, to long-term, procedural memory.

Procedural memory cannot be reduced to either (a) or (b). Time-relevant components depend on time-irrelevant components for themes of structural content. In other words, specific ratios of time-irrelevant constraints and degrees of freedom establish a set of thematic parameters out of which phase relationships can emerge.

On the other hand, time-irrelevant components are shaped by time-relevant components, since transitions and shifts in phase relationships are established through these latter components. Consequently, in procedural memory both a time-relevant and a time-irrelevant component are needed.

In cases of anterograde amnesia, the ratio of the two components (i.e., time-relevant to time-irrelevant) is the key to being given access to long-term memory. If, in a given learning task, the requirements for the time-relevant component of the ratio are too high, as in the case of episodic memory, then entry into long-term memory will be blocked or inhibited.

Alternatively, if, in a given learning task, the time-irrelevant component is too high, as in the case of semantic memory, then,, again, entry into long-term memory will be blocked or inhibited in the individual who is suffering from anterograde amnesia. In each case, the ratio provides the wrong sort of dialectical arrangement of phase relationships and structural content.

The question, then, becomes this: why are the memories of people suffering from anterograde amnesia still open to certain kinds of time-relevant to time irrelevant ratios, but not to other kinds of such ratios? Certainly, this is a question that has to be answered if one is to work toward having a full theory of the transition process between short-term memory and long-term memory. It is also a question that has to be answered if one is to develop a greater understanding of the problem of anterograde amnesia.

There is a second question that might be closely related to the foregoing question. Do the memory problems displayed by those who suffer from Korsakoff's syndrome have any implications for normal, everyday sorts of difficulties encountered by people when they try to commit something to memory? In other words, maybe the reason why there is often a hit or miss, almost random-like, character to whether we retain something or not has to do with the kind of phase relationships one has with the material that is to be learned.

Some kinds of phase relationship might be more conducive to the retention of material than are other sorts of phase relationship. Something of this sort already has been suggested when mentioning the data that indicated that children who were read a story in the mid-to-late afternoon seem to retain material in long-term memory better than do children who are read stories earlier in the day.

Closely aligned with the issue of whether or not the structural character of a phase relationships plays a central role in fixing something in long-term memory, is another issue. Maybe the ratio of time-relevant components to time-irrelevant components is of critical importance in determining whether or not something will or will not be fixed in memory and, therefore, learned.

The present inability to provide an answer to the foregoing question does not invalidate the ratio theory of the structural character of memory. In fact, if anything, the ratio theory proves to be a heuristically valuable tool since it not only has generated the question, but, as well, it provides an orientation or approach for engaging, exploring or probing such a question in the context of broader issues of memory, learning, structural character, phase relationships and focal/horizonal dialectical interaction.

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According to Campbell, logic is essentially atemporal. This sort of perspective reflects a recurring theme in thinking about the nature of logic. From the 'traditional' perspective, logic generally is construed as some sort of universal set of principles that holds in all times and in all places and is, therefore, independent of spatial and temporal considerations.

Perhaps, this traditional perspective should be challenged. More specifically, one might have a fruitful line of exploration, if not explanation, if one were to suppose logic is intimately connected to certain aspects of temporality.

For example, logic could be conceived as a reflection of the structural character of the phase relationships to which a given point-structure, neighborhood, or latticework gives expression. By tracing out, or mapping, the way different aspects of the internal character of a given structure are related to one another, or by tracing out or mapping the way different aspects of various structures interact with one another, or by mapping the way the spectrum of ratios of constraints and degrees of freedom of a given structure dialectically engage the spectrum of ratios of constraints and degrees of freedom of other structures, one comes to grasp the 'logic' of these structures.

One of the reasons why, throughout years of philosophical discussion, the study of logic seems to have promised so much and, yet, failed so miserably, as well as proven, for the most part, to be so heuristically infertile an area of exploration, is because it has been treated as, or construed as, a static, unchanging entity that is atemporal. In point of fact, however, logic might be dynamic, dialectical and very temporal. This is the case since logic gives expression to the manner in which structures relate to themselves or to other structures, as a function of the transitions, shifts, transformations, alterations and so on, occurring in the manner in which spectrums of ratios of constraints and degrees of freedom interact with one another.

While there might be certain constants associated with the dialectical interaction of structures, these constants occur in a context of change, transition, transformation and so on. One cannot understand the structural character of dialectical interaction by looking at only the constants. One also must look at the ratio of constants to parameters of variability.

The story of structural character and phase relationships is told through the way this ratio changes over time. In order to look at the ratio of constants to parameters of variability, one must map the way in which constraints dialectically play off against degrees of freedom in a given set of circumstances. Such mapping gives expression to the logic present in a given dialectical and structural context.

Viewed from the foregoing perspective, logic is not a search for, or study of, universal, static, constant, unchanging relationships among premises, situations and so on. Logic is a search for, or study of, the inferential mappings of the phase relationships manifested through a spectrum of ratios of constraints and degrees of freedom that exist within a given point-structure, neighborhood, latticework or set of latticeworks. Logic is the study of the orientation and vectored/tensored character of the phase relationships linking the themes of constancy and variability in and among, particular structures. Logic becomes a study of the manner in which phase relationships shift during the transitions and transformations brought about by the dialectics of structural engagement.

In addition, part of logic might involve the phenomenon of entrainment. During the entrainment process, certain aspects of a given idea's (or value's or principle's or rule's) spectrum of constraints and degrees of freedom establish a state of phase relationships with certain aspects of other ideas, values, principles, rules, and so on. The entrainment process serves to generate a synchronous set of phase relationships that have a particular orientation. This orientation is what gives expression to the logical character of a relationship.

In fact, the grasping of logical relationships might have something to do with the detection of the structural character of such entrainment processes. In other words, one is able to see how the entrainment process maps out an orientation among a set of phase relationships. By locating the logical counterparts to, or analogs for, a zeitgeber (i.e., time-giver), one is able to trace the phase currents generating hermeneutical orientation.

In a sense, traditional logicians have been seeking to do something akin to what Einstein accomplished in the special theory of relativity. Traditionally, logicians have attempted to identify and preserve universal laws of logic that are manifested during all transactions of thinking.

This is similar to the manner in which Einstein's methodology attempted to identify and preserve certain universal physical laws in relation to transactions involving different inertial frames of reference.

Unfortunately, among other things, logicians have never been able to locate a constant like the speed of light in a vacuum that could anchor their systems as the velocity of light did for Einstein in his special theory of relativity.

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William James' spoke of the notion of the specious present, so-called because of the tendency of people to construe the present as a mathematical-like point that has position but no size or quantity or structure. According to James, this sort of characterization is an illusion. It leads people to believe one can neatly separate the present from the past , when, in point of fact, the present overlaps with the past.

Thus, from James' perspective, the present is not a mathematical point. The present is a unit of duration that carries a certain amount of the past with it.

Treating the present as a unit of duration had certain implications for James. If one were to maintain that conscious experience were merely a sequence of autonomous events, there would be no psychological justification for connecting or relating experiences, one to another.

Yet, if the present is a unit of duration combining certain elements of the present as well as the past, then, one could not represent consciousness to be a succession of independent points of sensation, emotion, ideas, images and so on. There are linkages among these experiences because of the way the structure of the present encompasses certain aspects of the past.

Although James did not make use of the phenomenological and hermeneutical idea of the horizon, such a concept fits in quite nicely with his position concerning the treatment of the present as a unit of duration that includes elements of the past. In fact, the idea of the horizon allows one to modify the structural character of James' notion of the present as unit of duration.

More specifically, not only does the present contain elements of the past, it also, in a sense, contains elements of the future. This is due to the way one is hermeneutically oriented toward, and prepared to engage, whatever occurs next.

The present also can be said, in a sense, to contain elements of the future due to the goal-directed strategies or plans that one is in the process of implementing. The following discussion gives a concrete texture to the contention that the present contains, in a sense, elements of the future.

One of the problems that intrigued Karl Lashley was the phenomenon of serial behavior. More specifically, he wanted to know how human beings are able to generate behavior consisting of a rapid sequence of movements.

For example, when a person speaks a language, this involves a coherent, sequential assemblage of different semantic components, syntactical elements, as well as movements of the tongue, mouth, and so on. All of this complex activity occurs very quickly.

Another example is when an individual plays a musical instrument. This usually requires the performing of a rapid series of intricate movements of hands and/or mouth and, sometimes, feet. So, the question that Lashley and others asked was: what makes rapid serial behavior possible?

The prevailing theory of serial behavior, up to the time of Lashley, considered such a process to be an example of a feedback process. According to the feedback hypothesis, once a sequence of behaviors begins, each unit of the sequence induces the next step in the series to occur.

Lashley discovered, however, that in certain cases (e.g., the playing of a piece of piano music) the time interval between steps in the sequence of playing notes was too short to fit in with what would be predicted on the basis of a feedback hypothesis. Lashley concluded some mechanism or process besides a reflex chain would have to be invoked in order to account for serial behavior.

Lashley theorized that a series of actions, probably, formed a unified sequence under the command of some sort of integrated motor control system, the whole of which was set in motion by the first note. Nevertheless, he could not explain how this took place.

The answer to Lashley's unresolved problem was uncovered in the 1980s. More specifically, a system of biochemical oscillators has been discovered that is responsible for regulating rhythmic sequences of movement.

These biochemical oscillators drive an integrated motor system Such motor systems of oscillators have been found in an extremely varied number of species.

In the terminology of this activity, the aforementioned system of motor oscillators can be construed in terms of the activity of a focal attractor basin working in conjunction with horizonal informational elements of the past and future. Indeed, the structural character of the present is given expression in terms of the phase relationships it has with those elements of the past and the future that are spread along the horizon. The dialectic of focal attractor basins with horizonal attractor basins manifests the property of duration to which James' position alludes, and such duration is what links together the different aspects of serial behavior.

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Evoked potentials refer to specific kinds of electrical activity in the brain that arise in response to the presentation of certain stimuli. Evoked potentials can be distinguished from background electrical activity by means of various techniques of analysis involving computers and mathematics.

Different waveforms of evoked potential have been associated with different contexts of stimulation. For example, an evoked potential waveform known as P300 occurs whenever an individual is surprised by one of the events in a sequence of stimuli. Another evoked potential is known as a contingent negative variation or, in less technical terms, the expectancy wave.

As the latter expression suggests, an evoked potential occurs when an individual is led to believe a certain kind of stimulus will occur at a given point in time or at a given point in a series of events. As the time approaches for the stimulus to appear, the contingent negative variation waveform increases in amplitude. The size of the amplitude increase will be a function of various factors in the personality, past history and current circumstances of the individual in whom the expectancy wave potential is being evoked.

An individual's perception of internal time consciousness can be affected by the structural character of the contingent negative variation waveform that is present. Generally speaking, the larger the amplitude of this wave - that is, the greater the individual's expectations concerning the time of occurrence of a given event, then, the more rapidly will run the individual's perception of events in internal time consciousness relative to some external measurement of the temporal duration of such an event. As a result, during the course of some event, the individual will feel external time measurement of the event is running very slowly relative to the individual's perception of the rate at which internal time consciousness measurement of the event is taking place.

The experimental work of Robert Hicks, a psychologist, seems to indicate the appearance of the expectancy wave can be traced to the activity of cells in the frontal lobes of the cerebral cortex. Apparently, these cells either: (a) are responsible for the synthesis and release (when activated by the action potential) of the neurotransmitter dopamine; or, (b) are sensitive to the presence of dopamine (i.e., they have receptor sites on their membranes that are dopamine-specific and that modulate the cells activity when dopamine occupies these sites). Hicks and others have found that the perception of events in internal time consciousness can be affected by giving the individual drugs that either increase the synthesis and release of dopamine or that prevent dopamine from occupying the relevant receptor sites on the membranes of dopamine sensitive cells.

Thus, for example, amphetamines, that lead to increased synthesis and release of dopamine, have the effect of speeding up the perception of events in internal time consciousness relative to some external mode of temporal measurement concerning those events. On the other hand, Haldol, which is a neuroleptic (i.e., a class of drugs used in the treatment of certain psychotic conditions), blocks the action of dopamine through competitive inhibition. As a result, the individual's perception of events, as measured by internal time consciousness, slows down relative to some external mode of temporal measurement with respect to those events.

Jeremy Campbell ties the expectancy wave phenomenon to the biological clock in the frontal lobes of the cerebral cortex. In other words, he believes the cells responsible for generating the sense of the 'passing moment of the present are the cells giving expression to the individual's perception of internal time consciousness. Therefore, according to Campbell, such cells are responsible for the individual's experience of the present as having a certain kind of structural character of duration.

Even if one accepts the proposal that increases or decreases in the levels of dopamine in the receptor sites of the membranes of certain cells in the frontal lobes are associated with the modulation of the individual's perception of internal time consciousness, this does not explain what is responsible for the process that leads to the increase of dopamine production, or to the increase of substances that will block the action or synthesis of dopamine. In other words, the presence or absence of dopamine is only a step in the causal sequence resulting in the modulation of an individual's perception of internal time consciousness.

Dopamine does not initiate this causal sequence. It merely is one of the effects of such an initiation process.

Consequently, in order to say one understands what sets an expectancy wave in motion or why a given expectancy wave has the amplitude it does, one is going to have to fill in quite a few missing facts. Moreover, these facts that are missing are not a matter of insignificant details. They go to the very heart of what is really going on in the case of the emergence of a contingent negative variation waveform of a given structural character.

Equally important, as far as problems with the dopamine hypothesis are concerned, is the following consideration. That theory provides no account of how the individual becomes conscious of the presence of such an evoked potential waveform of given character.

All that has been shown, at best, is there is an association between the presence of such a wave and the character of the individual's perception of internal time consciousness. The existence of the wave and the individual's awareness of the wave might be two separate things.

If one treats consciousness as a separate dimension (rather than an emergent by-product of a certain level of complexity of neuronal activity), then, the phenomenology of the experiential field or the phenomenological manifold can be dialectically linked to the waveforms of evoked potentials by means of phase relationships - both in terms of being shaped by such wave forms, as well as in terms of giving rise to such wave forms. Because both neural activity and the phenomenological manifold share a common bond by virtue of their respective links with the temporal dimension, they have an opportunity to exchange phase quanta during states in which phase relationships are established between these dimensions.

Moreover, phase relationships are established through focal, intentional activity whose structural character is a joint function of physical/material processes (i.e., neural activity) as well as phenomenological awareness and reflexive awareness. Consequently, focal awareness is like a complex vortex or twistor that forms at the intersection of a dialectic involving, among other things, dimensions such as awareness, intelligence, materiality, energy and time.

As such, neural activity can act as an attractor that draws focal activity into its sphere of influence, just as focal activity can serve as an attractor when it draws certain aspects of neural functioning into its sphere of influence. However, in each case, the process of 'drawing into a sphere of influence' occurs on the level of phase relationships and will subsequently be manifested in an appropriate structural form of the dimensional medium to which a given set of phase quanta has been transmitted.

Phase relationships do not occur at a physical, material locus. They occur in the temporal dimension as a function of the ordered, sequential, rhythmic, oscillatory character of the way in which a given structure, taken as a spectrum of ratios of constraints and degrees of freedom, temporally relates to different aspects of itself.

Said in a slightly different way, phase relationships are a matter of the way in which the different ratios of constraints and degrees of freedom of a given spectrum are temporally ordered with respect to one another. The aspect of being 'temporally ordered with respect to one another does not just refer to what comes before and after. It also encompasses the dialectic of these ratios.

As a result, the character of the phase relationships established through this dialectic are capable of shaping the manner in which the ratios will be activated. Indeed, even in the case of a single ratio, the dialectic between the constraints and degrees of freedom of that ratio will generate phase relationships capable of causing the ratio to undergo transitions, thereby altering the manner in which the structure, to which the ratio gives expression, is manifested.

Underlying all of this dialectical and phase relationship activity is the order-field by means of which a variety of dimensional currents are given expression. These dimensional currents are different ways in which the order-field manifests itself in an structural fashion. In other words, each dimension constitutes one of the ways in which an order-field has of giving expression to itself.

Every dimension has a structural character that is, in a sense, prime. In other words, the structural character of the dimension cannot be reduced or factored further to some set of sub-dimensions. Consequently, a dimension cannot be shown to be a function of either another dimension, or some combination of such dimensions. Each dimension brings something unique to dimensional dialectics, and the order-field generates, shapes, organizes and regulates the unique structural currents of different dialectic of dimensions.

Some of the unique structural currents of the temporal dimensions are given expression through phase relationships and phase quanta. Phase relationships and phase quanta, in turn, shape, color, orient and organize the structural character of temporal identity across a variety of levels of scale, ranging from: the biological to the social, and from thinking to awareness and memory.

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Chapter 7: Holographic Images

Objects have the effect of distorting or altering the waveforms that engage such objects. The manner in which a wave form is altered serves as an index or signal of the character of the object encountered. In a sense, the nature of the alteration of the waveform is sort of like a lingering trace of the character of the object engaged by the waveform.

For example, if a given object has the property of absorbing a certain range of wavelengths, then, when it meets a complex waveform, the object will 'extract' those energies that it is capable of absorbing from the waveform complex. Those wavelengths in the waveform complex falling outside the object's absorption range will be reflected. By extracting certain wavelengths, the object has altered the character of the waveform, and the nature of the alteration provides an index for one of the properties of the object involved. We usually refer to this property as color.

Objects with a penchant for absorbing all manner of wavelengths will appear dark or black because little of the original waveform is reflected back or permitted to be further transmitted due to the absorption property. On the other hand, objects possessing little capacity for absorbing any of a range of wavelengths in an encountered waveform complex will appear to be whatever color happens to predominate in the wavelengths of the waveform complex being engaged.

Thus, if the entire spectrum of wavelengths is present, the object will appear to be white. However, if the wavelengths in the waveform complex are dominated by those corresponding to the blue region of the spectrum, then, the object will appear bluish, and so on.

Beside the property of color, objects also will alter the character of encountered waveform complexes as a function of a variety of other features. These other features include general shape, texture, surface contours, and so on.

The energy associated with a given form of electromagnetic radiation is directly proportional to wavelength. The shorter the wavelength of the radiation, the greater will be the energy of that radiation. Furthermore, the shorter the wavelength of a given form of radiation, the greater will be the frequency or cycles per unit of time of such radiation.

Finally, as the wavelength of a given form of electromagnetic radiation becomes smaller, the amplitude of the waveform increases - that is, the peaks of this radiation's waveform become higher, and the valleys or troughs become deeper. The intensity of a waveform is directly proportional to the height of its amplitude. One should keep in mind, however, that although frequency and amplitude are functionally linked in the various forms of electromagnetic radiation, these two characteristics are independent in other kinds of waveforms such as in the case of sound waves and water waves.

No matter what kind of waveform one is dealing with, one can define that waveform completely by considering only its amplitude and phase. In mathematical terms, amplitude and phase constitute the essential variables in the function describing a given waveform, whether simple or complex.

Phase refers to the portion of a cycle that a wave has passed through at a given moment. The term 'cycle' is used because waveforms can be mapped onto points along the circumference of a circle. This provides one with the opportunity to describe the waveform in mathematical terms.

More specifically, the circumference of a circle covers an angle of 360 degrees. Since frequency is the rate at which a waveform repeats itself per unit of time, the 360 degrees circumscribed by the circumference of a circle can be used as a unit measure for the number of cycles completed per unit of time by a given waveform of a certain frequency.

A function's value depends on what happens to some other value. When such an independent value changes, then the value of the function will also change in an appropriately dependent fashion.

A sine has numerical values ranging from 0 to 1 and from 1 to 0 as the value of an acute angle varies, respectively, from 0 degrees to 90 degrees and from 90 degrees to 0 degrees. Cosines are also numerical values. However, as acute angles vary from 0 to 90 degrees and from 90 to 0 degrees, cosines range, respectively, from 1 to 0 and from 0 to 1.

When the sine value is at its maximum, the cosine is 0, and when the cosine is at its maximum value, the sine value is 0. Sine and cosine are opposite in value, both with respect to magnitude as well as sign, so if one of the two is positive, the other will be negative in value.

If one draws a unit circle, in which the radius of the circle remains constant at 1, then, any right triangle one inscribes in the circle with angle A's vertex at the center, will have a constant hypotenuse of 1. On the other hand, one moves the right triangle around the unit circle, the values of 'A', 'x' and 'y' all will change.

As 'A' changes from quadrant to quadrant (one should envision the unit circle with diameters running from top to bottom and from side to side, forming a perpendicular axis), one gets two non-zero values for 'x' and 'y' of the right-triangle. That is, one gets two nonzero values for the sine and cosine of the right triangle.

If one constructs a graph, plotting values of sine and cosine (fluctuating between +1 and -1 and forming the y-axis) against the corresponding degree readings of the unit circle (ranging from 0 degrees to 360 degrees and that will form the x-axis), one gets a wave form. In the case of the sine wave, one starts off at 0 (for the sine value) versus 0 degrees.

As the sine value approaches a maximum of +1, the degree value approaches a maximum of 90 degrees. At 180 degrees, the sine value becomes 0 again. As the sine value approaches a value of -1, the degree value works toward 270 degrees. Finally, when the degree value is 360 degrees, the sine value once again returns to 0, and the wave cycle has been brought to its original starting point of a 0 sine value and a 0 degree value.

In the case of the cosine wave, one starts off with a cosine value of +1 and a degree value of 0. As the cosine value approaches 0 for the first time, the degree value comes closer to 90 degrees. When the cosine value reaches a value of -1, the degree value is at 180 degrees. When the cosine value reaches 0 for the second time, this corresponds to 270 degrees. Finally, as the unit circle completes its cycle at 360 degrees, the cosine value once again approaches its initial value of +1.

The formula for the circumference of a circle is $2\pi r$. In the case of a unit circle, however, where $r=1$, then, the formula for the circumference becomes merely 2π. If one translates degree values into 'π' values, 90 degrees, that corresponds to 1/4 of the circumference, converts into 1/4 x 2π = 1/2π. 180 degrees becomes 1/2 x 2π= π, and 270 degrees translates into 3/4 x 2π = 1 1/2π. With each new cycle, one merely adds 2 (which represents one complete circumference or cycle) to all the 'π' values for the corresponding degree values. Thus, 450 degrees (that is, 90 degrees into the second cycle) becomes 2 1/2π, and so on.

The value of +1 represents the highest point of amplitude for either a sine or cosine wave. However, the value of +1, in and of itself, does not inform one whether one is dealing with a sine or cosine wave (or some form of wave in between a sine and cosine wave), nor does it tell one exactly where one is in the cycle.

The aspect of phase enters in at this point, for in giving the phase spectrum with the amplitude value, one is providing a means of locating where a given amplitude value occurs in a cycle, relative to some identifiable point of reference such as 0 degrees, or the starting point of a cycle.

A sine wave reaches a maximum of +1 at 1/2π, 2 1/2π, 4 1/2π, etc.. A cosine wave, on the other hand, reaches a maximum amplitude of +1 at 0π, 2π, 4π, and so on.

If one has a wave, for example, of amplitude +1, with a phase spectrum of 1/2 π, 2 1/2π, or 4 1/2π, one knows that one is dealing with a sine wave. As long as one has both amplitude and a phase spectrum, one has the basic components for defining a regular wave.

In short:

(a) amplitude and phase define sine and cosine waves; (b) sine and cosine waves define regular waves; (c) a series of sine and cosine waves can define a compound wave; (d) amplitude and phase define compound waves.

In a sense, the cycle of a waveform marks the transitions in amplitude that the waveform undergoes over time, ranging from zero, to maximum, and back to zero again. If one wishes to inquire about the character of the amplitude at any given point in the cycle, then, one will have to engage the cycle at an appropriate point in time during which the aspect of the cycle in which one is interested is being expressed. The precise stage of transition of the wave's amplitude at that point in time constitutes the wave's phase.

Amplitude gives expression to a quantitative measure of the energy of a wave. For example, a wave has maximum energy at the crest point and minimum energy at the trough point. Phase, on the other hand, locates or places a particular manifestation of a given waveform relative to the structure of the entire cycle of transitions that such a waveform goes through over time.

The character of transition in amplitude referred to earlier does not refer to the absolute magnitude of the amplitude at a given point. It refers to whether the amplitude is increasing or decreasing as well as whether the amplitude is approaching or leaving: (a) a zero point in amplitude; (b) a maximum point in amplitude, or (c) a minimum point in amplitude. These themes of whether the amplitude is increasing or decreasing -- together with the nature of the relationship of this increasing/decreasing activity with the maximum/minimum points of the cycle -- describes how the current expression of amplitude (as a pure magnitude) stands in relation to the structural character of the waveform as a whole.

Thus, phase constitutes the facet of the waveform's structural character being engaged at a given point in time. Phase is the waveform's amplitude orientation to the world at a given instant of engagement or manifestation. As such, phase is not something that can be weighed with scales or measured, calibrated and scanned with instrumentation.

Phase is essentially relational in character. Therefore, it requires a reference point against which it plays off in order to establish its orientation within the structure of which phase is an expression. For the most part, the relational character of phase is expressed as a function of time and/or angles.

As long as one knows where to place 0π, which serves as a point of reference, one has a means of determining both amplitude and phase. However, if one has no means of identifying the point of reference through which one starts the 'π' scale, one really has no means of establishing whether a regular wave is a sine wave or a cosine wave or some other form of regular wave.

As a general principle, one might argue that any methodology involves, as part and parcel of its being a methodology, a means or technique for locating or establishing a point of origin or a reliable point of reference. This sort of point of reference is one that is rooted in, or is purported to be rooted in, the structural character of reality or that which reflects an aspect of such structural character. Through this point of reference, one can locate or orient oneself in relation to a wave's or latticework's (considered as a complex or compound waveform structure) current expression of its phase spectrum.

As long as one's methodology is unsuccessful in establishing this referential point of engagement, one will have no means of locating, identifying, determining or establishing what the phase spectrum of a latticework is or where one is in that phase spectrum when one experientially engages that latticework. Moreover, if one selects an incorrect, distortive or problematic point of reference as a basis through which to engage a given latticework, the difficulties surrounding that initial selection will be transmitted throughout the whole subsequent engagement and orientation process.

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Even if one is not able to establish an absolute point of reference for locating where the n-scale begins, relative phase can still be given a determinate characterization under certain circumstances. For example, this can be done when one has two waves that are out of phase with one another by a specifiable amount of 'π'.

In other words, when one looks at the phase difference between two waves, one has a means of engaging the waves in a relative manner that permits one to orient oneself with respect to them to a certain extent. The phase difference between two waves is usually calculated as an angle.

Interference involves two or more waves that are interacting through their phase differences. For instance, if one considers two waves of different amplitudes but that are in phase, when the two waves interact with one another, they will tend to produce a wave with higher crests and lower troughs than either of the original waves considered individually. This is a case of constructive interference in which there is a relative phase difference of 0.

However, if two waves of the same amplitude, but opposite phase, interact with one another, the result will be a wave in which troughs and crests coincide and, therefore, cancel out to have zero amplitude. This is a case of destructive interference in which the relative phase difference of the two waves is a non-zero value.

As the relative phase difference approaches a maximum value when the two waves are precisely opposite in phase character, the crests of the daughter waves will become increasingly less than either of the parent waves and the troughs of the daughter waves will become increasingly less than either of the parent waves. In short, both the crest and trough of the wave will approach the horizontal axis of the graph as a limit.

A definite phase relationship must be established between two or more sets of waves in order for an interference pattern to be created. A phase relationship that is well-defined is referred to as being "in step".

On the other hand, when the phase relationship is not well-defined, then, the waves are said to be "out of step". Out of step waves cannot produce interference patterns. Therefore, even in the case of destructive interference, there must be some degree of well-definedness to the phase relationship of the waves involved.

The situation becomes more complicated if one keeps the amplitudes of the interacting waves equal but allows the phase difference to have values less than n or 180 degrees. Under these circumstances, the waves sometimes will manifest constructive interference and, at other times, will give expression to destructive interference, depending on the value of the relative phase difference. Nonetheless, for each specific relative phase difference, there will be a unique daughter wave whose shape is a reflection of that specific relative phase difference.

If we permit one more complicating factor to be introduced (namely, variable amplitudes for the interacting waves), in addition to a relative phase difference of less than ‘π’, one will generate a daughter wave that has a unique size (as a function of the interacting amplitudes) and unique shape (as a function of the interacting phase differences). In other words, the magnitude of the daughter waves will be a function of the amplitudes of the parent waves, while phase differences will determine where and when constructive and destructive interference will occur.

In general, the magnitude and shape of the daughter wave produced by the interaction of n-waves will be completely determined by the amplitudes and relative phase differences of the interacting waves. Therefore, any compound wave can be represented as a summation series of amplitudes and phases of a set of interfering waves.

In an optical hologram, information is stored in the form of alternating zones and bands of light and dark. These alternating bands are the telltale signs of the presence of interference. The density of these interference regions depends on the intensity of the light being used to make the hologram.

As indicated earlier, the intensity of the light wave is an index of the wave's amplitude. Therefore, density of the interference patterns provides one with a means of deriving information about amplitude.

This is one of the two factors necessary to be able to give a complete description of a given waveform. The other factor enabling one to describe a waveform is the relative phase.

Such information is reflected in the rate at which transitions occur in relation to the shifts in constructive and destructive manifestations of interference as one moves from one point or zone of the hologram to another contiguous point or zone in the hologram. This rate of transition carries the phase code.

In simplified terms, objects alter the structural character of those light waves interacting with it. This alteration affects both the amplitude and phase character of the waveform. These altered characteristics will be transmitted to, and given expression in, the pattern of interference that develops when the light that has encountered an object meets up with light waves that have not encountered such an object. Photographs of a conventional sort record data about amplitude but not about phase. Holograms also record and keep track of data on phase relations as well.

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Initially, Dennis Gabor was not trying to invent a holographic process. He was trying to enhance the resolution of the pictures taken through electron microscopes.

Resolution concerns the problem of separating or sorting out the details, one from the other, in an image of some object, irrespective of whether the image is in the form of a photograph or a reflection. Although there are a variety of factors affecting the degree of resolution obtainable in a given instance, one of the more essential shaping factors is the wavelength of the form of radiation being used to 'illuminate' the details of the object one is trying to resolve. In general, the shorter the wavelength of the illuminating radiation, the better will be the resolution of the object being illumined and the better will be the resolving power of one's means of illumination.

Gabor believed that if one could get an electron picture containing all the available information in relation to a given object, and, then, if one corrected this picture through optical means, one might obtain a far greater degree of resolution than one could get otherwise. However, everything depended on being able to preserve the phase information that is often lost.

An essential tenet in Gabor's ideas concerning the enhancing of resolution through optical means was his belief that one tended to lose phase information because one had nothing with which to compare such information. He believed he had a way to preserve the phase information that was usually lost.

Gabor proposed to split the waves of a light source. One of the split beams would make contact with a target object. The other beam did not interact with the target object but would be permitted to recombine with the 'target-object wave' later on.

Gabor believed that if one split the light in the foregoing manner, the subsequent, 'post-object-engagement' interference pattern of the two beams of light would allow phase information to be preserved. In other words, the interference pattern would provide a means of keeping track of the differences in amplitude and phase between the object wave and the reference wave from the time that the two were split from the initial light beam, until they came together again in the form of an interference pattern.

The information concerning amplitude and phase differences was to be stored on a photographic plate. Gabor believed that if one reconstructed the wave-front of the interference pattern stored on the photographic plate, one should be able to give enhanced resolution to the object's image because the hologram would have preserved all of the relative phase variations as well as a record of the changes in amplitude.

Gabor's technique is referred to as the 'in-line' method due to the way the object to be photographed is placed in a direct line between the light source and the photographic plate. As originally developed by Gabor, the in-line method was limited to objects that were transparent. It could not handle non-transparent or dense objects.

The diffuse-illumination hologram was developed by Juris Upatnieks and Emmett Leith in the 1960s. Unlike Gabor's 'in-line' method, the diffuse-light hologram used reflected light rather than direct light and, consequently, was referred to as an 'off-axis' hologram.

In the Upatniek-Leith method, the initial light beam was passed through a partially coated mirror that split the light beam. The split beams of light were then, transmitted along their respective paths by a series of mirrors.

One series of mirrors conveyed one of the light beams to an object and, then,, onto a juncture where it would meet up with the reference beam. The reference beam had been transmitted by another series of mirrors through an alternate route that by-passed the object being photographed. When reunited, the beams created an interference pattern that preserved variations in phase and differences of amplitude.

Leith and Upatnieks used laser light (lasers were invented in 1960) as their coherent light source. Laser light consists of twin emissions of light that are perfectly identical both with respect to phase as well as amplitude.

In addition, Leith and Upatnieks put a diffuser on the light source of the laser. This had the effect of scattering the light somewhat.

However, the light was scattered in in a way that did not affect or alter the coherency of phase relationships of the twin emissions. The addition of the diffuser had the remarkable effect of permitting each and every point of an illuminated object to act as a light source.

Furthermore, each and every point of the photographic plate was able to store a complete record of the information received from the multiple light source of the object being illuminated by the diffuse but coherent laser light. In short, each point of the photographic plate preserved all amplitude changes and phase variations that resulted from the interference pattern created by the interaction of the object beam and the reference beam.

While the stored message is believed to be whole and complete at every point of a hologram, nonetheless, resolution of the message is lost as the size of the fragment of the hologram becomes smaller and smaller. The reason for the lost of resolution is due to the increasing weakness of the signal with decreasing size of the signal carrier.

As the signal grows weaker, it becomes more susceptible to the effects of noise or competing signals. This results in an eroding of the image being transmitted by the signal. How badly the image is eroded will depend on the ratio of noise to signal.

Theorists, however, consider the eroding of the image to be a problem of the signal carrier rather than the actual message itself. Therefore, they believe that although resolution is lost as the size of the hologram fragment decreases, the message always remains intact.

As indicated above, theorists believe there is no lower limit on the size of the point of the photographic plate that can retain all the amplitude changes and phase variations. The absence of a lower size limit is because of the supposedly 'sizeless' nature of relative phase. However, there are certain questions that might be raised about this contention.

To be sure, relative phase is a relational rather than a purely quantitative relationship. Yet, in the case of holograms, the relationship still involves physical entities in the form of energy interference patterns. Consequently, one might not be able to escape entirely from the realm of the material or physical and, therefore, quantitative and 'sized'. At some point on the far side of the Planck length, one might suppose the physical disappears and with it the 'things' that are being related through relative phase.

In any event, intuitively, one might presume that the smallest possible means of storing, as well as transmitting, an optical hologram is the photon that is the carrier of the electromagnetic force. This raises some interesting questions about how a single photon could transmit and store the entire interference code of a hologram.

For example, how does the structural character of a single photon (which is, supposedly, like a sizeless, geometric point-particle) allow the photon to preserve the amplitude changes and phase variations that occur when the photon engages some, given target object? If one supposes that the field generated by a photon, or that accompanies a photon, is where a signal is 'inscribed', the fact is, something has to keep the structural character of the encoded field intact. Something has to permit the phase relationships to be preserved so that the message does not dissipate prior to being recorded on the plate at the point of interference.

Presumably, this 'something' is the dialectic of forces and/or dimensions that establishes the set of constraints and degrees of freedom that are described in the field equations governing a given phenomenon. In this case, the phenomenon consists of coherent optical processes that are: (a) separated into reference beam and object beam, (b) sent along different paths (one of which encounters an object) and, then, (c) rejoined in the form of an interference pattern.

A field cannot account for the existence of the forces generating and shaping it. The field is merely the phenomenal expression of the dialectic of such forces. Consequently, the capacity of photons or the photon field to encode or store messages seems to depend on an underlying substratum of ordered or ordering activity. This ordering activity permits encoded signals to be preserved by organizing the way photons, photon-photon interactions, or photon fields manifest themselves.

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Holograms need not be restricted to instances using light as the only means of creating the reference waves and object waves that subsequently interfere with one another. Any kind of wave phenomenon could be used, including: electrons, X-rays, microwaves, and so on.

In fact, since wave motion is equivalent to any kind of periodic or harmonic motion, theoretically, one should be able to generate a hologram using any sort of periodic motion as long as one can find a means of preserving the changes of amplitude and the phase variations involved in such motions. In other words, what is important is the set of relationships that capture the character of amplitude and phase, together with any transitions occurring with respect to amplitude and phase.

Frequency modulation of radio waves utilizes the phenomenon of phase modulation. In FM radio waves, the amplitude is kept constant while the frequency of the wave is modulated. The modulation of the wave's frequency that is conveying the signal is what constitutes the message being transmitted. Since phase is the primary index of the location of amplitude, and since the location of the crest and trough of amplitude shifts as the frequency of the wave is altered, frequency modulation is actually a matter of phase modulation, and phase modulation is central to the holographic process.

For quite some time, neurophysiologists knew that neural signals utilize principles of frequency modulation. Consequently, these signals revolve around phase variation.

The neural impulse is represented on an oscilloscope as a moving wave-front. This wave-front constitutes the fluctuation in voltage along the exterior of the neuron's cell membrane subsequent to the ebb and flow of ions brought on by, first, the collapse, and, then, the restoration of, the resting membrane potential. The moving wave-front on the oscilloscope is usually referred to as a spike.

The neural impulse is governed by the all-or-none law of transmission. Essentially, this law stipulates that: (a) unless the critical value of a neuron's threshold is reached, the cell will not generate an impulse wave; (b) once the threshold value has been achieved, the subsequent impulse will travel down the axon in a wave of uniform amplitude and constant velocity; and (c) neither the amplitude's uniformity nor constancy of transmission velocity will be affected by increasing the intensity of the signal triggering the neural impulse.

People such as Karl Pribram believe sensory receptors produce signals that trigger different sets of on/off or excitation/inhibition combinations of neurons. These different sets collectively form interference patterns. Where there are interference patterns, there, too, are phase modulations.

The magnitude of frequencies and energies required to generate holograms in the laboratory are not to be found in the nervous system. Consequently, one cannot draw direct comparisons between holographic theory and what goes on in the nervous system. However, the means by which events are encoded and stored in the nervous system might be an analog for the holographic process (or vice versa).

An analog is a structure or latticework or pattern capable of preserving a certain kind of logic, principle, relationship or set of relationships that is found in some other structure, latticework or pattern. Furthermore, the character of the two structures, latticeworks or patterns that are analogs of one another involve different mediums.

Oscillations, periodicies, vibrations, cycles, undulations, and so on that occur in a variety of different mediums are all analogs of wave phenomena. In each case, the logic, principles and relationships of amplitude and phase are preserved despite differences in the character of the medium in which, and through which, these phenomena occur or take place. Therefore, if a given medium has a means of preserving phase relationships, it has the potential for being an analog for a hologram.

Consequently, the brain or the mind, in some analog fashion, might be able to preserve data on amplitude and phase relations, as well as provide a means of reconstructing this data, without requiring the high energies necessary to produce the intensities associated with coherent light. In fact, what might be most important, if there were an analog process for the holograph in the mind or nervous system, is not even amplitude.

In the mind, neither amplitude nor energy, per se, might be as important as being able to have a means of recording gradations in the intensity of intentional orientation or focus. This aspect of the intensity of focal orientation (together with the feature of phase relationships that locates or orients that focal intensity within an aspect of the phenomenology of the experiential field) might be the means by which the latticework of an event's structural character is encoded to form a memory.

Alexander Metherell believes the heart of the hologram is actually phase. In fact, he was able to produce the phase-only hologram by keeping amplitude constant at one level and just focusing on the variations of phase. Metherell's discovery suggests that one might, yet, be able to show that memory is rooted in the idea of a hologram - but a phase-only hologram.

Similarly, one might want to treat the vectored interaction of ideas and concepts as interference patterns of a special sort. For example, instead of conceiving of the interference of ideas as a simple function of amplitude, frequency and phase spectrum, or instead of conceiving of such interference as merely giving rise to some simple daughter wave as a function of whether the interference is constructive (i.e., additive) or destructive (i.e., subtractive), the interference of ideas might best be construed in terms of being dialectic, multi-dimensional and non-linear in character. In short, the ideational or conceptual waveform might be a complex latticework that behaves differently than normal waves usually do - yet, still retains some qualitative properties of wave phenomena in an analogical form.

Normal waves give expression to the principle of superpositioning in which they 'flow' through one another without their structures being affected when they come out the other side of the interaction. During the course of interference, naturally, the 'daughter' wave resulting from the constructive/destructive interference of the parent waves will give expression to an altered structural character. However, once the interaction is over, the parent waves revert to their original character.

In the case of hermeneutical interference, the interaction might be less like a standard case of interference and more like a holographic context. In the latter case, the light wave is distorted or warped or altered by the structural character of the object with which it comes into contact. Furthermore, the light wave remains in a distorted or warped condition even after the wave departs from the scene of object-engagement.

In other words, as ideas move through one another, a dynamic, dialectical vectoral field is generated that is capable of altering the structural character of one or more of the ideas involved in the interaction. Which, if any, ideas will be altered, or to what extent and in what way, will really depend on the character of the ideas involved. Moreover, the character of the alteration will depend on how the individual brings the ideas together in a given context and how susceptible each of the ideas is to certain kinds of motivational, emotional, physical and spiritual forces that might be impinging on the interaction.

Inferential/mapping functions might play an especially prominent role in this vectoral, dialectical process of ideational interference. In this sense, the field generated by the interaction of the ideas is, or can be, greater than the sum of the parts since the phase relationships given expression through the inferential mapping functions have a tendency to generate further phase relationships and inferential mapping functions - somewhat as an electromagnetic field continues to propagate itself at right angles to the direction of primary propagation. As a result, the initial ideas involved in dialectical engagement begin to be altered by the very properties of the hermeneutical field that such ideas have helped to establish.

In the context of hermeneutical interference patterns, notions of phase, relative phase and phase difference are likely going to be a be more structurally complicated, subtle, dynamic and dialectical than is the case for ordinary waves of even an irregular and compound nature. Under such circumstances, phase might have a lot to do with the hermeneutical orientation of an individual at a given time as different ideas, concepts, values and so on are brought into juxtaposition with one another and begin to interfere with one another.

Moreover, in the case of hermeneutical interference processes, relative phase and phase difference might involve inferential/mapping relationships that become manifest, or are generated, during the period of ideational interference. Such inferential/mapping relationships might not establish what the ultimate truth is, but the phase differences of such relationships allow one to orient oneself with respect to the ideational interference at hand and to grasp the structural character of the 'daughter' latticework resulting from such interference. This provides one with a point of engagement through which to attempt to try to work out the character of the interaction between certain aspects of ontology and phenomenology that makes possible experiences of an observed structural character.

The relationship between focus and horizon often constitutes a relative phase difference and not necessarily an absolute one. An 'absolute' phase difference would be indicated if the relationship between focus and horizon was congruent with, or reflective of, some aspect of reality.

Even in the case of congruency, however, there would be a certain relativity of phase difference inherent in the situation since the truth being expressed or reflected would not necessarily constitute the deepest, most essential penetration of the truth concerning a given aspect of the structural character of reality. Nevertheless, a phase difference latticework having some degree of congruency with the structural character of the scene being reflected is certainly more objectively accurate than a phase difference latticework that has little or no congruency with the structural character of the scene to which identifying reference is being made.

In any event, when an 'object' is encountered in the phenomenology of the experiential field (irrespective of whether that object is a sensory experience, a concept, a dream, an emotion or some other kind of experiential latticework), the beam of consciousness is split, with horizon and focus traversing different paths until they reunite to create the dialectic of interference in which focus and horizon play off against one another to generate an n-dimensional hermeneutical holograph of the scene to which identifying reference is being made.

The term "n-dimensional hermeneutical process" has been used above in order to draw attention to the way, in the phenomenological context, one gets a multi-faceted point of view with the hermeneutical holograph, just as one does with a normal holograph. However, in the phenomenological case, one is not restricted to merely the exterior surface and contours of what is being holographed. One also has access to the qualitative, non-physical 'surfaces' and 'contours' of the structural character of the n-dimensional dialectical product of a hermeneutical holographic process.

In other words, the penetrating power and capacity for resolution of understanding goes far beyond the limits of purely physical/material process. Indeed, in a sense, one could say that the penetrating and resolving power of even material/physical techniques is a function of the underlying hermeneutical latticeworks in which such techniques are rooted and that shape and direct and orient the latter processes.

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At the heart of Fourier's thesis for analyzing waveforms is the contention that any compound, irregular wave can be shown to be equivalent to the summation of a series of simple, regular waves. This series is known as a Fourier series. In turn, any physical phenomenon displaying an oscillatory nature or a periodic character can be expressed as a Fourier series of sine and cosine waves.

An irregular, compound wave can be treated as a series of increasingly smaller regular waves. In fact, as one proceeds along the series, the frequencies of the smaller and smaller waves becomes increasingly greater. In other words, they complete their cycles at progressively faster rates.

Fourier's technique involves selecting some initial regular wave to be used as a working representation of the period of the compound, irregular wave in which one is interested. He, then, used his method to establish a set of coefficients to be used in conjunction with the selected working representation of the initial, compound, irregular waveform. This process of finding the coefficients is called Fourier analysis.

When integrated, the series of coefficients and the corresponding increasingly higher frequencies for the increasingly smaller waves will add up to the value of the fundamental frequency used as a model for the irregular, compound wave. The coefficients were selected in order to make the frequencies of these increasingly smaller waves whole number multiples of the initial regular wave frequency.

Fourier's method actually uses a kind of dialectic to guide the process of generating the coefficients to be selected for the Fourier series. By gathering together the values for all the regular waves derived through Fourier analysis and using these values to make a compound wave, one has an opportunity to compare this synthesized wave against the original irregular, compound wave.

When the synthesized wave can be shown to closely match the original wave, then, one terminates the analysis. If, on the other hand, the match-up is not sufficiently close, then, one continues to proceed with further analysis.

The initial wave in a Fourier series is referred to as the fundamental harmonic. Each successive wave in the Fourier series is called, in turn: the second, third, fourth, etc., harmonic. In most cases, a series consisting of nine coefficients (that is, up to the ninth harmonic) is able to provide a sufficiently close approximation for even very complicated, irregular, compound waves.

Once the series of coefficients has been determined, one is in a position to plot a graph involving amplitude versus frequency. Graphs can be symbolized in the form of an equation. An equation consisting of a series of coefficients that represent the amplitude/frequency properties of a set of regular waves is known as a Fourier transform.

There were certain technical limitations inherent in the idea originally conceived by Fourier. However, a number of other theorems have been introduced to permit one to circumvent these limitations. The most important of these supplementary theorems is the Laplace transformation.

The term "transform" can be used in either a verb or noun form. Usually, however, the term is used in its noun form of transformation- as that which is generated from, or is the result of, a transforming process. In its noun form, transform refers to either the graph-figure or the equation that is produced by a specific functional ordering of the Fourier coefficients.

In essence, then, a transformation represents both the transition from one mathematical form to another, as well as the structure produced by that process of transition. Moreover, in accomplishing this transformation, one also has undergone, in the case of Fourier analysis, a transition from perceptual space (which is the medium through which the original irregular, compound wave that is being modeled is given expression) to Fourier transform space.

In perceptual space, frequency is a function of time, and, as a result, the 'perceptual frequency' is expressed in terms of cycles per second or Hertz units (Hz). However, in transform space, frequency becomes a spatial function. More specifically, frequency is measured by the density of stripes occurring in a given area of an interference pattern.

The term 'stripes' refers to the periodic patterns of light and dark that are manifestations of the junctures of constructive and destructive interference. In fact, the density value of stripes in a given area depends on the character of the phase difference between the interfering set of waves.

Therefore, frequency is fundamentally linked to phase. For example, signals in the nervous system are sent as waves in which amplitude and frequency are independent of one another, but the signal is transmitted in transform space as a spectrum of phase differences.

One of the benefits resulting from the transition to the 'spatial' form of transformation is to help simplify calculations. In Fourier transform space, one often can accomplish with multiplication and division what only could be accomplished with the use of calculus in perceptual space.

Furthermore, the periodic character of a phenomenon often manifests itself more clearly and markedly in Fourier transform space (as well as in the still more abstract counterpart of Fourier transforms known as Laplace transforms) than it does in perceptual space. For example, the message, signal or interference pattern of a holograph more clearly manifests its structural character in transform space than it does in perceptual space.

The key to gaining access to transform space is the Fourier transform. However, the enhanced clarity of the holographic message in transform space does not mean one visually can see a clearer signal. The clarity is a manifestation of the way the structural character of the logic of the relationships involved in, and among, different transforms becomes better resolved in our understanding. As a result, one can better grasp the structural character of the latticework of phase relationships that cannot be seen visually.

A Fourier series of coefficients has a corresponding Fourier transform. Therefore, if the structural properties of superimposing waves (i.e., the operation of convolution) becomes difficult, if not impossible, to grasp in perceptual space, one might perform the requisite transform operation to generate a mathematical form that is more accessible to the understanding, and, therefore, is more open to exploration, manipulation and so on.

The alterations and transitions occurring in the amplitude and phase of the light waves as a result of engagement with an object do not constitute an image of the object. These alterations of the light wave constitute a transform of the object. In order to restore the image of the object inherent in the information carried in the transform of the object, one needs to perform a transform of the transform.

The first Fourier transform translates the object's structural character into an 'object' (which could be a figure, graph, set, or magnitude of some sort) of transform space. Then, a second Fourier transform operation occurs when the first transform is run through a lens system that translates the object of transform space into an object of perceptual space.

The first Fourier transform operation is comparable to Fourier analysis. This similarity is due to the way in which the transform translates the irregular, compound wave, constituting the object, into a set of regular, uniform, simple waveforms in transform space. These latter waveforms are capable of modeling the original compound wave (i.e., the object).

On the other hand, the second Fourier transform operation corresponds to Fourier synthesis. This is the case because the second operation has the effect, like Fourier synthesis, of recombining the set of waveforms of transform space into an image or figure of perceptual space that gives synthesized expression to the irregular, compound waveform with which one started.

One of the essential defining differences between the object and reference wave revolves around asymmetric alterations in the property of phase variation arising as a result of differences in the character of the paths undergone by the object and reference waves. For each aspect of the compound object wave, phase will vary in relation to the corresponding aspect of the reference wave.

Furthermore, among all of these phase variations, there will be at least one phase variation that will remain the same both before and after the point of interference. This fixed-point phase variation serves as the invariant reference point relative to which all the other phase variations will take place.

The foregoing consideration concerning fixed-point phase variation is at the heart of one of the basic requirements underlying the hologram phenomenon. More specifically, there must be a spectrum of phase variations in transform space that has the property of being well-defined. Usually, the meaning of being 'well-defined' involves being able to tie a given variation to some invariant feature. Thus, one of the minimum conditions that must be satisfied in order for a hologram to be possible is for there to be a fixed-point relationship between the object and reference waves.

People, like Karl Pribram and Paul Pietsch, argue that memory is a particular spectrum of phase variations in transform space. These phase variations exist as a transform analog of relationships among different sets of neurons in the brain.

As such, mind is not stored in the form of molecules, action potentials, neuronal cells or any other aspect of brain functioning or anatomy. Mind is an expression of the variations in phase relationships that are stored in transform space.

The physical/material activity of the brain's neural networks might serve as part of the instrumentality that is necessary to help generate the compound reference and object waves. However, the storage of the interference patterns of these waveforms is a function of the spectrum of phase variations arising as a result of the differences between the reference and object waves. These differences are stored in transform space, not perceptual/material space, since they involve phase relationships, not actual 'things'.

Seen from the foregoing perspective, memory is a transform of a transform. This transform of a transform moves, as well as translates, a structure from transform space into perceptual space. It is an analog of the reconstruction of a wave-front that occurs when one passes coherent light through a holographic plate at the appropriate angle of incidence.

Although the foregoing has a nice theoretical ring to it, one should not lose sight of the fact that transform space is a mathematical construct that is, at best, an analog for what is occurring in the dialectic of dimensions (including the material processes of brain functioning). In other words, the model being put forth by Paul Pietsch, Karl Pribram, and others presupposes that transform space is primarily mathematical in character, consisting of the results of operations on sets of points or on magnitudes or on geometric figures in perceptual space. Nonetheless, actual transform space might not be at all mathematical in character, although mathematics might provide a means of generating analogs for the structural character of the ontological counterparts to such a mathematical model.

In the case of human understanding, transform space might be entirely a function of the hermeneutics of the phenomenology of the experiential field. This field is generated by the non-linear dialectic of various dimensions.

The dialectic of dimensions is, in turn, vectored, oriented, shaped, arranged and organized by an underlying order-field. Such an 'order-field' establishes the set of constraints and degrees of freedom governing the flow of the dimensional dialectic that generates the complex waveforms giving expression to the phenomenology of the experiential field having the structural character it does on a given occasion.

In the light of the foregoing possibilities, transform space can be approached in terms of its being a concrete reality rather than merely a mathematical abstraction. In other words, transform space is concrete in the sense that it is comprised of a determinate set of constraints and degrees of freedom as a result of an underlying dimensional dialectic.

However, the ontological character of this reality is not necessarily physical or material in nature. The ontological character might involve other dimensions such as consciousness, understanding (expressed as hermeneutical operations), will, and so on.

All of these other dimensions are capable of interacting with the physical/material realms, but the former cannot be reduced to being functional expressions of these latter dimensions. Indeed, the structures or waveforms generated through, for example, neural activity might have to be subjected to a set of non-material/non-physical operations in order for the neural waveform activity to be translated into hermeneutical transform space. Once translated in this fashion, the neural activity might act as vectors that are capable of helping shape and orient the events of hermeneutical transform space. However, one need not suppose that transformed neural waveform structures are the sole vectored determinants of that space.

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In one sense logical relationships are really a study in phase differences either within one latticework or between latticeworks or among latticeworks. However, rather than being linked with issues of frequency or temporal/spatial functions as is the case with frequency modulation or neural activity, respectively, logical relationships concern phase differences involving focal/horizonal orientation and engagement.

These phase differences can be relative since one can choose either horizon or focus or any one latticework as the point of reference against which one explores and measures differences in phase orientation and engagement in relation to whatever other structures, foci or horizons one is studying. Nevertheless, these phase differences can exhibit greater and lesser degrees of relativity depending on which dimensions and latticeworks, or that foci or horizons, one selects as a basis for reference and exploration.

Some reference points are more accurately and objectively reflective of the structural character of certain aspects of reality than are other such reference points. As a result, the former sorts of reference points are more capable than the latter sort of reference points of permitting one to properly orient oneself in relation to the study of logical relationships among different latticeworks or within a latticework or among various dimensions.

In any event, when one treats logical relationships as a species of phase differences, one is drawing attention to the way latticework orientation and engagement properties have vectoring and structural characteristics that manifest themselves in the form of various kinds of connections, linkages and relationships under different circumstances. These orientation and engagement properties are capable of being mapped as a set of complex dialectical interactions.

These interactions, in turn, are characterized by shifting ratios of constraints and degrees of freedom. Such shifting ratios reflect transitions in logical relationships as a function of alterations in the structural character, orientation and mode of ontological engagement of latticeworks and dimensions, one with another, as well as within themselves.

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When two or more wave systems interact to generate a memory, one cannot stipulate that memory is attached to any particular structural feature of the interacting systems. In holographic theory, any given memory is stored in transform space as a set of phase relationships. These phase relationships describe periodicity in terms of its essential characteristics.

Such relationships or characteristics do not, in and of themselves, give expression to any specific size, proportion or concrete form. They indicate relationships in the form of phase differences that do not have size, nor do they occupy space, nor do they have any particular concrete form of a physical or material nature.

As a result, in the holographic theory of mind, the mind cannot be reduced to the activity or anatomy or chemistry or electrical activity of the brain. This cannot be done since, in essence, the mind exists in transform space while the brain exists in perceptual space.

A question facing anyone who would propose a holographic theory of memory involves the problem of going from perceptual space to transform space. More specifically, what makes possible the translation or transduction process that converts perceptual space structures into transform space structures in view of the unlike nature of the two kinds of 'spaces'?

Seemingly, this is just another version of the mind-body problem of Descartes, for one would like to know how a physical/material process produces a non-physical and non-material structure. Perhaps even more importantly, how is transform space able to maintain or sustain or preserve relationships, given that it is non-physical and non-material in nature? Similarly, how does an element of transform space get re-converted into a perceptual space structure?

A holographic plate stores interference patterns in a form that can be re-accessed through wave-front reconstruction. The mathematical description of this process describes the movement between perceptual and transform space.

This sort of description is useful because it permits one to understand, within certain limits, some of the structural character of what is going on. One can, then, exploit that understanding to produce tangible results of a determinate, predictable sort. However, as previously suggested, the mathematical description or model might be, at best, only an analog for what actually occurs.

Even if one assumes that the physical plate only intercepts, somehow, the interference pattern existing in transform space and that the interference pattern is completely separate from the physical system used to intercept it, one still needs to know how such a process of interception works. How does a physical/material plate get affected and shaped by a non-physical and non-material set of relationships in transform space? Where and how do perceptual space and transform space interact? What serves as the mediator between these two realms?

The mathematical model can be shown to work because of the existence of a physical medium-namely the plate. In other words, theory maintains that the holographic plate stores the interference pattern in a form that is accessible by physical means.

Thus, if one wishes to retrieve the stored information, all one has to do is to engage the photographic plate with coherent light at the appropriate angle of orientation in order to reproduce the image of the object. What constitutes an 'appropriate angle' will be a function of the angle at which the interference pattern interacted with the plate when the transform of the object's image was originally stored. Without the plate, the mathematical model would be just an empty theory without any counterpart in the perceptual world.

Consequently, one wonders what will serve as the mind's counterpart for the physical plate of the holographic process. If the mind in holographic theory cannot be reduced to the brain, and if memories are not stored in the brain but in transform space, then, how does wave-front reconstruction take place so that one can have a memory-correlate in perceptual space? How does the brain manage to intercept the interference pattern of transform space to produce an image in perceptual space?

In addition, none of the foregoing mentions the problems surrounding the identity of the coherent light (or its source) that is to be used to help reconstruct the wave-front that exists in transform space. One also would like to know how such coherent light is to be sent through transform space at the appropriate angle. After all, transform space has no size or proportion or structure that would seem to permit one to have angles of any sort.

One possible approach to some of the foregoing issues and questions is outlined briefly in the following considerations. To begin with, the idea of transform space can be construed as an analog representation of the possibilities inherent in the dimensional dialectic that underwrites or makes possible the holographic process. In other words, transform space is a description of certain aspects of the structural character of the complex latticework generated by the dialectic of dimensions such as energy, temporality, space, materiality and intelligence (the latter introduced through the efforts of the scientists and mathematicians who devise and set up the holographic process).

More specifically, transform space is an analog representation or model of a subset of the phase relationships that are generated by the aforementioned dimensional dialectic. Transform space involves an inferential mapping that attempts to capture, or give expression to, the character of some of the linkages tying together the different dimensions under a given set of experimental or applied circumstances.

Therefore, in the case of a transform of a transform, such as occurs in wave-front reconstruction, a description is being given. This description is an analog representation of the sorts of phase transitions that are necessary to induce the dimensional dialectic to give expression to certain aspects of the phase relationships that were created when the original holographic interference waveform was generated.

Nothing is stored in transform space except a conceptual description. Indeed, transform space is just a label given to a certain kind of hermeneutical construction. This construction makes identifying reference to, as well as establishes inferential mapping relations and congruence functions with, those aspects of ontology involving holographic phenomena.

Information concerning the latter sort of phenomena is stored in the phase relationships that have been generated, and that are being maintained, by a specific arrangement of dimensional dialectics created through the holographic set-up. Viewed from this perspective, a holographic plate doesn't store information, so much as it is part of the dimensional dialectic that collectively underwrites the holographic phenomenon. As such, the plate is really a passageway through which one gains access, under appropriate circumstances of reconstruction, to those phase relationships that arose when the original pattern of interference was generated.

Thus, irrespective of whether one is talking about mental or material holographic plates, the principle might be the same. In each case, reconstructed images might be translations or reflections or transductions of certain aspects of the phase relationships that arose as a result of dimensional dialectics concerning the initial holographic process.

Although the plate and/or brain play a role in this dialectic, the role of the plate/brain might be that of a transducer rather than a storage medium. In other words, certain aspects of the plate or brain might serve as the physical/material pole of a complex latticework of phase relationships that links the plate/brain to other dimensional poles by means of the temporal dimension. As such, the plate/brain is capable of serving as a transducer that: translates, interprets, and generates, as well as, is shaped by, shifts in phase relationships concerning a wide variety of themes involving emotion, motivation, spirituality, intelligence, sensation, and so on.

A second point to keep in mind is this. In the hermeneutical/phenomenological context, phase gives expression to the individual's mode of engagement of, or orientation toward, the spectrum of ratios of constraints and degrees of freedom constituting the range of possibilities inherent in the structural character of the dialectic between individual and ontology.

While the attractor basins giving expression to the foregoing dialectic circumscribe all the possibilities inherent in the spectrum of ratios, under normal circumstances, not all of these possibilities can be engaged at any one time. When one of these possibilities is manifested- whether through inducement or spontaneous activity, the individual becomes oriented toward the on-going dialectic in a particular way. Consequently, the individual's mode of engagement or orientation becomes the hermeneutical angle of dialectical interaction at a given moment in time.

The term "hermeneutical angle" is used in the foregoing because the point of engagement or the point of orientation represents a phenomenological encounter of one ratio from among the spectrum of ratios of constraints and degrees of freedom that are possible to experience. Therefore, hermeneutical engagement establishes an experiential asymmetry that stands in focal relief to the horizon of remaining possibilities of the spectrum of ratios of constraints and degrees and freedom. This relationship between focus and horizon constitutes the hermeneutical analog counterpart to the notion of angle in geometry.

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In June of 1854, Georg Friedrich Bernhard Riemann, gave a lecture entitled: "On the Hypotheses which lie at the Foundations of Geometry". In this lecture he said:

"...geometry presupposes not only the concept of space but also the first fundamental notions for constructions in space as given in advance. It gives only nominal definitions for them, while the essential means of determining them appear in the form of axioms. The relation (logic) of these presuppositions [postulates of geometry] is left in the dark; one sees neither whether nor how far their connection [cause-effect] is necessary, nor a priori whether it is possible."

In essence, what Riemann was getting at in his lecture is that philosophers and mathematicians had imposed an Euclidean order on the ontology of space without bothering to determine whether or not such an imposition was warranted. Furthermore, the imposition had occurred without anyone having a fundamental and clear grasp of the extent to which the logical relationships among the set of postulates that have been imposed on ontological space are necessary.

Riemann felt one of the fundamental problems with geometry was that its foundations had been left in shadows. Instead of having started from true first principles, Riemann claimed Euclidean geometry had emerged from certain kinds of presuppositions that were somewhat removed from, and beyond, the realms of defensible foundational considerations.

One of the shadows that had been cast across the foundations of geometry concerned the idea of a point. Riemann believed the same fundamental principles governed the properties of points in both curves as well as straight lines, but this set of common principles could not be elucidated as long as one approached geometry in the traditional manner of Euclid. Consequently, Riemann proposed to construct a multi-dimensional concept of space using the idea of quantity as the basic building block in his construction process.

Riemann's starting point was an intuition about the nature of quantity. This intuition revolved around the idea that one encountered quantity through measurement.

In other words, whatever quantity is, it is something that is measurable or to which the process of measurement is applied. For Riemann, measurement involved the superimposing of two magnitudes: one magnitude was the quantity whose magnitude was not currently known; the other magnitude was the mode of measurement that was to be used to determine the character of the first magnitude.

The key to this process of superimposing was locked within the idea of continuity. Superimposing could only occur, according to Riemann, when one magnitude is part of the other magnitude with which it is being compared. In other words, one magnitude only could be superimposed with another magnitude when the two were, in some way, continuous.

The aforementioned feature of being 'part of consists of a very precise and exacting sense of the notion of continuity. More specifically, in order to demonstrate that two magnitudes are continuous in the way that would be necessary to make superimposing possible, one had to show that, at a minimum, at least one of the elements of a magnitude had the capacity to affect at least one of the elements of the other magnitude.

Suppose one had two elements x and y. Suppose, further, that a one unit change in element x brought about a one unit change in element y.

If one constructs a graph of x versus y based on the foregoing relationship, one will get a straight line. A straight-line graph describes a linear relationship between the elements being graphed. In such a relationship, the ratio of x to y remains constant irrespective of the size of the values involved.

A curve can be described as the envelope of its tangents. When dealing with the very prototype of curvature - namely, a circle, tangents can be constructed for each and every point of the circle.

Of importance here, as far as Riemann's project is concerned, is the fact that the tangent is linked to a single point. A tangent is also a function of an angle, and this angle can be construed as being a sort of indicator of directionality.

In the case of a straight line, all the points on that line are considered to have the same direction. As a result, any attempt to construct a tangent for the points on a straight line would not be able to reveal any information about changes in directionality.

On the other hand, in the case of a circle, neighboring points along any aspect of the circle's curvature will display slightly different directional characteristics. These directional characteristics are revealed in the differences manifested in the unique nature of the tangent that can be constructed for each of these neighboring points. When these tangents are altered, as one traverses from one point to a neighboring point along the curvature of the circle, the transitions in the value of the tangent inform one about how the aspect of directionality is affected by shifting from one point to the next.

If one assigns a tangent to any given single point on the x-y curve, the curvature of the point at that juncture will establish the slope of the assigned tangent. Furthermore, if one could actually examine a single point on the curve, the direction of that point would coincide with the slope of the tangent that had been constructed for that point.

In actuality, however, one could never really examine such a single point. This is the case since the points on the line supposedly have position without occupying space, and are, therefore, infinite in a way that does not permit any individual point to actually be identified in a concrete manner. The points exist as neighboring relationships of relative position without size.

Nonetheless, one can increasingly reduce the values of x and y so that they approach the hypothetical point on the curve to which a tangent has been drawn. As the values of x and y get closer and closer to this hypothetical point, the discrepancy between the value of curvature and the slope of the tangent becomes increasingly smaller.

In short, one approaches the limit of changes in y in relation to x. The process of locating such limits is the task of differential calculus.

Through the operation of differentiation, which is one of the basic operations of differential calculus, one attempts to establish those limit-approaching ratios of x and y (known as derivatives). These ratios permit one to identify the juncture where the curvature of a single point on a curve is synonymous with the slope of the tangent that can be drawn to that point.

Supposedly, the derivative acts as a guarantee of the continuity between x and y at a given point. Theoretically, this limit ratio or derivative is capable of satisfying Riemann's requirements for the process of superimposing of magnitudes such that y becomes part of x.

Derivatives have an important link to 'e' - the base of natural or Naperian logarithms. 'E' links y to x as a function: namely, $y = e^x$. Thus, when x = 1, then, $y = e^x = e^1 = 2.71821...$ ; if x = 2, then $y = e^x = e^2 = (2.71821...) \times (2.71821...)$ and so on. The plotting of the graph of this function yields a smooth, regular sigmoid curve. The uniqueness of 'e' lies in the fact that the value of the function y = ex in any given case yields the same value as the derivative in that case.

Although, as indicated previously, one never actually can see the relationship of points being referred to in the limit ratio that constitutes the derivative, in the instance of 'e, the graph of $y = e^x$ gives a macro depiction (i.e., a structure in perceptual space) of the structural character of curvature on the micro scale of infinitesimal points. The implication here is that if one actually could see what the structural character of a derivative is like on the infinitesimal scale of neighboring points along a curve, one would see what one sees when one plots the graph of the function $y = e^x$ - namely, a smooth, regular sigmoid curve.

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There might be a confusion in the foregoing between the idea of a derivative that serves as an index of relationship in a given region of space and the actual point itself. In other words, the derivative associated with e designates a limit-area or region near to, or in the neighborhood of, a given point that is part of the graph of $y = e^x$. When this derivative is translated into graph form, it yields a smooth, regular sigmoid curve. However, this sigmoid curve might not so much capture the structural character of a given point as it captures the structural character of the relationship of a set of neighboring points when the property of directionality undergoes transition as one moves through curvature.

The derivative is always relational and contextual. The derivative never concerns a single point in isolation. It focuses on how one point relates to another point in terms of alterations of directionality as one goes from one point to another along a curve.

Similarly, the function of $y = e^2$ is always relational. As such, although one can isolate points on the curve that are described by this function, these points are indices for relationships between x and y. In this sense, they are special kinds of points - relational points.

Relational points link together two or more values or magnitudes in the form of a juncture that can be static, dynamic or dialectical, depending on the character of the things that are being linked. Therefore, neither the graph of the derivative associated with 'e', nor the graph of the function $y = e^x$, actually isolate or identify or make reference to a single point.

One might suppose, nonetheless, that the reason why Riemann's intuition works is due to the way it allows one to explore the structural character of relationships among points and values in regions of space that can be made arbitrarily small to suit one's current needs for precision and rigor. The fact one has not captured the actual fundamental unit of space (assuming, of course, there is such a fundamental unit) doesn't really matter since one has found a unit that is small enough to help one to explore and capture the structural character of what one is studying.

In this sense, what is important in Riemann's methodological process of superimposing is not that one element, y, becomes part of some other element, x. What is important is that one's units of measurement provide a means of capturing the relationship among a set of points that are fundamental to the structural character of the magnitude or quantity being measured.

The better one's mode of measurement, the more congruent will be the structural character of the fundamental relationships in one's mode of measurement with the structural character of the fundamental relationships in that to which identifying reference (through measurement) is being made. The key lies in congruence (broadly construed) and not in Riemann's notion of superimposing.

Continuous relationships are a matter of discrete continuity in which discrete features, aspects, properties, etc., are linked together by a set of inter-locking and overlapping relationships. The continuity is provided through these facets of inter-locking and over-lapping properties that provide a means for certain aspects of a structure to continue to manifest themselves despite the fact other aspects of that structure no longer are expressed. This is like the way in which the handing on of the baton in a relay race permits the race to continue despite the fact that a new, discrete entity (i.e., a runner) has entered the picture, while previous discrete participants in the race no longer continue to play a role.

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In an attempt to elucidate Riemann's thinking, Paul Pietsch, in his book *Shufflebrain*, asks us to suppose that 'e' is the only metering device available to one. In addition, Pietsch suggests one consider the visual image of a string of pearls made up of e-units. These units can be increased or decreased in number and that together can be used to form different kinds of curvature. However, the string of e-units can neither be stretched nor broken.

If one had a flat surface on which there were two points x and y and one wished to determine the shortest distance between them, one could use the string of e-units as a measuring device. Seemingly, the shortest path between the two points would be that one which contained the least number of e-units. If the shortest path were represented as being 'x' e-units in length, this length would not change if one were to curve the string by putting it around a person's neck.

Thus, flat surfaces and curved surfaces can be related through the notion of least curvature of the path that links any two points on either surface. As indicated previously, least curvature is defined in terms of determining the least number of e's that can link the two paths.

Next, Pietsch asks one to imagine a triangle that is to be measured by the string of e-units because the string is very loose relative to the rigidity of the lines of the triangle, there is considerable difficulty in getting an accurate measurement of the length of the triangle's sides. Yet, if one decreases the size of both the triangle and the string of e-units, then, the accuracy of the measuring device becomes increasingly more accurate when any given side of the triangle and the length of the string of e-units approach one another as a limit.

Supposedly, at infinity, at least one of the points of the string of e-units can be superimposed on at least one of the points of the sides of the triangle. When this occurs, then, at least at one point, one magnitude (i.e., the measuring device) becomes part of another magnitude (i.e., the structure to be measured).

In this way, the measuring magnitude, consisting of e-units, is said to have one feature in common with the quantity magnitude being gauged by the measuring device. The feature that they hold in common is said to be curvature.

One cannot actually argue that a given length of a string of e-units is the same as any given side of the triangle. This would give rise to an apparent contradiction in which the straight line of a triangle has the same smooth, regular sigmoid character that a graph of e-values has. Nonetheless, at least at one juncture, the relationship between the string of e-units and a side of the triangle manifests the property of superimposing in which both have the same degree of curvature and, thereby, one becomes a part of the other.

The foregoing account seems to create a problem. If one cannot say that any given side of a triangle, taken as a whole, has a superimposable relationship with a string of e-units, taken as a whole (i.e., a straight line is not the same as a sigmoid curve, then, just what becomes of the idea of measurement?

Presumably, in order for one magnitude to be able to measure or gauge another magnitude, then, one of the magnitudes taken as a whole must be superimposable on the other magnitude taken as a whole. Whenever and wherever there is deviation from a relationship of superimposing of the two magnitudes, one introduces a degree of error or inaccuracy into the measuring or gauging process.

If one is uncertain as to the number of points at which superimposing holds, then, one is really uncertain about the actual gauge of the magnitude being measured. Furthermore, one does not have any means of estimating just how frequently superimposing deviations occur.

To be sure, Riemann might be less interested at this point in the idea of measurement than he is interested in trying to determine the structural character of the fundamental unit of space- namely, curvature. However, as suggested previously, Riemann has not really established that the fundamental unit of space is that of curvature.

What he has established is that one can use the idea of curvature as a fundamental unit of relational measurement and, thereby, produce heuristic results. Such results allow one to model various facets of the magnitude of quantity to which one is making identifying reference through the measurement process. In other words, Riemann has found a means of making operational the concept of quantity as a function of curvature, but he has not necessarily fathomed the fundamental structural character of the magnitude of quantity per se.

Curvature in Riemann's sense is a relational concept that exists among a set of points or values and does not necessarily reflect the fundamental structural character of a unit of space. As a result, once again, a distinction has arisen between the structural character of methodology and the structural character of the ontology such methodology is attempting to engage as a means of helping the individual to orient himself/herself with respect to some aspect of experience.

According to Riemann: "About any point, the metric [measurable] relations are exactly the same as about any other point.". In other words, the same fundamental units are involved in the construction of lines, surfaces and spaces, irrespective of whether those lines, surfaces and spaces are linear or curved. Each of these geometric structures is determined by, and a function of, the property of curvature.

Riemann claimed to demonstrate that when one analyzes the magnitude of flatness in terms of its most fundamental aspects or units (namely, points), one discovers that these fundamental units are but a special case of the property making up the fundamental units of curved geometric structures. In effect, the fundamental linear units making up the structure of straight lines, flat surfaces and rectilinear spaces give expression to the property of zero curvature.

For Riemann, geometry, of whatever sort, was constructed from fundamental or elementary units of curvature, and curvature was a manifestation of the character of the relationship among a set of points or values. These relationships could assume a positive, negative or zero value, and, taken collectively, they represented a spectrum of infinite curvature with respect to which any possible geometric figure could be subsumed as a simple or complex function of such curvature.

Riemann's position is not anti-Euclidean. Riemann is attempting to show that geometry does not begin and end with the Euclidean methodology.

Moreover, he is attempting to show there are limits to what Euclidean methodology can be fruitfully and accurately applied. Euclidean geometry works quite well in the context of simple and uncomplicated spaces, planes and dimensions. However, Euclidean geometry is incapable of handling geometry involving infinitely small regions.

Moreover, the structural character of the Euclidean plane is such that one could never show that parallel lines are capable of crossing. The reason for this is because the Euclidean plane is constructed from units displaying zero curvature. However, in those geometric planes constructed from units of non-zero curvature, one is able to show there are cases in which the appropriate kind of curvature will permit parallel lines to cross at some point.

In general terms, Riemann holds that the shortest distance between two points is the path showing least curvature among all the paths that might be drawn between those two points. In the case of Euclidean geometry, the shortest path is the one displaying zero curvature. This is expressed as a straight line.

Riemann held a dynamic understanding of what Pietsch refers to as the idea of "active zero". This is the zero between +1 and -1, not the zero of nothingness.

It is a relational concept forming part of a continuum with other values. It is not an absolute emptiness. Active zero is a relational but neutral presence.

As such, zero space identifies that part of the infinite spectrum of continuous curvature that lies between positive and negative curvature and that serves as a connecting link between positive and negative curvature. Zero space geometry encompasses those aspects of the infinite continuum of curvature involving units of construction displaying zero curvature, and this is the realm with which Euclidean geometry deals.

In summary, there are at least three basic principles characterizing Riemann's position:

(a) Geometric coordinates are a function of the elements of curvature and not vice versa.

(b) point (a) follows from Riemann's discovery that the relationship of points in the neighborhood of any given point is the same as the relationships of points in the neighborhood surrounding any other point. This means the geometric properties describing a given coordinate system will actually be a transform of the properties describing some other coordinate system. This is the case since underlying both coordinate systems will be a common structural bond in the form of the basic unit of curvature.

(c) the property of least curvature constitutes the structural theme that is at the heart of the transform operation linking one coordinate system with any other coordinate system.

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Using the basic ideas of Riemann, Pietsch attempts to construct a holographic theory of mind. For example, Pietsch treats any instance of periodicity in perceptual space as a set of coordinates that can be given transformational expression in an appropriate counterpart coordinate system in the mind. Moreover, such a transform will be an expression of an operation revolving around the basic notion of least curvature.

Thus, the constructs of perceptual space will be built from the units of least curvature that are inherent in perceptual space, whereas a corresponding construct in mental space will be built from the units of least curvature that are appropriate to mental space. However, in each case, the units of least curvature of perceptual space are transforms of the units of least curvature of mental space and vice versa.

One of the problems with Pietsch's foregoing position is the assumption that mental space actually has units of least curvature. This assumption geometrizes the mind and makes it a function of geometric conceptions of, and approaches to, ideas concerning the identity of the structural character of basic building blocks in the mind (assuming, of course there are such things as basic building blocks). With this geometrization of the mind comes the spatialization of the mind.

When one tries to represent other, non-spatial dimensions through the perspective of spatial coordinate systems, then, irrespective of how many coordinate axes one uses to construct this representation, the representation will always be problematic in its presentation. This is because each of the additional spatial axes being used is constructed from points whose structural character is peculiar to the spatial dimension and might not be translatable into, or reflective of, the structural character of the 'points' of the dimension being represented - assuming, of course, that non-spatial dimensions can be analyzed in terms of points of any kind whatsoever.

At the very best, the relationship between the spatial axis and the non-spatial dimension that that axis purports to represent might be an analog one. However, even if the spatial axis could have an analog relationship with the dimension being represented, one needs to understand the non-spatial dimensional significance of the structural character of the complex function to which each point on the spatial axis will give expression.

In other words, the 'points' of another dimension - to the extent that they can legitimately be referred to as points at all - will have a significance and meaning peculiar to that dimension's latticework nature. As such, these 'points' give expression to that dimension's unique set of constraints and degrees and freedom that describe what can and cannot occur through, or within, such a dimension.

What is expressed as curvature in the spatial dimension might not be expressed as curvature in the other dimension in question. In fact, the idea of spatial curvature might have no meaning or significance or counterpart - analog or otherwise - in a non-spatial dimension.

Curvature is but one instance of structural character, and an important question to ask oneself in this regard is this: Is any function based on curvature - no matter how complex that function might be - capable of generating a model that is congruent with the structural character of a non-spatial dimension being represented through a spatial axis system? The answer to this question will depend on whether or not an analog relationship between the spatial and non-spatial dimensions can be generated.

The capacity to plot the graph of a function in a spatial context is a very fruitful procedure. It provides a way of helping one to visualize and see relationships that might not be readily apparent in the functional form of those relationships.

This heuristic component carries over into the realm of transforms in which a transform of a structure in perceptual space might permit one to interact with the underlying set of constraints and degrees of freedom to which the perceptual structure gives expression, in a way that would not be otherwise possible. Nonetheless, if the initial functional characterization of something - in this case, some dimension 'x' - is problematic, this will carry over into the graph of that function.

When it comes to the representation of non-spatial dimensionality through the use of n-axes of a spatial coordinate system, people seem to forget that such systems are expressions of the constraints and degrees of freedom characteristic of the geometrization of space.

Consequently, the point-structures of spatial systems, whether considered in Euclidean or non-Euclidean terms, have the potential for distorting, if not totally obscuring, the actual structural character of the non-spatial dimensions being represented. In short, the structural character of points in the spatial dimension (and, again, Riemann views this structural character as a matter of curvature) might not be capable of capturing, or be translatable into (as a transform operation of some sort), or be an analog for, the structural character of some other non-spatial dimension.

The geometric perspective assumes, in principle, that a spatial transform or spatial analog or a function based on the spatial property of curvature inherent in the basic building blocks of space - namely, points - can be found for any and all other non-spatial dimensions. More specifically, in the case of the mental realm, the geometric perspective assumes: (a) that the mind is continuous in the same way that such a perspective claims space is continuous (i.e., as an infinite set of infinitesimal points); (b) that the mental realm is constructed from basic unit points in the same way that space is thought to be constructed from basic unit points; (c) that such points give expression to the idea of least curvature in the generation of lines, surfaces/contours and solids that occur in both physical and mental space and that the structures generated in these respective 'spaces' are transforms of their corresponding counterparts in the other mode of space; and, finally, (d) that there is a one-to-one correspondence between the structures are capable of being generated in physical space and the structures that are capable of being generated in the mental mode of space.

The foregoing assumptions should be questioned very closely, if not abandoned altogether. A tremendous amount of distortion, error, problems and biases enter into the idea of dimensionality as a direct result of a failure to examine the assumption that underlies the geometrization and spatialization of dimensionality.

To be sure, where analogs or transforms or functions can be established that permit one to develop a heuristic dialectic between non-spatial dimensions and spatial coordinate systems, then, one should pursue this opportunity. However, one also should approach such a dialectic with a healthy amount of circumspection and reflect, from time to time, on what one is doing and what is meant when one uses the structural units of the spatial dimension to construct representations of non-spatial dimensions.

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According to Paul Pietsch, all forms of feeling, thinking, motivation and so on which occur in the mental realm constitute least curvature structures capable of being expressed in transform space as a particular kind of phase spectrum. As such, behavior -- whether as an explicit form or in the form of thoughts, feelings and so on -- is a mental transform of sensations and perceptions.

The 'mechanism' making transformations, of whatever sort, possible is rooted in the idea of tensors. Tensors were developed after Riemann's introduction of curvature into the vocabulary of geometry. Just as Riemann had discussed the manner in which the relationships about a point (relationships that constitute curvature) remain invariant, even under transformation, tensors also describe a set of relationships that remain invariant across transformation operations.

One might argue, however, that tensors constitute a methodology for handling the dynamics or dialectics of the ways in which the points of a region or neighborhood interact with one another. Thus, whereas curvature represents a sort of static kind of look at the structural units of which geometric figures are constructed, tensors appear to involve a dynamic exploration of how the structural units of space interact with one another under various conditions of stress and strain. In short, tensors are used to represent and explore the idea of change.

Tensor relationships are very much like relative phase relationships in the way in which they behave when subjected to transform operations. For example, the absolute values of change being described by tensors might be quite different in various situations to which identifying reference is being made.

Moreover, these absolute changes are often not accessible to measured determination, any more than absolute phase relationships are accessible to measured determination. Nonetheless, the relative aspects of change occurring in the context of such absolute changes tend to transform in the same way from situation to situation.

Tensors have the capacity to capture the structural character of the relative relationships in conditions of change or transition and to be able to preserve that structural character (usually in the form of complex ratios) as one goes from one coordinate system to another by way of transform operations. This capacity goes to the very heart of the idea of a tensor.

Because of the capacity of tensors to preserve the structural character of relationships across coordinate systems, Pietsch argues that tensors actually define the coordinate system into which they are transformed. In other words, most mathematical operations presuppose the existence of an already defined coordinate system of given structural character and are, then, introduced into a given coordinate system in terms of the basic structural properties of that system.

Apparently, however, tensors actually determine the character of the structural properties out of which the coordinate system is constructed. As such, rather than being thrown into a pre-defined coordinate system and adapting itself to conform to that pre-defined coordinate system, a tensor actually gets a coordinate system to conform to the invariant properties of the tensor.

In other words, a tensor shapes a coordinate system from the bottom up rather than merely being grafted onto that system in an adapted form. Therefore, a tensor imposes its own invariant infrastructure on a coordinate system and, in a sense, forces that coordinate system to observe or respect that invariance.

A coordinate system is relative or derived in the sense that it constitutes a representation of some other previously manifested reality- of a physical, material, mental or spiritual nature. A coordinate system, at the very least, presupposes a hermeneutical orientation toward, or approach to, certain aspects of the phenomenology of the experiential field.

In effect, a coordinate system constitutes an expression of this orientation in the form of a geometrization of an aspect of the phenomenology of the experiential field to which identifying reference is being made. Therefore, to argue, as Pietsch does, that tensors define a coordinate system by virtue of the way they impose their invariant, relative relationships onto a coordinate system does not necessarily really say something about the structural character of ontology apart from, or beyond, the character of the interaction of a given tensor with a given coordinate system.

As geometrizations of various aspects of the phenomenology of the experiential field, a coordinate system is generated from a certain arrangement of basic geometric units - namely, points. In geometry, of whatever sort, straight lines, curves, surfaces, contours, solids and dimensions are all generated by ordering points in a prescribed fashion. This prescribed fashion is the methodological process that is required to produce a geometric figure of a given structural character.

Tensors also are about points. More specifically, tensors describe the structural character of the relative relationships that occur during processes of change or transition involving these points. In this sense, tensors presuppose the existence of points.

In fact, one might suppose that points represent something like the simplest possible structures one can imagine that are capable of undergoing processes of transition and change. If there were no points undergoing transitions, then, there would be nothing for tensors to describe.

One cannot have relationships in the abstract that do not relate to, or are not linked to, interacting structures, of some sort, that undergo change. The very concept of relationship, especially of a relative nature, presupposes the existence of some sort of structure (or structures) which is (or are) being explored in terms of the character of the network of relationships linking two or more aspects of the structure (or structures). These "aspects" that are being referred to, and that are being studied in terms of the character of their linkages, are geometrically represented by points.

To be sure, one can drop these points or aspects from consideration once one has a handle on the structural character of the relationships among them and, thereby, derive an abstraction or abstract representation of the original context of change. However, one must not forget that a tensor - as an example of one kind of possible abstraction of such a context of change - is derivative, ultimately, from a context in which the structural character of relationships is a function of the structures being related, together with the dialectic that is made possible by the spectra of ratios of constraints and degrees of freedom encompassed by those structures.

Relationships are not independent of structures being related. Relationships are not autonomous, self-sustaining entities. The character of a relationship is colored by the structures that it ties together.

The very character of a tensor's unique manner of abstraction is the way such an abstraction zeroes in on the character of relative changes in various contexts and eliminates all other properties from consideration. What colors the character of those relationships is very much a function of the structural character of the aspects or points that are being studied vis–à–vis the character of their relationships.

As indicated previously, Riemann argued that the measurable relationships in the neighborhood of a given point are exactly the same as the measurable relationships in the neighborhood of any other point, irrespective of the coordinate system in which the point exists. Similarly, in the case of tensors, the argument seems to be that the measurable relationships of change in the neighborhood of a given point are the same as the measurable relationships of change in the neighborhood of any other point irrespective of the coordinate system in which such change occurs. Thus, the structural character of the relationships involved in relative change remains the same irrespective of the kind of coordinate system one uses to give representational form to the character of that change.

In the foregoing sense, the structural character of the relationships that are captured and preserved by tensors actually represent a set or envelope of constraints and degrees of freedom that specify how any given coordinate system can give expression to the structural character of that change in the context of the properties of that coordinate system. Therefore, tensors do not so much define a coordinate system as they are a means of guiding, orienting, and ordering a coordinate system in terms of the structural character of the relationships of relative change that the system is attempting to capture and preserve vis–à–vis some other coordinate system.

In general, from the perspective of tensor analysis, there are two kinds of relationships that can be used to describe the structural character of the dynamics of change: covariation and contravariation.

Covariation refers to relationships of transition having the same directional character; that is, they proceed in the same direction. Contravariation, on the other hand, refers to the sort of contrary relationship that the opposite ends of a stretched rubber sheet or rubber band have with one another.

Tensors are able to give representation to either of these sorts of change relationships individually, as well as both of them together in whatever combination suitably captures the structural character of the change to which the tensor is making identifying reference. These latter forms of tensor are known as mixed tensors.

Tensor transformations consist of a set of rules for translating a given tensor, R, into a different coordinate system. If a given tensor R in one coordinate system does not equal a given tensor counterpart, R, in another coordinate system after the rules of tensor transformation have been applied to the first tensor (or vice versa), then, the changes being described do not constitute a true tensor - that is, they are not invariant changes.

Such changes are, instead, fluctuations of a local nature and reflect, at best, conditions of local constancy in the relationships of change that are manifested in the system in question. In other words, these sort of fluctuations are thought of as being empirical in nature. They are not analytical as supposedly is the case in instances of true tensors.

This empirical/analytical distinction seems a little odd in light of the fact that the structural character of a given tensor is derived originally from examining the nature of change in some region of the phenomenology of the experiential field. To be sure, to the extent that a tensor is supposed to capture and preserve, in abstracted form, the structural character of a given instance of changing conditions, then, a given tensor, ONCE it has been determined, should remain invariant across coordinate systems. In this sense, of course, the tensor is somewhat analytical, but this quality or property of analyticity is predicated on, and presupposes, an empirical context. As a result, thinking in terms of such an analytic/empirical distinction, might be somewhat misleading.

Seemingly, what really is being referred to in the foregoing is a distinction between: (a) conditions of change manifesting relative relationships that are invariant across coordinate systems, as opposed to (b) instances of change manifesting properties of relative relationships that do not remain invariant as one moves from one coordinate system to another via the agency of transformation operations. In essence, the distinction between tensors and relationships of change restricted to localized, coordinate contexts is that the former exhibit the quality of symmetry, whereas the latter do not.

Symmetry relationships in a given coordinate system reflect, or are alleged to reflect, the structural character of some aspect of ontology or some aspect of the phenomenology of the experiential field or both, to which the coordinate system is making identifying reference. Consequently, when one seeks to understand something, there will be tensors on each side of the hermeneutical equation that purports to reflect congruence between ontological and hermeneutical/phenomenological structures.

One side of the hermeneutical tensor equation consists of the aspect(s) of ontology that help make possible an experience of a given structural character to which identifying reference is being made through the focal/horizonal character of a given aspect of ongoing phenomenology. The other side of the hermeneutical tensor equation consists of the aspect of understanding/orientation that the individual has with respect to, or has toward, the aspect of the phenomenology of the experiential field to which identifying reference is being made.

The tensors on each side of the hermeneutical equation must have the same character in order for that equation to have epistemological status or meaning. In other words, such an equation needs to give expression to a tenable, if not accurately reflective, relationship between, on the one hand, certain aspects of the ontology and, on the other hand, certain aspects of the hermeneutics of the phenomenology of the experiential field that are being linked through the hermeneutical tensor equation.

Thus, hermeneutical applications of the idea of tensors is a matter of seeking symmetry -- that is, relationships of invariance -- that are preserved across different contexts. In the hermeneutical frame of reference, these contexts do not necessarily represent geometric coordinate systems. Nonetheless, one needs to discover tensors whose structural character remains invariant as one moves from the context of the phenomenology of the experiential field to the context of ontology to which that phenomenology is making reference but that is, to some extent, independent of that phenomenology.

In effect, hermeneutical field theory can be construed as involving an attempt to establish hermeneutical equations that contain tensors displaying the same character. When the tensor components on each side of the hermeneutical equation display the same character this indicates that some feature of invariance concerning the structural character of change has been preserved in both ontology as well as phenomenology. The existence of such symmetries permits the structural character of an aspect of phenomenology to reflect the structural character of an aspect of ontology.

Seen from a slightly different perspective, hermeneutics involves, among other things, a study or exploration of the structural character of the properties of change occurring in and around the neighborhood(s) of one or more aspects of the phenomenology of the experiential field. This exploration is done in an attempt to determine the structural character of the forces of stress, strain and vectoring being exchanged with different aspects of ontology and that together (that is, as a dialectical function of both phenomenology and ontology) generate a focal/horizonal 'point'-structure of an observed experiential character.

There are many aspects of the holographic process that cannot be easily, if at all, subsumed under the structural wing of ordinary transformations. Use of tensor transformations renders the idea of decoding the data of transform space into the structures of perceptual space much more tractable than do ordinary transformations.

From the perspective of tensor transformations, the transition from transform space to perceptual space can be described in terms of how a given set of relative values concerning the structural character of certain changes is preserved as one moves from one kind of space to the other. Through the maintaining of symmetry with respect to the property of the relative values of structure to which a given set of changes give expression, tensors are able to show how the underlying structural character of change is able to manifest itself across coordinate systems.

In short, tensors can be used to represent phase relationships in a way that is independent of any specific coordinate system. Because Pietsch believes tensors actually define, through the rules of tensor transformation, the character of the coordinate system into which the tensors are introduced, he maintains that when tensors are used to represent relative phase relationships, then, in effect, phase relationships can be said to define the coordinate system into which the phase relationships are introduced by means of tensor transformations. Pietsch believes this would be the case irrespective of whether one was talking about memory, perceptions, thoughts, and so on.

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Pietsch summarizes his position in the following way:

(a) mind can be treated as a species of complex information-namely, information concerning phase;

(b) as a methodological starting-point, one approaches the phase information of (a) by characterizing and exploring it in terms of the geometry of a Riemannian universe in which the basic unit of structure is that of curvature in a continuum of indefinite dimensions;

(c) the relative phase values that are used to describe different aspects of mind are expressed as ratios of curvature;

(d) tensors can be used to represent the ratios of curvature;

(e) the activities of mind can be treated as instances of tensor transformation in which the same underlying structural character of relative change is preserved as one moves from one mental modality or operation to another;

(f) due to the manner in which tensors allow one to consider the structural character of change independent of any given coordinate system, one has no need to specify whether one is dealing with perceptual space or some other transform of perceptual space such as Fourier transform space;

(g) the structural character of coordinate systems are a function of tensor transformations rather than tensor transformations being a function of the structural character of a given coordinate system.

Relationships involving relative phase values in perceptual space are said to be time-dependent. This time dependency is translated into a spatial dependency in the transform space of, say, Fourier analysis.

However, both the time-dependent, as well as the space-dependent, relationships of relative phase values are governed by a set of constraints and degrees of freedom that are manifested in each coordinate context. In other words, in the case of ordinary transforms, the coordinate axes don't expand or contract. As a result, the ordinary transforms give expression, in each coordinate context, to an inherent structural framework on to which, respectively, the time-dependent or space-dependent relationships are grafted - a structural framework to which these relationships must accommodate themselves.

Thus, there is an analogical relationship between perceptual space and transform space in the sense that phase relationships in transform space are required to obey a set of rules or principles that are comparable to, or analogs for, the sort of rules or principles that the phase relationships in perceptual space are required to obey. Furthermore, in each case, these rules or principles are reflections of the fixed character of the coordinate structure of the respective spaces.

Tensors, on the other hand, are independent, supposedly, of the sort of rules and principles that the structural character of any given coordinate system imposes on ordinary transformation. Therefore, the distinction between, on the one hand, perceptual space, and, on the other hand, various kinds of transform space becomes empty.

There is only the underlying structural character of relationships that are undergoing transition. If these relationships in transition are expressions of true tensors, then, that underlying structural character will remain the same from one coordinate system to another.

For all practical purposes, the structural character of different coordinate systems ceases to have primary importance as a shaping force. In other words, from the point of view of tensor symmetry relationships, the structural character of any given coordinate system becomes derivative from, and predicated on, the character of the shaping force that the form of a given tensor has on such coordinate systems.

Seemingly, on the basis of what has been said above, a tensor would appear to be a fundamental shaping force in determining the structural character of curvature. After all, curvature is said to be at the heart of the geometry of any coordinate system.

Since tensors are said to be the defining determinant of the shape of a given coordinate context, presumably, curvature is really giving functional expression to the structural character of some underlying dialectic among a set of changing - relative to one another- phase relationships. The feature of capturing the structural character of symmetry (i.e., invariance) in an underlying dialectic among a set of changing phase relationships is precisely what constitutes a tensor.

Therefore, in view of the foregoing considerations, tensors represent the internal dialectics of curvature dynamics. This is the case since tensors establish the set of constraints and degrees of freedom that will regulate how a coordinate system must manifest itself if the structural character of the conditions of change being undergone by a set of relative phase relationships in one coordinate system are to be preserved in some other coordinate system.

According to Pietsch, subjective constructions concerning the structural character of space and time represent information transforms of those aspects of ontology being gauged by various modes of operationalizing methodology such as rulers, clocks, and so on. However, whereas the methodology of measurement is rooted in issues of physical structure, the character of subjective constructions are rooted in the realm of ideas. Both, however, are said to be expressions of nature.

The above position seems to be somewhat shaky since one could easily argue that the methodology of measurement is, in fact, a subjective construction and, therefore, squarely rooted in the realm of ideas and the mental. As such, the methodology of measurement is as much an expression of information transforms as are other modes of subjective constructions.

To be sure, the methodology of measurement tends to focus on how to establish congruence between the structural character of a given mode of measurement and the structural character of a given aspect of reality that is assumed to be independent of subjective constructions and that is referred to as being physical/material.

Nonetheless, the characterization of something as being physical/material is itself a subjective construction that might or might not reflect the actual character of the aspect of ontology to which identifying reference is being made, depending on what one means by the idea of 'the physical' or 'the material'.

The distinction between, on the one hand, subjective constructions, which are inclined to focus on so-called non-physical aspects of experience, and, on the other hand, modes of measurement, which tend to explore the properties of supposedly physical aspects of reality that are encountered and engaged through experience, is really a matter of what sorts of things each mode of engagement is inclined to focus in on and emphasize. However, both constitute instances of subjective construction seeking congruence between a structure of experience and that aspect of ontology that would make experience of such structural character possible.

The search for, and attempt to establish, congruence relationships marks the dialectic of the hermeneutical realm. This realm consists of an overlap of structures-namely, those structures that are rooted in the phenomenology of the experiential field and those structures of ontology that are, to a certain extent, external to the phenomenology of the experiential field but that touch upon, engage, interact with, shape, affect, or are affected. as well as shaped and engaged by, the phenomenology of the experiential field. When operating properly, this realm gives expression to the merging of horizons.

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A fundamental part of the hermeneutical challenge is the need to search for, and struggle to determine, the precise nature of the appropriate hermeneutical tensor equation in a given context of ontological/phenomenological interaction. The nature of what is appropriate in any given situation will be a matter of what permits one to grasp the structural character of that aspect(s) of ontology that helps make a given aspect of one's phenomenology of the experiential field have the character it does.

Hermeneutical field theory involves the problem of how one goes about identifying, reflecting on, characterizing, questioning, and mapping the character of the 'point-structures' of the phenomenology of the experiential field so that one can try to establish congruence relationships with the character of the 'point-structures' in the fabric of ontology that are of the same tensor character as the point-structures of the phenomenology of the experiential field. The dynamics/dialectics of point-structure interactions and the use of point-structures to generate configurations, not merely in the form of geometric lines, contours, surfaces, solids and so on, but also in the form of hermeneutical latticeworks of varying degrees of complexity, non-spatial dimensionality and discrete continuity, etc., become extremely important components of the process of understanding.

This all could go under the rubric of the manifold problem introduced in a previous chapter in relation to a brief discussion of some of Kant's ideas. In other words, the foregoing makes reference to the problem of determining the structural character of both the phenomenological manifold as well as the ontological manifold.

Furthermore, questions are raised about what these two manifolds have to do with one another, as well as what principles of dialectic govern the interaction of these two kinds of manifold under different circumstances. Here, of course, one enters the realm of hermeneutical tensors and hermeneutical tensor equations.

Brillouin speaks of tensor density and tensor capacity. Capacity and density are not the same thing.

Density concerns the ratio of how tightly a given magnitude, quantity or substance is packed into a given context that constitutes an independent magnitude from the first magnitude. Capacity refers to the maximum magnitude to which a given degree of freedom of a latticework can be extended before it is constrained by other aspects of the structural character of either that latticework, or before it is constrained by the structural character of other latticeworks with which it interacts.

Brillouin maintains that a true tensor is "the product of a density and a capacity". Under normal circumstances, density and capacity are independent of one another. However, when one is dealing with a true tensor, Brillouin contends that the respective operations of density and capacity cancel the features that make them independent under normal circumstances.

In this sense, capacity becomes a set of constraints and degrees of freedom that shape the way in which density can be manifested in the context of that capacity's structural character. Of course, density is also a set of constraints and degrees of freedom, but it is the expression of a dialectic that occurs within the context of, and is encompassed by, the structural character of capacity.

Every capacity has its own unique density. Density is an expression of how that capacity's latticework distributes the set of constraints and degrees of freedom to give expression to that latticework's structural character.

Moreover, every density has its own unique capacity. Capacity marks the parameters or limits within which, and through which, a given density of constraints and degrees of freedom can be distributed in order to give expression to a latticework's structural character.

Capacity and density represent two facets of the dialectic of structural character, either with itself or with some other, independent latticework. As such, every structural character constitutes a tensor.

This tensor determines the shape or form of the 'point-structures' giving expression to the manner in which a given capacity and a given density engage or encounter one another in the region of intersection. This is the case irrespective of whether: (a) the region of intersection is a function of the way a given latticework spontaneously distributes its own set of constraints and degrees of freedom; or, (b) the region of intersection is an induced function of the way two or more latticeworks dialectically engage one another to generate interference patterns that re-distribute and shape and vector their respective sets of constraints and degrees of freedom.

In short, every structural character is a product of, at a minimum, a capacity (which is the thematic woof and warp that establishes the envelope of possibilities constituting a latticework) and a density (which is a distribution pattern of relative phase relationships within the set of constraints and degrees of freedom that give expression to capacity's structural themes). Furthermore, every structural character is a true tensor as long as the integrity of that structural character is preserved across coordinate systems - that is, as long as the spectrum of ratios of density to capacity characterizing a given structure retains its essential integrity across transformations

The rules of transformation permitting one to move from one kind of representational space to another kind of representational space (e.g., from perceptual space to Fourier transform space - both of which are, actually, species of representational space) are the various hermeneutical operations. These operations seek to establish or discover the identity of the tensor character that might permit one to treat one species of representational space as an analog for the other species of representational space.

From this search, one hopes to establish a tensor equation. This equation needs to show that, despite the differences of 'curvature' in the two species of representational space, nonetheless, the structural character of the latticework in question has been preserved, both with respect to its thematic characteristics (i.e., its capacity) as well as with respect to its dialectical characteristics (i.e., its density), as one moves from one representational space to another such space. Thus, one can say that a true tensor is an analog structure whose properties are independent of the curvature medium (including hermeneutical, phenomenological and ontological mediums) through which they are given expression or into which they are introduced.

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Chapter 8: Gauging Meaning

The idea of symmetry

The property of symmetry is observed when one performs a transformation on some object, structure or process, and a pattern or form that was initially manifested in such an object, etc., remains invariant after the transformation. Thus, although other aspects of the object, structure, and so on, might be altered as a result of a transformation that is applied, as long as some given form or pattern remains invariant across the transformation, then symmetry is said to be preserved in that object or structure with respect to the given pattern, form, or aspect.

For example, a circle is said to have continuous symmetry with respect to rotational transformations since: (a) the properties of the circle remain invariant both before and after the transformation; (b) the invariance is preserved independently of the extent of the transformation (i.e., irrespective of the number of degrees involved in the rotation).

On the other hand, a square shows positional symmetry only with respect to 90 degree rotational transformations (or multiples thereof). In other words, one cannot discern any difference in positional orientation of a square that has been moved through one or more rotations of 90 degrees.

However, any rotational transformation of a square that is less than 90 degrees -- or more than 90 degrees but less than 180 degrees -- will display a positional orientation distinguishable from any sequence of rotations of 90 degrees. Therefore, the symmetry of positional orientation will not have been preserved under such circumstances.

The foregoing examples of symmetry are geometrical. In fact, the idea of symmetry originally arose in the context of geometrical investigations.

Nonetheless, the concept of symmetry has been extended to non-geometrical contexts as well. For instance, if one changes the polarity of the charges in an electromagnetic field whose strength is known, the character of the forces acting between charges does not change.

Consequently, whether one is discussing geometric or non-geometric contexts, the underlying principle remains the same. If a given symmetry is to be preserved, then some property must remain invariant across the transformation that is being applied to an object, structure, process or event.

One might have to make a distinction between methodological symmetry and ontological symmetry. In methodological symmetry no variance in a given property can be detected from the perspective of the methodology being employed to determine whether some given feature remains invariant. However, from some other methodological perspective, one might become aware that a variance has occurred in relation to the feature that is being subjected to a transformation of some sort and, therefore, symmetry has not been preserved.

In ontological symmetry, on the other hand, there is an invariance of a structural, thematic or essential character that is preserved independent of methodological considerations. For example, suppose one were to place a small mark on the back of one of the corner angles of a square, and, then one rotated the square through 90 degrees or 180 degrees or 270 degrees.

One would not be able to detect any difference in positional orientation by looking at the front of the square. Yet, by looking at the back of the rotated square, one would be able to see that the ontology of positional symmetry had not been preserved. Furthermore, if one were to perform the same kind of marking procedure with respect to the so-called continuous symmetry of the circle, one also would discover that ontological symmetry had not been preserved with respect to positional rotation.

In each of the foregoing cases, one only would be able to see that positional symmetry had not been preserved if one's methodology enabled one to take both sides of the rotated object into consideration. Consequently, a variety of methodological approaches are capable of arriving at different answers to the issue of the preservation of symmetry with respect to some given property, principle, pattern and so on. On the other hand, when a variety of different methodological perspectives all point in the direction of a given property remaining invariant despite undergoing one or more transformations, then this is strong evidence -- albeit not conclusive -- that an ontological symmetry relationship of some sort has been preserved.

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Symmetry relationships identity and coupling constants

Another feature to keep in mind with respect to symmetry relationships is that one is not necessarily talking about an entire structure, object event, etc., when one speaks of the preservation of symmetry. Usually, one is speaking of only a certain property or relationship or a small set of such properties or relationships.

In the context of a given structure's spectrum of ratios of constraints and degrees of freedom, the foregoing point means only certain ratios from amongst such a spectrum need to remain invariant across one or more transformations in order for one to say that a certain kind of symmetry has been preserved. This point might be important when it comes to talking about the identity of a given structure.

More specifically, part of the problem of identity is the need to be able to justify saying that a structure has remained essentially the same despite obvious alterations in some of the ratios of constraints and degrees of freedom of that structure's spectral character. In fact, one might speak of a law of structural identity in which the character of a given structure retains its identifiability as the structure with which one began, despite undergoing a sequence of transformations.

The spectrum of ratios, together with the accompanying set of coupled phase relationships, constitutes the superpositional expression of a structure. Various aspects of the ratios of constraints and degrees of freedom to which the phase relationships help give expression are sometimes induced to manifest themselves (and, sometimes, do so 'spontaneously') as the result of undergoing transformations of one form or another. As long as these induced, or spontaneously manifested, transitions in phase relationships do not violate the coupling constant basis of the structure's integrity, this would be an instance of preserving symmetry with respect to structural identity.

The hermeneutical coupling constant is an index of: (a) the way a given structure's spectrum of ratios of constraints and degrees of freedom holds together as an integral unit; (b) the way a given structure's spectrum of ratios either spontaneously can manifest different aspects of its spectrum of ratios, or such a spectrum can be induced to manifest different aspects of its spectrum of ratios. Each structure has its own, unique coupling constant, which differentiates that structure's spectrum of ratios from all other spectrums of ratios of constraints and degrees of freedom.

The coupling constant – which might be either quantitative or qualitative in nature or both -- gives expression to the set of phase relationships binding a spectrum of ratios together over time and across a variety of circumstances. The coupling constant is an index of the identity of a structure. It determines the manner in which a structure's spectrum of ratios of constraints and degrees of freedom will be manifested (either spontaneously or as a result of field induction) under a given set of circumstances.

Furthermore, the coupling constant specifies the principles that govern the attractor basins that are operative in a given structure. In addition, it sets the mode(s), current(s) or theme(s) of phase quanta exchange that will occur in and through a given structure.

Moreover, the coupling constant is an index of a structure's action character, and, therefore, the coupling constant is an index of a structure's dialectical potential. The coupling constant marks the presence of the order-field that makes possible a structure of given character with its concomitant aspects of action and dialectical potential.

If a given structure loses its coupling constant quality, the integrity of that structure is violated, and it will no longer manifest itself in characteristic ways. A structure whose coupling constant has been disrupted will no longer manifest itself in terms of the spectrum of ratios that normally establish the set of parameters within which, through which, and by which that structure's character is given expression.

One might use the foregoing perspective in order to approach the old philosophical problem of identity posed by Hume. The problem concerns a ship that leaves port, and during the voyage, each of the planks of the ship is removed and replaced by another plank. The question is: is the ship that returns back to port the same ship that left port originally?

Conceivably, one could answer as follows. Despite the transformations that have been applied to the ship, nonetheless, one might still wish to argue the general form and structural character of the ship have remained invariant. Indeed, if the replacement process is done correctly, each new plank must be introduced in accordance with the phase relationships that the old plank had with the other planks of the ship. Thus, like the 90 degree rotation of a square, or the n-degree rotation of a circle, or the 60 degree rotation of a snowflake, there will be no detectable variance, as far as the general structure of the ship is concerned, if one were to compare the pre-voyage ship with the post-voyage ship.

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<u>Gauge theory in relation to global and local symmetry</u>

In physics, symmetry comes in two varieties: global and local. Global symmetry occurs whenever a certain property remains invariant across one or more transformations that are applied simultaneously everywhere in a given framework. Some form of global symmetry is present in virtually every kind of physical theory.

Local symmetry, on the other hand, requires some property of a field to remain invariant despite the fact that different transformations might be occurring at every point in the field. Obviously, the conditions that must be satisfied in order for local symmetry to be preserved are considerably more rigorous than is the case with respect to global symmetry.

In modern physics, gauge theories are intimately linked with the concept of symmetry. A gauge theory is a mathematical model that, among other things, refers to a particular class of quantum field theory. Such a theory contains within it aspects of both the special theory of relativity as well as quantum mechanics.

More specifically, the essential element of a gauge theory is that it should encompass a group of transformations, referred to as gauge transformations that are performed on the various variables of a quantum field and, yet, that leaves unchanged the physics of that field.

The aspect of the theory that preserves the basic physics of the field is known as gauge invariance.

The quality of gauge invariance places constraints on the character of the group transformation equations used to describe the quantum field. Such constraints mean, in turn, that the field is not free to engage, or interact with, other quantum fields in just any way. A given field must interact with other fields in accordance with the restrictions inherent in the structural character of the set of group transformations that preserve that field's symmetry.

Although the idea of a gauge transformation was not introduced until the early part of the 20th century, Maxwell's electromagnetic field theory is considered to be an excellent exemplar of a gauge theory.

In the theory of the electromagnetic field, the strengths of the electrical and magnetic fields are the fundamental field variables. These variables are often expressed in terms of vector and scalar potentials. When, in accordance with certain gauge transformations appropriate to an electromagnetic field, the values for the field variables or potentials are altered, the basic physics of the electric and magnetic fields is preserved through gauge invariance.

Einstein's general theory of relativity is another example of a theory displaying gauge symmetry. However, in the general theory of relativity, the gauge symmetry involves a coordinate system representing space-time rather than a matter field. In other words, instead of assigning values to each point-particle of a field, values are assigned to each point of the coordinate system giving expression to the structural character of space-time.

Each point of the coordinate system is assigned four numbers, three of which are spatial coordinates and one of which is a temporal coordinate. The origin of the coordinate system marks the point where all four numbers have the value of zero.

The point of space-time one chooses to be the origin is entirely a matter of convention. However, once this point is established, all of the other coordinates will be assigned numerical values relative to that reference point.

When one performs transformations -- such as rotations, mirror reflections, or translations -- on a given coordinate system as a whole, all the laws involving relationships between or among various points of the system will remain invariant. In other words, the laws of the coordinate system have symmetry with respect to the transformation operations of rotation, mirror reflections and translations.

All of the invariances outlined in the previous paragraph are instances of global symmetry. In effect, each of the transformation operations shows one how to generate a new set of coordinates by performing certain kinds of operations on the old set of coordinate values, provided that the transformations are applied to every point in the old coordinate system.

The general theory of relativity, however, provides a means of preserving the laws of nature despite allowing for transformations that might vary from point to point in the coordinate system. The theory accomplishes this by introducing a gravitational field that has properties able to establish local gauge symmetry. Thus, just as is the case in relation to electrodynamics, gauge symmetry is established by introducing a field that has the appropriate vectored characteristics.

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<u>Virtual particles and field quanta</u>

Irrespective of whether one is dealing with global or local gauge symmetries, one needs to introduce the concept of a force. This is necessary for two reasons: (a) in order to account for how influences are propagated from point to point in a given field; (b) to be able to account for how symmetries are preserved.

In one sense, forces in a field are not exerted directly by one particle on another. Each particle is considered to be a local generator of field properties.

Consequently, any given particle in a field interacts with the fields that are generated by the other particles of that field. Indeed, the field, taken as a whole, is really the dialectical product of all the locally generated fields.

However, in another sense, and this is largely for the sake of conceptual convenience, the interacting fields of any two given particles are construed in terms of a virtual particle that is exchanged between the particles. Such exchanged particles are the field's quanta.

These field quanta are said to be virtual because their existence is transitory. In fact, their existence is so ephemeral they cannot be experimentally detected. Moreover, the larger the amount of energy is that is being transmitted by these virtual particles, then the shorter the duration of their postulated existence.

According to quantum theory, and this comes largely from Heisenberg's uncertainty principle, there is said to be a conjugate relationship between the energy of the virtual particle and the amount of time the particle exists. Supposedly, a virtual particle must steal energy from the cloud of uncertainty surrounding any given particle and, then, replace that energy before any laws of nature are violated.

The more energy that is borrowed, then the more quickly the energy must be returned, and, therefore, the more ephemeral the existence of the virtual particle. Furthermore, the shorter the duration of the virtual particle's existence, the shorter will be the range of the force carried by the virtual particle, since the ephemeral duration translates into a restricted travel distance during the course of a virtual particle's life span.

There are a number of aspects concerning the time-energy relationship of virtual particles in the context of Heisenberg's uncertainty principle that seem problematic. For instance, one wonders how a virtual particle -- which, presumably, only exists by virtue of the energy that is borrowed from the cloud of uncertainty -- presupposes itself in order to be able to borrow such energy? In other words, just what is it that is doing the borrowing here?

If it already exists in order to direct the borrowing operation, then what is its form of existence and what makes it possible? Moreover, one wonders 'what' it is that 'knows: how much to borrow, and where to borrow it from, or when to borrow it, as well as when to return what has been borrowed, and where to deliver what has been borrowed.

No matter which way one goes, the idea of a virtual particle encounters problems. Either one is faced with a virtual particle that presupposes itself, or one has something at work during the process of the exchange of quanta that has a structural character quite different from the way in which the virtual particle has been described -- but that makes possible the structural character of the phenomenon for which the idea of a virtual particle has been theoretically invented as an explanation.

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<u>Gauge symmetries, phase shift transformations and hermeneutics</u>

There are certain gauge symmetries occurring in relation to phase shift transformations that are preserved in an electromagnetic field. For instance, in the two-slit experiment, when the waves of the electromagnetic field pass through the slits and form interference patterns on the other side of those slits, then phase accounts for where the peaks and nodes form in the interference patterns.

More specifically, wherever the peaks of constructive interference occur, the waves of the field are in phase. On the other hand, wherever the nodes of destructive interference occur, the waves of the field are out of phase with one another.

If one were to subject the field to a phase shift -- although this transformation would alter the field's form significantly -- the interference pattern created in the two-slit would remain unaltered. Therefore, interference patterns remain invariant with respect to phase shift transformations.

As indicated above, subjecting a field to a phase shift transformation alters the field's configuration or form. This means there would be a different pattern of waves manifesting itself in the field after the phase shift transformation relative to the pre-shift phase state of the field.

For example, where, prior to a phase shift, there had been, say, a peak, after the phase shift, there would be a trough or node. Moreover, where, prior to a phase shift, there had been a trough, after the phase shift, there would be a crest or peak.

However, as far as interference patterns are concerned, nothing really would be affected. One still would have the same set of waveforms coming together to generate the interference pattern. The only difference would be that the waveforms would be coming together in a sort of mirror image manner relative to how the waveforms interacted prior to the phase shift.

In order for interference patterns to show symmetry across phase shift transformations, the transformations must be applied globally to the electromagnetic field. Moreover, because the interference patterns remain invariant throughout the transformations, the phase shifts are not detectable. Since the phase shifts are not detectable, they are not measurable.

In a sense, the ideas of simple constructive and destructive interference might be too static and two-dimensional to be of much use in helping one to grasp the structural character of the dialectic of waveforms in the hermeneutical field. One might require a more sophisticated and nuanced version of constructive and destructive interference.

The hermeneutical counterpart to the crests and troughs of normal waveforms, are the patterns of focal emphasis and de-emphasis that occur in relation to the manner in which a spectrum of ratios of constraints and degrees of freedom (involving, say, an idea or understanding) give expression to various kinds of phase shifts. A spectrum of ratios of constraints and degrees of freedom is not, in and of itself, enough to give expression to structural character.

One also needs to take into consideration transitions in phase relationships that, among other things, show shifts in the character of the way different combinations of ratios manifest themselves. More specifically, one needs to consider the degree of intensity (which could be a manifestation of curiosity or some emotion) with which phase relationships manifest themselves in various phase state patterns.

If the degree of intensity is high, the phase relationship is being emphasized in the structure, and it is like a peak or crest in a waveform. If the intensity of a phase relationship is low, it is being de-emphasized in the structural character.

This corresponds to a trough or node of a wave. The total set or spectrum of ratios of constraints and degrees of freedom, together with the shifting patterns of emphasis and de-emphasis in various combinations of ratios, constitute the structural character of a person's understanding or mode of engagement concerning some given object, event, state, or process.

In addition, there might be an aspect of hermeneutical phase relationships that is somewhat like the notion of left-handed and right-handed optical isomers in organic molecules. These are interpretive variations on a given phase relationship theme by the same individual. In a way, they are like different angles of hermeneutical engagement of one-and-the-same phenomenological structure.

If the foregoing is the case, then the hermeneutical structural character of a particular ratio of constraints and degrees of freedom depends, in part, on the pattern of the orientation of the phase relationships that are coupled together to help give expression to a given ratio of constraints and degrees of freedom. However, in any given set of circumstances, there might be a multiplicity of orientation configurations that are possible, and, therefore, the number of hermeneutical isomers will be more varied than the left-handed and the right-handed optical isomers of organic molecules.

In light of the foregoing discussion, hermeneutical structural character is a function of the following elements or aspects: (a) the spectrum of ratios of constraints and degrees of freedom associated with a given hermeneutical perspective; (b) the emphasis/de-emphasis pattern of phase relationships that help give expression to shifts in the way various combinations of ratios of constraints and degrees of freedom manifest themselves across time and circumstances; (c) the orientation of phase relationships as an expression of the property of hermeneutical isomerism alluded to above; (d) the coupling constant that brings together, and maintains, the components of (a), (b) and (c) as a spectral character of one sort, rather than another. The coupling constant is a function of the dimensional dialectic that has been set in motion by the order-field.

As indicated previously, local gauge symmetries identify themes of invariance under conditions of transformation that vary from point to point in a given field. This sort of symmetry is likely to take on fundamental importance in the development of understanding.

Especially important in this respect, will be those symmetries or invariant features that are preserved in relation to transduction transformations along with the hermeneutical operator's transformation of these transduction transformations. These kinds of invariance open the possibility that one might be gaining insight into the structural character of some aspect of reality or ontology. Therefore, one of the tasks of hermeneutical field theory will be to identify those spectra of ratios of constraints and degrees of freedom that, despite undergoing a variety of local gauge transformations, nonetheless, remain 'largely' invariant with respect to the general structural character of such a hermeneutical perspective.

The term "largely" has been used in the foregoing sentence to serve as a reminder that a given hermeneutical structure need not remain invariant in every respect in order to be considered the same structure. Some ratios of a particular spectrum will undergo phase shifts or phase transitions. These phase shifts will alter the character of the ratio of which they are apart.

However, despite such phase transitions and despite the concomitant alteration in some of the ratios of the spectrum being considered, the structural character to which the spectrum gives expression might remain intact. As such, these spectrums conform to the law of structural identity in the sense that one can identify the post-transformational structure as being, effectively, the same structure as existed prior to the transformation.

A further aspect to be considered is this. The more complex a hermeneutical structure is, then the more allowances one has to make for the degrees of freedom that are exhibited by the structure, under various circumstances, as a result of either spontaneous activity or induced activity or the dialectic between spontaneous and induced activity.

Considered from the foregoing perspective, the fact certain phase relationships or ratios of constraints and degrees of freedom are not preserved across transformations (whether spontaneous, induced or dialectical) is not evidence that symmetry with respect to structural character has not been preserved. In fact, just the opposite might be the case. Such alterations in ratios might be part of the fluidity or flexibility of a given hermeneutical structure's character.

Consequently, part of the task of hermeneutical field theory is to differentiate between critical instances of symmetry failure and noncritical instances of symmetry failure within conceptual and interpretive systems. In a sense, a given conceptual structure can go through a multiplicity of states as various ratios and phase relationships undergo transitions. As long as these phase transitions are of the non-critical variety, then symmetry still might be preserved with respect to a given hermeneutical structure's coupling constant character.

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Semiotic quanta isotopic-spin and hermeneutical tensors

In quantum field theory, when one describes the interaction of two particles, the force that is manifested during the course of that interaction is in the form of an exchange of virtual particles. Consequently, from the perspective of quantum field theory, a force is construed as that process that mediates various kinds of quantum interactions by means of the exchange of virtual particles.

The mass of the virtual particle being exchanged determines the range of the force manifested during the transaction. Thus, because the graviton, which has been postulated to be responsible for mediating gravitational effects, is believed to have a mass of zero, the range of the gravitational force is considered to be infinite. The same is said to be true of the range of the massless photon that is responsible for the electromagnetic force. On the other hand, the massive, relatively speaking, W boson that helps mediate the weak force has an effective range of approximately $10^{-18}$ centimeters, which is exceedingly small.

The number of different states that can be assumed by a field's force-carrying quantum determines the number of components for that field. Moreover, the number of different states or orientations that is possible for a field's quantum is a function of the spin angular momentum of the different particles that make up a given field.

Spin angular momentum can only have discrete integer or half integer values. The magnitude and the direction of the spin are assigned these discrete integer or half integer values.

The general rule for any given field quantum is that the number of possible states for a quantum is equivalent to two times its spin's magnitude, plus one. For example, the electron, which has a spin magnitude of 1/2, will have, according to the above rule, two spin states. The photon, on the other hand, has a spin magnitude of one, and, therefore, will have three spin states.

The graviton is postulated to have a spin magnitude of 2, which means that, according to the foregoing rule, it has five spin states. However, the case of the graviton is complicated somewhat by its massless nature.

According to theory, the graviton is massless and, therefore, travels at the speed of light. This means that, unlike quanta with finite masses, the graviton's transverse spin states will not be observed (This also is true of the one transverse spin state of the massless photon). Since the graviton is believed to have three transverse spin states, only two of the graviton's spin states are capable of being detected.

The gravitational field has 10 components. Not all of these components are independent from one another. As a result of the non-independence of some of these components, the mathematical techniques used to solve problems involving these components involve tensors. Consequently, the gravitational field is referred to as a tensor field.

Similarly, in the case of the hermeneutical field, not all of the components of that field are independent from one another. They have covariant and contravariant relationships with one another. Therefore, the hermeneutical field can be considered to be, given certain qualifications, an n-component tensor field.

The kinds of stress, tension or dialectical relationship that the components of a hermeneutical field can have with one another might be more complex than can be expressed through the ideas of covariance, contravariance, and mixed tensors in the usual mathematical sense. Nevertheless, the term "tensor" is retained in order to allude to the complexity of the stresses, tensions and dialectical currents that are possible in a hermeneutical field.

The various aspects of the semiotic quantum (such as reflexive awareness, identifying reference, characterization, etc.) are comparable to a sort of isotopic-spin. What is meant here is similar to the structural character of the nucleon.

The proton and neutron are alternative versions, states or expressions of a single particle known as a nucleon. Depending on its internal spin characteristics, the nucleon sometimes manifests itself as a proton, and at other times, the nucleon manifests itself as a neutron.

The semiotic quantum, like the nucleon, also will manifest itself in different ways depending on its internal spin characteristics. However, the internal spin characteristics of the semiotic quantum are far more complex than is the case for the isotopic-spin of the nucleon. In other words, rather than having only two alternative modes of expression as is the case for the nucleon, the semiotic quantum has six distinct modes of expression, together with an indefinite variety of dialectical combinations of these six basic modes.

The character of hermeneutical isotopic-spin is like a tensor-matrix (a hermeneutical tensor-matrix that has similarities to, but is quite different from, the mathematical notions of either a tensor or matrix) in which the individual cells of the matrix weave together covariant, contravariant, and mixed currents from the other five orientations or spin states of the semiotic quantum.

In addition, the tensor character of the semiotic quantum's isotopic-spin takes into account what might be referred to as transvariant currents. These sorts of currents do not conform to the largely linear characteristics of covariant tensors, contravariant tensors, or mixed tensors. Transvariant currents refer, instead, to multi-dimensional, non-linear tensions, stresses, and dialectical activities – all of which are capable of affecting the manner in which the semiotic quantum gives expression to its property of isotopic-spin.

The hermeneutical tensor process of weaving together different currents of the semiotic quantum's complex isotopic-spin takes place in a context of specific experiences, ideas, values, beliefs, actions, desires, emotions, motivations, needs, sensations, and so on. With the passage of time, there is a stream of differentiated semiotic quanta.

Individual semiotic quanta are generated through focal/horizonal dialectical activity. Said in another way, focal/horizonal dialectical activity is the gateway through which semiotic quanta are emitted.

Focal/horizonal dialectical activity is rooted in the phenomenology of the experiential field. In fact, the hermeneutical field is embedded in the phenomenological field as a potential for generating structure or curvature in that phenomenological field. This potential is activated, or turned on, in one of two cases: (a) through inducement by externally impinging forces, and (b) 'spontaneously'.

In the former case, semiotic quanta are generated or released when certain thresholds of the phenomenology of the experiential field are surpassed. This is somewhat akin to what happens in the case of the photoelectric effect when in-coming photons cause electrons to be emitted as a result of raising the energy level of those electrons engaged by the photons.

Phenomenological thresholds do not exist just with respect to sensory stimuli. They also exist in relation to: motivation, memory, fantasy, interests, likes, dislikes understanding, beliefs, values, and so on.

On the other hand, when semiotic quanta are spontaneously generated or released, this is an expression of underlying attractors involving, for example, insights, interests, beliefs, values, commitments, and methodological frameworks that aperiodically release semiotic quanta. The spontaneous release of these quanta can give expression to shifts in attention in relation to various horizonal components.

In the case of the spontaneous transition in the orientation of intentionality, once this sort of semiotic quantum arises, an investment is made in a given horizonal attractor. The selection of investment venue can be arbitrary, or it can be made on the basis of a series of brief dialectical interludes (a sort of mini-sampling process) with different horizonal attractor candidates (for example, as a result of general curiosity, interest, questions, or temperament -- which constitutes a natural inclination inherent in the individual).

The dialectical activity of the semiotic quantum brings together a number of dimensions such as time, space, materiality, energy, consciousness, will, and understanding. However, the primary contribution of the semiotic quantum concerns its various modes of hermeneutical isotopic-spin -- along with the concomitant capacity of such spin states to engage, and be engaged by, a variety of dimensions across a variety of levels of scale.

Semiotic quanta are discrete point-structures that are linked together into neighborhoods, lattices, and latticeworks through a network of phase relationships. These phase relationships are bound together in the form of hermeneutical counterparts to strings, sheafs, fiber bundles, and so on. In other words, hermeneutical structures are generated and woven together in an attempt to 'cover', or account for, why various aspects of the phenomenological manifold to which they are experientially linked have the structural character they do.

The hermeneutical operator or semiotic quantum is an intrinsic part of the phenomenology of the experiential field. Indeed, it gives expression to the "curvature" of the different levels of scale of the n-dimensional character of the phenomenological manifold.

When the hermeneutical operator generates a structure that accurately reflects some aspect of the phenomenology of the experiential field or of some aspect of ontology that makes an experiential field of such character possible, it has zero curvature -- that is, it does not distort what it reflects. When the structure that is generated does not accurately reflect the structural character of that to which identifying reference is being made, then the curvature of the phenomenology of the experiential field, due to the presence of such semiotic quanta, will be some non-zero quantitative and/or qualitative value. The greater the degree of distortion, the greater will be the magnitude of the non-zero curvature value.

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<u>Gauge fields in physics and hermeneutics</u>

A field is a region of space-time for which some variable quantity has been assigned to each point of that region. In broad general terms, there are two kinds of fields that are possible -- namely, scalar and vector fields.

A scalar field exists when a magnitude, without orientation, is assigned to each point of the field. For instance, if one were to assign a temperature to every point of a given region of space-time, this would constitute a scalar field.

A vector field exists when one adds the property of orientation to the magnitude that is assigned to every point of a given region of space-time. Thus, a vector field has a directed magnitude assigned to every point of a given region of space-time. For example, if one were to describe a field in terms of the thermal currents that run through it, then such a field would be a vector field.

A gauge, in field theory, refers to a standard of measurement that is capable of undergoing change as a result of being transported to different points of the field. If the value of measurement of a gauge changes during the process of transportation, such changes are said to be due to the effect of the field on the gauge.

For example, since a field gives expression to a vectored quantity, the strength of the field has the capacity to register on the gauge both with respect to magnitude of intensity as well as with respect to orientation or direction of that intensity. Therefore, if one's measurement gauge is a dial that contains a pointer, then the pointer will take on different orientations, depending on, say, the varying strength of the field, as the gauge is moved about the field.

Any field that is capable of bringing about the foregoing sorts of changes in the gauge as it is transported about the field is known as a gauge field. Moreover, because a gauge field actually involves a dialectic between a measuring methodology and a given ontological field, the gauge field incorporates a set of rules. These rules permit one not only to describe, but keep track of, the transitions undergone by the gauge. This rules-property of the gauge field enables one to make comparisons of the strength of the field at different points in that field.

The hermeneutical operator also satisfies the conditions for a gauge field. The following points outline how the gauge field conditions are satisfied.

To begin with, the hermeneutical operator is a standard of measurement. As is true in all cases of measurement, the operator provides a methodological mode of engagement with that which is to be measured. This mode of engagement is intended to provide a standard that can serve as a uniform basis for comparison (either quantitatively or qualitatively) from engagement to engagement.

Of course, the idea of measurement in relation to the hermeneutical operator is considerably more complex than normal modes of measurement. This is primarily because of the problems that surround the establishing of a uniform basis of comparison both for a given individual, as well as for a community of individuals.

To be sure, the number and general structure of the components of the hermeneutical operator are the same from individual to individual. In other words, there are six basic modes or components in the hermeneutical operator activity of every human being capable of even minimally intelligent behavior.

Moreover, the general character of these components or modes is the same in everyone in the sense that they involve: identifying reference, reflexive awareness, characterization, the interrogative imperative, inferential mappings and congruence functions. In addition, the hermeneutical operator always manifests itself in the context of a focal/horizonal dialectic.

However, despite such common themes in the character of the hermeneutical operator as it is manifested from one person to the next, there are tremendous differences in the power, sophistication, scope, and quality of the way the various components of the hermeneutical operator are given expression as one goes from individual to individual, community to community, and historical period to historical period.

Nevertheless, while the degree of difficulty of the kinds of problems encountered in the hermeneutical search for a uniform basis of comparative measurement might be more complex than is the case with many instances of physical measurement, such problems really are only variations on the sorts of themes that arise regularly in the theory of measurement underlying the physical sciences. Even in the, relatively speaking, less complex problems that surround the issue of measurement in the physical sciences, there are a variety of sources of contamination and/or fluctuation that affect the uniformity of measurement from one situation to the next and from one individual to the next.

Furthermore, like its counterparts in the physical sciences, the hermeneutical operator is a standard of measurement capable of undergoing changes as a result of its being transported -- due to shifts in intentionality and the concomitant transitions in the focal/horizonal dialectic -- from place to place in the phenomenological field. This satisfies the conditions of a gauge as well.

In addition, when the hermeneutical operator gauge is transported from point to point in the phenomenological field, it is capable of responding to, or being affected by, differences in the strength of the field, at various points in that field. However, in the case of the hermeneutical operator, although the strength of the field can be expressed as a vectored quantity, nonetheless, under appropriate circumstances, the strength of the field also can be expressed as a vectored or tensored quality.

This means the structural character of the orientation aspect of the hermeneutical vector field cannot be restricted to purely quantitative issues. It will include, as well, qualitative issues such as meaning, value, purpose, likes, dislikes, attitudes, judgments, beliefs, and so on.

Finally, the hermeneutical operator's engagement of the phenomenology of the experiential field generates a set of rules or principles that permit one to both describe, as well as keep track of, the changes in the strength of the phenomenological field as the hermeneutical gauge is moved about from point to point in the field. This set of rules or principles consists of the field equations (see Appendix 5) which give expression to the spectrum of ratios of constraints and degrees of freedom that is characteristic of the dialectical activity of the six components of the hermeneutical operator over time.

Thus, in view of the foregoing considerations, the hermeneutical operator's dialectical engagement of the phenomenology of the experiential field satisfies the conditions of a gauge field. In short, the dialectics of this engagement involve a standard of measurement capable of being affected by variations in the strength of the field through which the gauge is moved. Moreover, this same hermeneutical gauge operates according to a set of rules or principles that permit one to describe and keep track of changes in field strength as the gauge is transported about the phenomenological field.

One of the dynamic aspects of the hermeneutical gauge field, however, needs to be highlighted, to some degree. While this aspect actually is present in all gauge fields, its role tends to be de-emphasized.

More specifically, the hermeneutical gauge is not just a passive recorder of fluctuations of the phenomenological field. The hermeneutical gauge also is capable of actively operating on that field and generating interpretations of the significance or meaning of the changes in field strength that are registered. Consequently, as is the case with any mode of measurement (but especially in light of the active, interpretive, projective character of the hermeneutical operator), the hermeneutical operator is capable of distorting the structural character of that which is being measured.

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Phase and orientation

Both the magnetic and the electric aspects of the electromagnetic field are vector quantities. This is because each point of the region of space-time that characterizes the field has a directional component as well a magnitude associated with it.

According to Maxwell's theory, the distribution of electric charges around a given point of the field gives expression to the strength of the field at that point. In practice, however, people who use the theory often speak in terms of the potential or voltage that exists in a given region of the field. This potential also is rooted in the charge distribution. More specifically, the potential is construed in terms of charge density for a given region of the field. The higher (lower) the charge density, the higher (lower) the potential.

Similarly, the value of a hermeneutical field at any juncture is determined, ultimately, by the density, together with the qualitative orientation and phase relationships, of the semiotic quanta of that field. These components of density, orientation, and character of the phase relationships determine the vectored/tensored 'charge' potential of the hermeneutical field.

This charge potential is expressed through the dialectic of focus and horizon. The vectored direction of a hermeneutical charge potential can go either: from the focus to the horizon; from the horizon to the focus; or, both ways simultaneously.

If an electrical field is kept stationary, it will not generate a magnetic field, and, therefore, the field will be a "pure" electric field. If one were to lower (or raise) the potential of the entire field, there will be no detectable difference in the general characteristics of the field (aside, of course, from the decrease/increase in potential) in any measurements that are taken before and after the change in potential.

Thus, one observes a case of global gauge symmetry with respect to the transformation of the field's potential. In other words, since the electric field's characteristics are a function of differences in potential, rather than absolute potential, as long as there are no differences of potential introduced into the field, the general characteristics of the field will be preserved, and global gauge symmetry will be observed.

If the aforementioned stationary electrical field is moved, it will generate a magnetic field. While, in terms of Maxwell's theory, the magnetic field is the result of the moving electric charges, the general practice is to speak in terms of a magnetic potential (similar to the idea of electric potential) as the cause of the magnetic field. If, in turn, the magnetic field is moving, it generates an electrical field.

The dialectic between moving electric and magnetic fields allows one to establish local gauge symmetries in the electromagnetic field with respect to various kinds of transformations. This is because every local transformation of the electric field is compensated for by a corresponding change in the associated magnetic field. The reverse is also the case. Therefore, despite local transformations, the general characteristics of the electromagnetic field remain invariant, and, as a result, local gauge symmetry is preserved.

In the quantum interpretation of electromagnetic phenomena, fluctuations in the field's electrical potential involve shifts in the phase character of the wave to which the electron gives expression. Because the electron has two spin states, the field to which it gives expression also is described in terms of two components.

However, the mathematical means of representing the two wave components involves complex numbers. This means one of the two components will be expressed as a real number, while the other of the two components will be expressed as an imaginary number.

From the quantum perspective, an electric field consists of a collection of quantum wave packets. The different amplitude values of these wave packets are reflected by changes in the magnitude of both the imaginary, as well as, the real components of the complex numbers used to represent the wave packets.

To be precise, the complex numbers used to describe oscillations in amplitude values of the wave packets do not actually describe a given electron's field. When the real and imaginary components of the complex number are squared, they describe the probability of finding an electron of a particular spin character at a particular juncture of space-time in the field.

If one wishes to determine a complete description of the oscillatory character of an electron wave packet, one has to work out certain equivalencies. For instance, the wavelength of the wave-packet's oscillatory character is proportional to the electron's momentum, whereas the frequency of the oscillation of the wave packet is proportional to the energy of the electron. In addition, one needs to take into consideration the phase character of the oscillation.

Phase refers to the degree of displacement of some aspect of an oscillation relative to a certain point of reference. This point of reference usually is selected arbitrarily.

Generally, phase is measured in terms of an angle. Moreover, the phase angle of the real component of the wave has an inverse relationship to the phase angle of the imaginary component of the wave. Consequently, whenever one complex component of the wave has a zero value, the other complex component has a maximum value.

The phase of the oscillatory character of the electron's wave packet is a function of the relationship of the two components of the complex number. This is the case not only with respect to some arbitrarily chosen reference point but also with respect to one another.

Similarly, the phase of the oscillatory character of the semiotic quantum's waveform structure is a function of the relationship of the six components of the hermeneutical operator, not only with respect to a given focal/horizonal point of reference, but also with respect to one another. Like its physical/mathematical counterpart, the focal/horizonal point of reference that is used to study phase properties can be chosen arbitrarily. Nonetheless, the arbitrary choice of focal/horizonal reference point can assume great importance when one is attempting to interpret the possible ontological significance of phase relationships in a given context.

The hermeneutical counterpart to using an angle as the measurement index of phase in the physical world, is orientation. The orientation of a given aspect of the hermeneutical operator is measured (in a qualitative sense) in terms of not only how that aspect relates to the current focal/horizonal point of reference but, also, how that aspect relates to other instances of hermeneutical operator activity. These other instances of hermeneutical operator activity might involve one's own past or future operator activity, as well as the hermeneutical operator activity of other individuals.

This is where intra-personal and intersubjective networks of phase relationships arise. These complex phase relationships can be given expression as some form of tensor-matrix -- whether covariant, contravariant, or transvariant.

Furthermore, just as when, say, the real component of a complex number has a maximal phase value, then the imaginary component of the complex number will have a zero phase value, so too, when any of the components of the hermeneutical operator (with one exception to be mentioned shortly) has a maximal phase value, all of the other components of the hermeneutical operator will have phase value tending toward zero (although that value might never, actually, be realized). When, for example, identifying reference has a maximal phase value relative to a given focal/horizonal point of reference, all of the other components of that semiotic quantum tend toward a zero phase value.

Therefore, the structural character of the given semiotic quantum's oscillatory waveform will be dominated by the phase character of the identifying reference component. However, when none of the hermeneutical isotopic-spin components of the semiotic quanta have a maximal phase value then, the other components will tend toward some non-zero phase value.

From the perspective of hermeneutical field theory, the hermeneutical field (and, therefore, the phenomenological field in which it is rooted and for which it is the source of curvature) consists of a stream of, or series of currents of, semiotic quanta, all of which have a phase relationship with the on-going focal/horizonal context.

This means all semiotic quanta that are not a part of the focal aspect of such a context will be part of the horizonal aspect of that context. As horizon, they are stored in the form of a phase relationship of a given tensor-matrix character (i.e., a memory).

One cannot determine the phase of an electron field because, in order to accomplish this, one would need to be able to establish the individual contributions of both the real and imaginary components of the complex representation of the wave packet. However, these two components are so inextricably intertwined in the mathematical representation of the wave packet that their individual contributions cannot be separated out or distinguished through the mathematical means employed to methodologically treat these components. All that can be measured with respect to phase are phase differences between various aspects of the field.

As far as the problem of separating out the character of various contributing components to phase structure is concerned, one might be in a somewhat better position in the context of hermeneutical fields than is the case with physical fields. This is so because the different components of the hermeneutical operator tend to leave a characteristic signature when they are present. Even if an absolute, precise quantitative determination of the contributions made by different aspects of the hermeneutical operator cannot be made, one, nonetheless, can detect the relative contributions of the shaping activity of the six different components of the operator with respect to phase structure.

Because a semiotic quantum's inner spin states of identifying reference, characterization, reflexive awareness, the interrogative imperative, inferential mapping and congruence functions all have different orientations to a given focal/horizon context, each of these components leaves a distinct 'phase signature imprint' on the structural character of the semiotic quantum. The different orientations or phase relationships that the various isotopic-spin states have with the focal/horizonal dialectic can be cited as reasons why any given semiotic quantum gives expression to an identifiable ratio of constraints and degrees of freedom with a characteristic phase signature imprint.

As a result, unlike the case with phase in the electron field, the phase character of a hermeneutical field can have an effect on the manner in which one assigns meaning, value, purpose, significance, or orientation to a given point-structure, neighborhood, or latticework. Therefore, one cannot add or subtract any phase angle to the hermeneutical field and expect the symmetry of the field to be preserved as is the case with respect to the adding or subtracting of phase angles to the electron field.

However, the foregoing comments notwithstanding, phase difference between any two given points of the hermeneutical field also plays an important role. In other words, differences in orientation with respect to a given focal/horizonal point of reference form an important source of information concerning the structural character of certain aspects of phenomenological experience and/or hermeneutical understanding. These differences of phase orientation (which are given expression through phase relationships) lead to, among other things, constructive and destructive patterns of interference that frequently, are expressed in terms of covariant, contravariant, and transvariant tensor patterns of dialectical interaction within a hermeneutical context.

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Coupled oscillators and dimensionality

A simple vibrating unit or element is referred to as an oscillator. One can construct more complex systems of vibrating elements by coupling a number of such oscillators together. The character of the medium through which the oscillators are linked together is presumed to be elastic so that the form and energy of the vibration in one oscillator can be transmitted to other oscillators in the coupled system.

A naturally occurring example of such a coupled oscillatory system is the array of atoms in a crystal. Each of the atoms of the crystal vibrates back and forth about its equilibrium position, and all of these individual units of oscillation are coupled together by means of the atomic forces that are active within the crystal. The whole system of coupled oscillators gives expression to what is known as lattice vibration.

The foregoing idea of lattice vibration might have counterparts in various phenomenological systems. Hermeneutical structures within such systems form an array or latticework of oscillators. These latticeworks are coupled together by a variety of dimensional forces that are manifested through the phase relationships that are characteristic of such systems

Thus, dimensions that interact might act like coupled oscillators. The nature of the dialectic of this dimensional interaction generates complex latticework patterns consisting of arrays of hermeneutical point-structures. The parameters of these point-structures give expression to the spectrum of ratios of constraints and degrees of freedom, together with accompanying phase relationships, through which various structures or complex waveforms are manifested within phenomenology.

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Dispersive and non-dispersive mediums

Phase velocity describes the rate at which any point on a wave is propagated through a given medium. If one has a fixed medium, such as a string, one can increase phase velocity by increasing the tension in the string.

In general, phase velocity is functionally dependent on the square root of the strain that exists in a given material, divided by the inertial mass of the material. The strength of the restoring force is given expression through the strain component, whereas the kinetic activity of the vibrator is given expression through the inertial mass of the medium.

In those cases when phase velocity is not dependent on wave frequency, the medium is referred to as being non dispersive. However, when phase velocity is dependent on wave frequency, the mediums in which this occurs are described as being dispersive.

An example of the latter takes place when white light is separated into different colors by a prism as a result of the interaction between the electromagnetic wave and electronic oscillators in the prism material. This is known as optical dispersion.

In the hermeneutical context, the rate at which phase shifts occur among a given spectrum of ratios of constraints and degrees of freedom might serve as the counterpart to the idea of phase velocity. However, the aspect of 'rate' might be somewhat problematic for it suggests a purely quantitative value.

One might not have any means of measuring the number of phase shifts occurring per given unit of time. Consequently, in the hermeneutical context, phase velocity might be treated as a purely heuristic device that enables one to have a way of making identifying reference to certain aspects of the hermeneutical engagement of the phenomenology of the experiential field. If this is the case, then one might be able to use the idea of phase velocity in conjunction with ideas such as dispersion, strain, and inertia in order to discuss the sorts of factors that affect the rate at which phase shifts are propagated through various kinds of hermeneutical medium.

One should keep in mind that when, say, light enters a medium, the medium is made up of electrons bound to atoms. Such bound electrons act like oscillators.

When these oscillators are engaged by the wave motion of electromagnetic radiation, they begin to vibrate as a result of that interaction. The vibration of these oscillators of the medium generates, in turn, their own electromagnetic field that interacts with the light wave radiation.

The aforementioned dialectic affects the rate at which light will be propagated through the medium. It is referred to as the refractive property of the medium. As such, the speed of light through a given medium will be given by: $v = c/n$, where c is the speed of light in a vacuum, and n is the refractive index of the given medium through which light is being propagated.

In the same way, one might speak of the refractive property of a given hermeneutical medium. This is the capacity of a given hermeneutical medium to affect the velocity (or quality of transmission) with which a certain kind of communication or understanding is propagated through such a medium.

A hermeneutical medium can be conceived of as being made up of a series of hermeneutical operators that act like coupled oscillators. They are given a complex vibrational mode through incoming hermeneutical, experiential, phenomenological, sensory, emotional, and/or spiritual waveforms. However, these hermeneutical oscillators also generate, in turn, their own field that is capable of entering into dialectic with the incoming waveforms. This dialectic will affect the rate, as well as the qualitative manner, by which the waveform is transmitted through the hermeneutical medium.

In fact, because the hermeneutical field is complex, there will be a differential distribution of oscillator properties as one goes from one locus of hermeneutical activity in the field to other loci of hermeneutical activity in that field. This is somewhat analogous to the way in which an electromagnetic field often will manifest differential strengths of electrical charge as one moves from point to point in that field.

As indicated previously, in physics, dispersive mediums are described as those mediums in which phase velocity will be affected by the frequency of the wave that is being propagated through that medium. In a sense, there are aspects of almost everyone's understanding that are dispersive in character.

One of the tasks of an educator is to be sensitive to how the phase velocity of a given communication or transmission can be affected by the potentially dispersive aspects of a recipient's medium of understanding. There might be qualitative/quantitative levels of frequency, intensity, wave-length, orientation and so on, in relation to a given communication, which are able to facilitate a transmission's phase velocity.

Such facilitating strategies have the capacity to either by-pass or catalytically transform dispersive elements in the recipient's phenomenological/hermeneutical medium. As a result, these sorts of strategies might help to bring about the emergence of non-dispersive mediums of understanding.

On the other hand, there might be qualitative/quantitative levels of frequency, intensity, orientation, etc., of communication that impede that communication's phase velocity through the recipient's phenomenological/hermeneutical medium. This will prove detrimental to the emergence of a non dispersive medium of understanding.

In the hermeneutical context, dispersive mediums are unfocused, without direction or orientation. Therefore, when a given complex waveform (i.e., communication -- spoken, written, behavioral, emotional) engages such a medium, the waveform tends to become dispersed or fragmented. Different facets of the waveform are separated out and treated as separate, autonomous entities, as a prism does with a light wave.

In a non dispersive medium, on the other hand, the waveform is treated as a whole. This is the case even though the medium might engage that waveform primarily through only a select ratio of constraints and degrees of freedom that is part of the spectrum of ratios making up the structural character of a hermeneutical waveform medium. Under such circumstances, there are ratios of constraints and degrees of freedom inherent in the medium that serve to vector phase shifts along focused, heuristic lines.

In the case of dispersive hermeneutical mediums, there is a relative absence of such inherent ratios. As a result, hermeneutical activity tends to fragment the incoming waveform and break it apart in ways that prove to have no focus or direction to them.

Under those circumstances, there tends to be an increased rate of phase shifts as a line or lines of focus is sought. This increased frequency of phase shifts gives expression to dispersive tendencies as the waveform is propagated through the recipient's phenomenological/hermeneutical medium.

One could construe education as a process in which there is an attempt to take a normally dispersive medium (namely, the undisciplined, unfocused, un-channeled hermeneutical operator at work within various individuals) and generate circumstances that are conducive to the transformation of that dispersive medium into a chaotic dynamic, out of which will emerge a non dispersive medium capable of lending focus, direction, orientation, organization, and so on to waveforms encountered during the course of the hermeneutical operator's activity. Looked at from another direction, the task of education might be construed as a matter of guiding the transition from one kind of non dispersive medium (which might be constructed around false beliefs, problematic values, weak or nonexistent congruence functions, untenable mapping relationships, unproductive expressions of the interrogative imperative, and so on) to a better focused, more stably oriented, more heuristically valuable non dispersive medium.

One also might note that keeping some sort of balance is important between: (a) the tendencies of a system to focus, direct and orient the activity of the hermeneutical operator in the sense of a non dispersive medium, and (b) the tendencies of a system to be open to proceeding and exploring in fluid, flexible ways. After all, orientation and focus are, in their own ways, biases that, sometimes, are capable of closing one off to certain heuristic possibilities.

The interrogative imperative might assume a large share of the responsibility in keeping alive this dimension of openness. However, maintaining an appropriate sort of openness by means of the interrogative imperative, involves a delicate balance.

On the one hand, one should not ask so many questions that everything becomes unstable and unreliable. Yet, on the other hand, one needs to retain a flexibility or receptivity -- through a questioning, inquiring probing -- to a variety of possibilities. Such possibilities might help one improve one's present understanding, or they might take one in directions that will enrich, deepen, broaden or inspire one's understanding with respect to new horizons and new levels of scale. This suggests that developing educational strategies that are designed to help an individual to develop balanced modes of inquiry and questioning might be of fundamental importance.

The interaction between individual and society occurring during the process of education is a complex dialectic transpiring on different levels of scale. For instance, this dialectic involves a variety of institutional currents that are aimed at preserving certain cultural principles of identity with respect to different kinds of historical, social, religious, philosophical, economic, and political transformations. Nevertheless, there are many currents, introduced by individual members of the community or culture, which give expression to dissipative structures in relation to various cultural and/or individual principles of identity.

Dynamic hermeneutical equilibrium exists with respect to the aforementioned dialectic when the ratio of unanswered questions to defensible congruence is low. In addition, in order for hermeneutical equilibrium to exist, the character of those questions that are unanswered must not be of a fundamental or essential nature. However, when the ratio of unanswered questions to defensible congruence is high, and/or the character of the questions left unanswered are of a fundamental or essential nature, then a far from equilibrium condition exists.

The relationship between equilibrium and dissipation gives expression to the hermeneutical remainder theorem. This theorem focuses on the quantitative and qualitative character of the questions that are left over in a given hermeneutical context at a given time.

Dissipative structures arise when, through a series of engagements by semiotic quanta, problems are generated with respect to: characterization, identifying reference, the interrogative imperative, inferential mappings and/or congruence functions, in relation to some given: theme, event, issue, idea, value, understanding, belief, theory, model, and/or methodology. Perhaps one of the primary modes of creating conditions conducive to the generation of dissipative structures is through the interrogative imperative that has the capacity to push a given hermeneutical context -- which previously had exhibited dynamic equilibrium -- into far from equilibrium conditions. The impetus for the interrogative imperative can come from both sides of the educational process -- that is, the individual as well as society.

Out of these far from equilibrium conditions a dissipative structure might arise that serves as a seed for the development, construction, generation, or emergence of a new hermeneutical attractor. In fact, a form of catastrophe theory, adapted to the structural character of hermeneutical gauge field theory, might be applicable to this issue of dissipative structures.

Essentially, such a theory of hermeneutical catastrophe would attempt to determine and grasp the character of the dissipative structures that might arise out of far from equilibrium conditions. In addition, this sort of theory would attempt to map out the kinds of problem that might emerge under such conditions.

Part of educational theory would be directed toward trying to show how to bring about such catastrophes in the beliefs, theories, values, ideas, methodologies and understandings of a student in as heuristically constructive a fashion as is possible. Obviously, one of the dangers here involves the possibility for indoctrination in which the individual becomes a passive and/or unwilling and/or unwitting participant in a catastrophic transition process directed toward establishing certain kinds of beliefs, values, ideas and so on in the understanding of the student.

Approached from another perspective, hermeneutical catastrophe theory could be seen as an exploratory journey into certain aspects of the creative process. In other words, the student is introduced to a set of algorithms, strategies and methodologies designed to help an individual to discover ways of resolving the tensions, stresses and so on which have been generated during the transitions or phase shifts to far from equilibrium conditions.

Resolution would result from the development of a new hermeneutical attractor capable of removing the tensions, stresses, etc. that arose during the phase shift away from dynamic equilibrium. Such hermeneutical attractors are characterized by giving expression to a low ratio of unanswered questions to defensible congruence in line with the requirements of the remainder theorem. Essentially, one is looking for an hermeneutical tensor-matrix of the 'right' structural character through which one can re-establish equilibrium and/or restore various kinds of phenomenological, ontological, or hermeneutical symmetries.

The other side of the dialectic of the educational process involving individual and society concerns the drive to preserve various kinds of hermeneutical symmetries involving cultural, religious, political, epistemological, economic and individual identity orientations. Both sides are fighting to preserve those sorts of symmetries that will permit a state of hermeneutical equilibrium to be maintained.

Unfortunately, the symmetries that each side is attempting to preserve are often in conflict with one another. Furthermore, often times, neither side pays very much attention to the fundamental role that needs to be played by the hermeneutical remainder theorem in the dialectical engagement of individual and society during the educational process.

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Hermeneutical gauge field theory

When one can preserve various kinds of symmetries in a field in spite of subjecting the quanta of that field to different sorts of phase transformation, one has what physicists refer to as a gauge symmetry. While one does not need to know the absolute phase value of the quanta of a field in order to be able to make measurements or run experiments with respect to that field, one does, nonetheless, have to select a gauge convention in order to be able to specify differences in phase value. Usually, the gauge convention that is chosen permits one to measure phase differences in terms of angles relative to some given point of reference.

The concept of gauge symmetry was first developed by Hermann Weyl in the early 1920s. This idea arose during the course of Weyl's attempts to marry Einstein's general theory of relativity to electromagnetic phenomena. At a certain point in his theoretical deliberations, Weyl needed to provide a means of deploying separate standards of time and length for every point of space-time in order to be able to preserve invariance in the face of, for example, spatial contractions or dilations.

The means Weyl had in mind for realizing his scheme of separate standards of time and length for the various points of space-time was akin to a method used by machinists. Machinists used different polished 'gage' steel blocks to establish standards of length in various circumstances. Like the machinists, Weyl proposed that measurements in physics required the selection of standards that were capable of being varied from one circumstance or point to another. This procedure of measurement is sometimes known as a gauge or calibration invariance.

In modern gauge theory certain changes and additions have been made in relation to the foundations laid by Weyl nearly 90 years ago. Among the most fundamental of these changes has been the substitution of phase angles for lengths as the basis for selecting a gauge or standard of measurement.

To say that an electromagnetic field conveys forces between, or among, the charged particles of that field, is to indicate that the transmission of force is capable of altering, in various ways, the character of the particles that come under the influence of these forces.

From the perspective of quantum field theory, the phase of an electron field is shifted whenever an electron of the field absorbs or emits a photon, and such a shift in the phase of the electron field is considered to be one of the ways in which the transmission of forces (that occurs through the exchange of photons that are the carriers of force in the electromagnetic field) is capable of altering the character of particles in that field.

From the perspective of hermeneutical gauge field theory, the phase of the hermeneutical field is shifted whenever a semiotic quantum of such a field is absorbed or emitted by other semiotic quanta of the field. In this sense it is like a photon-photon interaction. Therefore, since the semiotic quantum is the carrier of force of the hermeneutical field, any semiotic-semiotic quantum interaction will give expression to a complex, vector/tensor dialectic of phase transformations.

The shifting of phase relationships alters the hermeneutical structural character of that which engages or is engaged by the presence of such a 'quantum' event. This results in the shifting of the ratio of constraints and degrees of freedom of the point-structure, or neighborhood or latticework that is involved in the transaction.

Obviously, in the light of the foregoing comments, a fundamental aspect of the educational process will revolve around the kinds of phase shifts that occur as a result of the packages of semiotic quanta that are directed at the student. These packages of semiotic quanta come in the form of: attitudes, beliefs, values, ideas, goals, theories, interests, motivations, fears, and so on, that are being transmitted through: the teachers, the text materials, the officials of the school, other students, the rules of the school, the surrounding community, and so on.

In other words, the educational process can be construed as a force field capable of altering or generating spectra of ratios of constraints and degrees of freedom by means of, among other things, causing shifts in the phase character or orientation or phase relationships of the point-structures, neighborhoods, and latticeworks of the students. The carrier or vector boson of the educational force field is manifested in the form of the exchange of semiotic quanta.

The phase of an electron wave is firmly established in a given field if one assigns determinate values both to the electric and magnetic vector potentials of that field. Moreover, since the electromagnetic field gives expression to local gauge symmetry, one can adopt different values for these vector potentials at every point of the field.

If this happens, the phase of the electron field also will vary at every point of the field. However, the phase that is fixed at any given point will always be a reflection of the convention that is used to set the values of the electric and magnetic vector potential for the various points of the field.

In order to establish the phase character of a given point of the hermeneutical field, one must assign determinate values for the vector/tensor potentials of each of the six components of the semiotic quantum in relation to a given focal/horizonal context. Once these values have been assigned, the phase relationships will have been fixed for that semiotic quantum in a given focal/horizonal context.

Moreover, just as one can assign different electric and magnetic vector potentials at each point of the field, so too, one can assign different 'vector/tensor potentials' for each of the six isotopic-spin states of the semiotic quanta at each point of the hermeneutical field, relative to some given focal/horizonal point(s) of reference. This means the phase relationships that are fixed at each point of such a hermeneutical field will be a function of the assigned values of the isotopic-spin states of the semiotic quanta at each of the points.

The key to theories involving local gauge symmetry is to find a field capable of generating, or giving expression to, units that carry force in a particular way. This particular way must permit one to perform transformation operations of different sorts from point to point in the field while preserving symmetry of the laws operative in the field.

The structural character of the unit that is the carrier of force in the field is made up of a spectrum of ratios of constraints and degrees of freedom. Shifts or transitions in this spectrum of ratios are the means by which transformations are propagated or communicated throughout the field.

In effect, the carrier of force must be able to transmit the character of the transformation accurately but in such a way that the laws of the field are preserved. If one selects a carrier of the field force that has an inappropriate structural character, then either: (a) the laws of the field will not remain invariant; (b) the transformation operations that are to be performed will not be transmitted accurately, or (c) both (a) and (b) will occur.

Obviously, the 'trick' in hermeneutical local gauge symmetry theory is to find a semiotic quantum with the right kind of isotopic-spin characteristics. However, in order to do this, the tensor-matrix of the isotopic-spin character of the semiotic quantum must be able to preserve certain kinds of symmetries of structural character that exist in the aspect of ontology to which the transformational operations of hermeneutical transduction are being applied, and to which those operations are giving identifying reference.

The symmetries to be preserved concern various laws of structural identity concerning the character of different aspects of ontology. The initial transformations that are applied to the ontological field are various kinds of sensory transduction processes.

The semiotic quantum gives rise to a field that has to be introduced in order to establish local gauge symmetry with respect to the ontological field being transduced by sensory processes. However, in order for the field generated by the semiotic quantum to accomplish this task, the field must be assigned an appropriate hermeneutical tensor-matrix. This tensor-matrix summarizes the dialectical shaping influences of the individual hermeneutical components of the semiotic quantum in a way that is capable of reflecting (that is, preserving) the invariance or symmetries inherent in the structural character of the ontological field.

Each individual cell of the hermeneutical tensor-matrix is determined by a process akin to the process of differentiation. In fact, the values for any given cell of the matrix are determined by taking a second derivative of the sensory transduction process that is the first derivative value.

By noting changes or transitions, through the process of hermeneutical differentiation, in the rate, shape, character, orientation, and so on, of the structural character of a given transduction process, one constructs a point-structure whose structural character provides an interpretation of, or reflection (if correct) of, what makes a sensory transduction process of such structural character possible. By repeating this process of taking hermeneutical second derivatives of different first derivative sensory transduction structures, one is in a position to generate or construct neighborhoods, lattices, and latticeworks.

This process of hermeneutical differentiation takes into account the structural character of the way different semiotic quanta at various points in the phenomenological field carry the hermeneutical force. Among other things, the carrier of hermeneutical force transmits phase information relative to various contexts of focal/horizonal dialectic.

The structural character of the hermeneutic mode of taking second derivatives is a far more complex process than is the mathematical process of taking a second derivative. This is the case because the tensor-matrix of the semiotic quantum allows for a lot more components, dimensions, degrees of freedom and dialectical interplay (the counterpart to the idea of rates of change) to be worked into the qualitative hermeneutical calculation than is the case with respect to usual mathematical instances of taking a second derivative in relation to rates of change involving certain quantitative variables.

When one wishes to key in on the contribution of any particular component of the hermeneutical operator, it seems to be akin to the process of doing partial differential equations. In other words, one holds constant the contributions of all the other shaping components, and then one proceeds to explore what happens to structural character when one manipulates one component across a variety of transformations and conditions.

In a sense, the cells of the hermeneutical tensor-matrix of a given semiotic quantum represent a sort of collective equation that has to be solved in order to determine if there is a means of reflecting (i.e., preserving symmetry) the structural character of a given aspect of phenomenology and/or ontology across the transformational currents that are impinging on each cell of the semiotic quantum. Solving the equation means coming up with a set of assignment values of hermeneutical isotopic-spin that are capable of preserving certain kinds of invariance with respect to: (a) the structural character of a given sensory transduction, as well as (b) the structural character of that (i.e., a given aspect of ontology) which helps make possible a sensory transduction (i.e., experience) of such structural character.

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Semiotic quanta as vector bosons

In 1954 C. N. Yang and Robert Mills proposed an isotopic-spin symmetry model. This theory began as a model intended to account for interactions involving the strong force, but after it was successfully re-normalized, investigators began to approach it as a possible model of weak force interactions.

According to Yang and Mills, when the rotational states of isotopic-spin are permitted to vary from one point of a field to another (i.e., when the field is given a local gauge character), the laws of physics would remain invariant only if one introduces six, new, vector fields of infinite range. These six fields involved three vector bosons (bosons are particles that carry force).

Among the new fields proposed by Yang and Mills, were two that were different from the photons usually encountered in physics. Although the Yang-Mills 'photons' were spin-one, massless particles, just like the normal photons carrying the force of an electromagnetic field, they had the further property of carrying a charge. In other words, one of the new vector fields involved positively charged photons, while the other new vector field involved negatively charged photons, whereas 'normal' photons carried no charge.

If one permitted photons to have charges of different character, this would set the stage for photons, which are carriers of force, to interact with themselves and result in a variety of strange phenomena that have not been experimentally observed. Consequently, the idea of a charged-photon field tends to be ruled out as being irreconcilable with observable reality.

Although physics does not permit charged photons to interact because of the strange effects that would arise when the carriers of electromagnetic force interact with one another, hermeneutical field theory does not preclude semiotic quanta interacting with one another, despite the fact that semiotic quanta are the carriers of hermeneutical force. Indeed, point-structures, neighborhoods, lattices, and latticeworks are generated when semiotic quanta engage one another -- and this sort of phenomenon is not at all inconsistent with empirical observation.

The structural character of any given amalgamation of point-structures in the form of a neighborhood or latticework depends on the dialectical character of the underlying set of semiotic-semiotic quanta engagements, together with the sorts of phase relationship that are established as a result of such dialectical engagements.

The idea of a semiotic-semiotic quanta engagement seems to suggest it is a sort of mechanical process that is, more or less, straightforward, without any need of conscious intervention or without any room for an intentional shaping of the structural character of that dialectical process. Nonetheless, while it is possible for autonomous, semi-consciousness, or non-conscious kinds of hermeneutical activity to occur, the component of reflexive consciousness is, to some extent, able to exert a directing, orienting, limiting, shaping, modulating, and organizing influence on how the semiotic-semiotic quanta dialectical interaction unfolds.

Reflexive consciousness has the capacity to engage things at several different levels of scale. One level of scale would be in relation to each of the components of the hermeneutical operator (including the operator itself).

For example, when one is aware that an identifying reference of a particular kind is being made, and one is aware that one is aware of this by reflecting on the character of the identifying reference while it is being made, the component of reflexive consciousness is dialectically interacting with the component of identifying reference. The same can be true for all of the components of the hermeneutical operator. On this level of scale, the 'reflexive consciousness-hermeneutical operator' dialectic constitutes the primary focal/horizonal event.

On another level of scale, the component of reflexive consciousness reflects on the structural character of the thematic currents that are being collectively contributed by all of the other components of the hermeneutical operator. In this case, the component of reflexive consciousness has the opportunity to integrate, or bring together, to some degree, the character of that collective tensor-matrix as it engages, or is engaged by, the thematic currents of certain aspects of the focal/horizonal dialectic of which the given semiotic quantum is a part. On this level of scale, reflexive consciousness serves to bring together a given semiotic quantum in the context of a broader or more complex focal/horizonal dialectic.

On either of the foregoing levels of scale, the component of reflexive consciousness brings together the phase relationships linking a number of point-structures, neighborhoods, or latticeworks. This is done in order to be in a position to apply, if appropriate and/or required, various hermeneutical transformations to these phase relationships. Such transformations would be an expression of the tensor-matrix character of a given semiotic quantum, or oriented mode of understanding, that was engaging some aspect of the focal/horizonal dialectic.

In the context of quantum electrodynamics, one can have an electron undergoing several, successive phase transitions, such as, for example, the emitting and absorbing of a photon. The end result of this sequence of phase transitions will be the same irrespective of whether a photon is: first, emitted and, then, absorbed; or, first, absorbed and, then, emitted. Thus, in such fields, symmetry is preserved with respect to phase shift transformations irrespective of the order of sequence of such transformations.

In Yang-Mills isotopic-spin local gauge fields, however, the order in which a sequence of rotational transformation occurs does affect the outcome of the transformation process. For instance, in one sequence of rotational transformations, the result might be a proton. Yet, if one were to reverse the order of the sequence of rotational transformations, the result might be a neutron.

A system in which the order of sequence of a series of transformations makes no difference in the outcome of such transformations is referred to as an Abelian system. On the other hand, a system is known as non-Abelian when the order of sequence of a series of transformations does make a difference in the character of the outcome of such transformations.

Quantum electrodynamics, general relativity theory, and Yang-Mills fields are all examples of non-Abelian gauge field theories. In fact, apparently, all of the fundamental forces of nature are expressions of non-Abelian gauge field theories

The hermeneutical force that is carried by the semiotic quantum is also quite frequently, though not necessarily always, non-Abelian in character. Thus, the order in which a sequence of rotational transformations of the hermeneutical isotopic-spin component is carried out often makes a difference to the hermeneutical structural character of the outcome of such transformations.

For example, if one asked several questions, the order in which the questions were asked might affect the direction in which subsequent inquiry proceeded. Or, if one carried out a sequence of inferential mappings, one might generate different outcomes, depending on the sequence in which the mappings occurred, and so on.

The same principle is also characteristic of the other components of the hermeneutical operator or semiotic quantum. Therefore, like field theories involving the other fundamental forces of nature, hermeneutical-dynamics often give expression to a non-Abelian gauge field theory.

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<u>The Higgs mechanism and the breaking of symmetry</u>

As indicated earlier, the idea of an electrically charged photon that was lighter than the electron had physical ramifications capable of totally altering the structural character of reality. Since such a reality is contrary to our experience, there were a number of theoretical suggestions for dealing with these anomalous aspects of the Yang-Mills model.

These suggestions had several goals. On the one hand, they wanted to avoid the problems entailed by postulating the existence of electrically charged photons. On the other hand, theorists wanted to retain those aspects of the Yang-Mills model that were quite attractive, both heuristically, as well as, aesthetically.

Some of these suggestions focused on finding a means of introducing mass into the fields postulated by the Yang-Mills isotopic-spin model. One of the most fruitful and promising of these theoretical suggestions concerns what is known as the Higgs mechanism.

Since the Higgs field is characterized by only a magnitude, it is a scalar field with a zero spin quantum. Moreover, unlike most fields, this field possesses the property of having non-zero energy in the vacuum state.

In physics, a vacuum, generally, is construed as a state in which fields are in their lowest energy mode. Usually, this means the energy value registers zero at any given point in the field.

When one attempts to reduce the energy value of the Higgs field to zero, this requires energy. Yet, when some non-zero energy value is uniformly distributed throughout the Higgs field, the field assumes its lowest energy state. This capacity of the Higgs field not to disappear in the vacuum state plays a central role in the contribution that it makes to resolving some of the outstanding problems of the Yang-Mills model.

One of the primary uses of the Higgs field concerns the manner in which it provides a frame of reference for determining the state of isotopic-spin. Such a means of determination was absent in the Yang-Mills model. As a result, one had no way to distinguish neutrons from protons.

The gauge character of the Higgs field provides an indicator of fixed length that can be superimposed on the Yang-Mills field. The constancy of the gauge character of the Higgs field is due to the nonzero value that that field has in the vacuum state.

Since the Higgs field rotates, along with isotopic-spin, during any gauge transformation, one cannot use the gauge character of the Higgs field to determine the absolute state of isotopic-spin. On the other hand, one can use the constancy of the gauge character of the Higgs field as a reference point against which one can detect transitions in the angle of relative orientation between the gauge indicator of the Higgs field and the gauge indicators of isotopic-spin. These differences in angle of relative orientation are used to distinguish between protons and neutrons.

The way in which the Higgs mechanism provides one with a means of distinguishing between protons and neutrons is an example of spontaneous symmetry breaking. Although the Yang-Mills fields preserve isotopic-spin across rotational transformations, the entities --

namely the neutrons and protons -- which undergo these transformations do not remain invariant and, therefore, lose their symmetry.

The hermeneutic fields generated by semiotic quanta seem to possess the property of spontaneous symmetry breaking as well. More specifically, if one considers the hermeneutical operator in and of itself, it shows no special preference for any particular phenomenological or dimensional orientation or direction. However, when the semiotic quantum comes under the influence of a given aspect of the phenomenological field, there arises an axis of orientation in relation to the focal/horizonal dialectic that develops with respect to the phenomenological field that is engaging and/or being engaged by the semiotic quantum.

The character of the aspect of the phenomenological field being engaged becomes the standard against which the semiotic quantum is to be measured. Moreover, even though the semiotic quantum might be able to preserve certain aspects of the field that it is engaging, by accurately reflecting the structural character of those aspects in the organization of its tensor-matrix, the quantum itself loses its pre-engagement symmetry.

In the above comments, the phenomenological field is the region through which the results of transduction activity can be given expression, provided that certain thresholds are exceeded. In this respect, the phenomenological field mediates between the transduction process and hermeneutical activity, just as the transduction process mediates between ontology and phenomenology.

Although the above comments focus on the phenomenological field, the structural characters of different aspects of that field are reflections of the transductional field. Therefore, by implication, if symmetry has been maintained, the structural character of different aspects of the phenomenological field are reflections of various aspects of the ontological field that have been involved in dialectical engagement with the transductional field.

What degree of distortion exists in either the transductional reflection or the phenomenological reflection (the latter being a reflection of a reflection) is not, at this point, the issue. The emphasis, instead, is on the general character of the linkage between ontology and phenomenology. The fact this linkage is somewhat circuitous or convoluted does not, in and of itself, render the linkage useless as a source of useful information with respect to the structural character of some given aspect of ontology.

The above point has parallels with the way in which telescopes and microscopes both are based on utilizing a series of mirrors to generate an image of certain kinds of objects or processes. The presence of mirrors, in and of themselves, does not render the observed image inaccurate -- although, to be sure, one must take into account the structural properties of the mirrors in order to better appreciate the sources of distortion that can creep into the observed image. Similarly, the fact a hermeneutical field introduces an additional reflective manifold (making it a reflection of a reflection of a reflection) does not, in principle, rule out the possibility that the linkage between the hermeneutical field and the ontological field, circuitous and indirect though it might be, is capable of providing an accurate or useful reflection, within certain limits of resolution and so on, of various aspects of the ontological field.

There is a sense in which the link between ontological fields and hermeneutical fields gives expression to a distributive property. In other words, various properties of the ontological field are capable of being carried over, or distributed across, to the phenomenological field. These properties subsequently become associated with, or entangled with, certain aspects of a hermeneutical field.

Consequently, under certain conditions, when one talks about the phenomenological or hermeneutical fields, one could be said to be speaking, in the foregoing distributive sense, about the ontological field. This should be kept in mind throughout this discussion.

One important difference between the Higgs field and its phenomenological counterpart is that, unlike the Higgs field, the gauge character of the phenomenological field often does not stay precisely the same from one situation to the next, even though the general structural character of such situations might be very similar. This is because, quite frequently, the principle (or set of principles) generating these sorts of situations is an expression of one or more chaotic attractors.

Therefore, the way in which a given phenomenological situation will manifest itself over time might be characterized by self-similar, rather than self-same, behavior. Nonetheless, despite the self-similar, instead of self-same, gauge character of the phenomenological field, the phenomenological structure (be it object, event, process, state, interaction, or condition) being engaged over time, still serves as a gauge standard against which the semiotic quantum measures itself in order to be able to accurately orient itself with respect to the character of the phenomenological or ontological structure being engaged.

In the context of hermeneutical gauge field, spontaneous symmetry breaking also can occur in another way. Instead of looking at the process of symmetry breaking from the point of view of the semiotic quantum, one also can look at this process from the point of view of the phenomenological field.

Considered in themselves, ontological or phenomenological fields do not give special distinction to any of the isotopic-spin components of a particular semiotic quantum. However, when such fields engage, or are engaged by, that semiotic quantum, an axis of orientation arises in relation to the focal/horizonal dialectic that develops with respect to the engagement process.

Under such circumstances, the hermeneutical structural character of a tensor-matrix of a semiotic quantum becomes the standard of reference against which the structural character of a given aspect of phenomenology or ontology is to be measured or assessed or evaluated. Although certain aspects of a semiotic quantum's structural character might remain invariant during the process of engagement, ontology and/or phenomenology lose their pre-engagement symmetry since orienting phase relationships will emerge that are a function, in part, of the character of the tensor-matrix to which the hermeneutical engagement process gives expression.

Point-structures, neighborhoods, and latticeworks of semiotic quanta can be linked together, through phase relationships, in a manner that creates a theory, belief system, model, methodology, or value system. Within these systems of phase relationships, there are certain spectra of ratios of constraints and degrees of freedom (and, this will vary from theory to theory, and so on) that arise. These key or essential or fundamental ratios become gauge standards (irrespective of whether, ultimately, they have real heuristic value or not) against which various aspects of the ontological or phenomenological are measured (irrespective of whether accurately reflective measures are generated or not).

In effect, the foregoing discussion suggests there is a mutual, spontaneous symmetry breaking that occurs. One kind of symmetry breaking is phenomenological (and, by implication, involves transductional and ontological fields). Another kind of symmetry breaking involves hermeneutical fields in relation to phenomenological fields. Furthermore, the point where each of these symmetries spontaneously break is through the process of dialectical engagement -- whether this is on the level of scale of transduction, on the level of scale of phenomenology, or on the level of scale of hermeneutical activity.

On this latter level of scale, the focal/horizonal dialectic of the engagement process, that marks a spontaneous breaking of symmetry, introduces a hermetical counterpart to the Higgs field in physics. In other words, just as in physics, when the spontaneous breaking of a symmetry is marked by the appearance of one or more fields (i.e., the Higgs fields), so too, in hermeneutics, the spontaneous breaking of symmetry that is marked by the dialectics of engagement gives rise to the field of semiotic quanta.

With each focal/horizonal interaction, at least one semiotic quantum is generated. In other words, at least one hermeneutical counterpart to a Higgs field is produced by the spontaneous breaking of symmetry that occurs during the process of engagement.

There are a variety of different directions in which this process of mutual symmetry breaking can go. For example, when a semiotic quantum loses its pre-engagement symmetry, even though certain symmetries in the interacting fields might be preserved, other symmetries in those fields might not be preserved. Similarly, when ontological and phenomenological fields lose their pre-engagement symmetry, even though certain symmetries might be preserved, the phase relationships that do arise might distort various aspects of the structural character of the interacting fields ... and, as a result, one's understanding of some facet of ontology might be skewed or distorted.

For mutual, spontaneous symmetry breaking to lead to an accurate understanding, in which the relevant symmetries - of, on the one hand, the hermeneutical field and, on the other hand, the phenomenological and ontological fields are preserved -- there must be a strong theme of congruence established between, or among, the interacting fields. In the terminology of 'traditional' hermeneutics, there must be a "merging of horizons" of the fields that are engaging one another.

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Quantum chromodynamics

Quantum chromodynamics (QCD) was introduced in an attempt to bring some semblance of structural order to the proliferation of hadrons that had occurred during the course of particle research. Although, initially, there were only three quarks (namely, the up, down and strange quarks), eventually, six quarks were necessary to account for the observed data (the additional three quarks being: charm, bottom, and top).

Originally, quarks were mathematical constructs. That is, while they constituted a mathematical means of accounting for observed data, there was no experimental evidence capable of demonstrating that they were anything more than a mathematical device.

In the 1960s, however, empirical evidence was forthcoming from a series of experiments that was designed to probe the internal structure of protons. Examination of the decay characteristics of the electron-proton collisions generated during these experiments indicated the proton was made up of a number of elementary particles with properties that were in agreement with what the quark model had predicted.

Despite the fact there is considerable evidence to support the existence of quarks that are bound together in pairs and triplets (and this also is true for their anti-particles), no one has ever been able to put forth evidence indicating quarks or antiquarks can exist as single (i.e., unpaired) entities. The inability to witness free quarks was rather disturbing since the experimental evidence indicated that, within the proton, quarks did seem to exist in a single state.

Scientists began to wonder how there could be a force sufficiently strong to confine quarks within the boundaries of the proton's structural character while, simultaneously, permitting the quarks to have relatively free movement within those structural parameters. The lack of success in producing isolated quarks has led theorists to search for an account of why quarks are confined within the structural parameters of, say, a protein or neutron. This is the problem of quark confinement.

According to Pauli's exclusion principle, if two quarks are within a certain distance of one another, they cannot each occupy the same quantum state. Prior to the ascendency of the color hypothesis, the quark model permitted predictions that violated the exclusion principle.

As a result, the quantum property of color was developed as a means of getting the quark model to conform to the Pauli exclusion principle. By postulating the quantum property of color, one could have two quarks packed closely together since one could assume they had different colors, and, therefore, they would be in different quantum states (the term 'quantum chromodynamics' gets the chromo- aspect of its name from the use of the color property).

The quantum property of color is never encountered in a single quark. This property manifests itself when quarks are combined in pairs or triplets.

However, the overall color property of the quark pair or triplet must be colorless. This requirement of composite colorlessness was hypothesized in order to eliminate a certain amount of particle redundancy that would occur if all color permutations were permitted.

Such redundancy is inconsistent with the observed data. On the other hand, the color hypothesis does indicate that as long as the quark pair or triplet is colorless, any combination of colors is equally possible.

In 1973 a number of investigators independently came up with the idea of a chromoelectric field. This field was introduced in an attempt to account for some of the lacunae of the quark model.

Essentially, the chromoelectric field was believed to be generated by the color property. The field was constructed in such a way that it permitted quarks to be weakly interacting when close together, thereby providing an explanation for why quarks move freely within hadrons such as protons and neutrons. At the same time, the constructed properties of the chromoelectric field were of such a nature that the force between particles would remain constant beyond a certain distance of separation.

Maintaining the constancy of force between particles beyond a certain distance was accomplished by taking the field between the particles and compressing the lines of force of that field into a thin string of uniform cross section. This sort of compression permits the force between the particles to continue to be constant irrespective of the distance between the particles. Therefore, beyond a certain distance, no matter how much energy is applied, one would not be able to separate the particles.

According to the dynamics of the chromoelectric field theory, a hadron is not a point-particle. It is thought of as a string. As indicated above, a string consists of a compressed bundle of lines of force.

These strings are believed to be capable of interacting with the structural character of the vacuum. As a result, the propagation of color forces in the chromoelectric field can be affected by the passage of such forces through the quantum vacuum. This kind of interaction is not permitted in Newtonian physics since the Newtonian vacuum is believed to be devoid of all matter and energy.

In an electromagnetic field, the lines of force are densest in the area between two particles of opposite charge. However, the lines of force that link the opposite charges also extend in a variety of other directions as well -- although they are not as dense as in the area between the two charges.

The strength of the force of a unit of electric charge impinging on any point in an electromagnetic field will be a function of the number of lines of force crossing a given unit area of surface that is orthogonal to the lines of force passing through that unit area of surface. In the chromoelectric field, this is expressed in terms of the idea of a string that constitutes a compressed bundle of lines of force.

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Hermeneutical strings, fiber bundles, sheafs and logic

In analogical form, the strength of a unit of hermeneutical charge (i.e., the impact of a given hermeneutical operator at a given point in the phenomenological field) will be proportionate to the number of lines of force (i.e., the phase relationships) which pass through a unit area of surface (i.e., the point-structure or neighborhood or latticework) of the phenomenology of the experiential field. However, in addition to the number of lines of force that pass through a given point of the phenomenology of the experiential field, the qualitative character of those lines also becomes extremely important. In other words, the qualitative character of the spectrum of the ratios of constraints and degrees of freedom that give expression to the phase relationships linking the 'oppositely' charged point-structures of the hermeneutical operator and the phenomenological field must be taken into consideration when assessing the intensity or strength of the impact of the hermeneutical operator on the phenomenological field.

From the foregoing perspective, one might describe a hermeneutical string in the following manner. Such strings are compressed bundles of phase relationships. In addition, the ideas of 'sheaf' and 'fiber bundle' might have analogical implications for development of the notion of a hermeneutical string. More specifically, in the context of hermeneutical strings, the notions of sheaf and fiber bundle might help lend definition to the idea of inference.

Inference is not necessarily about truth. Inference is about the issue of continuity.

In other words, inference is about what links one idea with another. Inference is about the way such continuity manifests itself and the degree to which continuity is manifested. Consequently, inference really is about the process of proposing or seeing mappings that describe the structural character of the phase relationships between one hermeneutical point-structure and other such points.

Hermeneutical strings, sheaves, and fiber bundles might all be different ways of referring to how inferential mappings operate. A hermeneutical string, for example, might refer to the compressed or focused character of the spectrum of ratios of constraints and degrees of freedom that constitute the complex, dialectical relationship between focus and horizon.

Hermeneutical fiber bundles, on the other hand, might be thought of as a group of such phase relationships or hermeneutical strings that have a common focus or common set of linkages. Thus, the hermeneutical fiber bundle represents a set of coupled, multiple mappings that interact to strengthen, a proposed inference between one point-structure (neighborhood or latticework) and other such point-structures (neighborhoods or latticeworks). As such, a hermeneutical fiber bundle, under normal circumstances, constitutes a stronger inferential argument than does a hermeneutical string.

Exceptions to the foregoing contention would involve instances in which a hermeneutical string gives expression to a better insight than does a given fiber bundle. Although hermeneutical fiber bundles tend to represent powerfully coherent sets of phase relationships, nonetheless, if this set is rooted in distorted hermeneutical transductions, then such a set of hermeneutical fiber bundles might offer less accurate insight than is provided by a given hermeneutical string.

Finally, hermeneutical sheaves might be construed as a way of organizing a variety of hermeneutical strings and fiber bundles in order to 'cover, or account for, the structural character of a given aspect of the manifold of the phenomenology of the experiential field. In this sense, hermeneutical sheaves give expression to models or theories.

Hermeneutical sheaves explore the way a model or theory is held together by a set of phase relationships between, and among, a variety of point-structures, neighborhoods, and latticeworks. The purpose of such exploration is to search for arrangements of hermeneutical strings and fiber bundles that are capable of 'covering' (i.e., explaining or understanding) a given aspect of the dialectic between phenomenological and ontological manifolds. Therefore, hermeneutical sheaves place emphasis on the inferential mappings and congruence functions that lend a theory or model its explanatory structural character vis–à–vis some aspect of experience as well as the aspect(s) of ontology that helps make experience of such structural character possible.

Seen from the foregoing perspective, entailment exists when one can show that the structural character of the continuity that links two (or more) point-structures, neighborhoods, or latticeworks, has a particular kind of vectored mapping character. More specifically, in order for entailment to be present, one must be able to show: (a) the structural character of, say, a given hermeneutical point-structure is largely shaped and determined by the phenomenological or ontological structure(s) with which it is linked through mapping; while (b) the reverse is not the case.

Under these circumstances, one would say the hermeneutical point-structure being shaped and determined is entailed by the phenomenological or ontological structure(s) which is doing the shaping and determining. Thus, entailment suggests a vectored component to the mapping process.

The last four or five paragraphs all tend to point in the same general direction with respect to the structural character of logic. In effect, logic is the study of continuity, structural form, and mapping relationships.

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Perturbative versus non-perturbative methodologies

The Heisenberg uncertainty principle concerns the measured relationships between certain conjugate pairs. One such conjugate pair involves momentum and position. Another conjugate pair concerns time and energy.

In the latter case, the uncertainty principle indicates that the product of the uncertainties surrounding the measured values for energy and time will be greater than, or equal to, a mathematical expression involving Planck's constant. Thus, if one fixes the measured value for the time of an event at an extremely small interval, there will be a very large uncertainty concerning the amount of energy that is associated with the event in question. Similarly, if one fixes the measured value for the energy of an event, then, there will be a large uncertainty concerning the precise time when the event occurred.

The uncertainties concerning the energy that, within a small interval of time, is to be associated with any given point of a field, give rise to variations in the measured energy values for that point of the field. These variations are known as quantum fluctuations.

Normally speaking, when one wishes to calculate the intensity of a certain aspect of the field between two points of opposite charge, one uses Maxwell's classical field equations. However, if one wishes to take quantum fluctuations into account in such calculations (as one would wish to do when dealing with high-energy collisions), then one must generate values involving weighted probabilities. Essentially, this means one must obtain an average of all the quantum fluctuations that are possible at a given point in the field, after one has assigned each of these possibilities a probability according to the likelihood of such a fluctuation occurring.

The standard method for making corrections for quantum fluctuations is, first, to make calculations concerning various field variables as if the field manifested itself in a classical vacuum. One, then, proceeds to introduce a series of successively more complex corrections for quantum fluctuation.

The more complex the correction is that is being introduced, the less likely such a fluctuation will occur in the field. This aspect of the standard method that involves introducing successively more complex corrections for quantum fluctuations is referred to as a perturbative expansion.

The method of perturbative expansion is only able to produce accurate results if relatively few corrections for quantum fluctuations are needed to supplement the classical method of field calculations. Moreover, the corrections being introduced should not be too complex since this would involve both uncertainties of a larger magnitude, as well as modes of fluctuation that are more improbable. The larger the magnitude of uncertainty and the more improbable the magnitude of uncertainty that are introduced into field calculations, the less probable will be the likelihood that the process of perturbative expansion can produce a result showing convergence toward a given predicted or observational value.

Field calculations that do not converge toward some given value -- as a result of the size of the magnitude of uncertainty and improbability that are introduced into those calculations -- are referred to as being non-perturbative. The compression of the lines of force that is called for in the chromoelectric dynamic approach to quarks is an example of such a non-perturbative phenomenon.

In a way, one could treat attempts like Kant's 'Critique of Pure Reason' as a sort of Newtonian classical approach to epistemology in which the knower is considered to exist in a largely, non-interactive, ontological vacuum. As a result, the ontological vacuum is not believed to contribute much in the way of structural currents, transformational energy, vectored forces, and so on, to the individual's construction of an understanding. At best, the ontological vacuum would be supposed to present a relatively static, non-interactive background against which the largely internal or subjective activity of epistemological construction takes place.

However, if one permits ontology to be a quantum-like vacuum, then ontology comes alive with interactive potential. Consequently, in order to come up with an epistemological framework that is capable of taking the effects of such a dialectical, interactive, dynamic 'vacuum' into account in one's epistemological framework, one is going to have to increase the complexity of one's mode of solving various kinds of issues. In other words, if ontology gives expression to a quantum-like vacuum that introduces a variety of fluctuations that disturb, affect, shape, alter and transform various aspects of the phenomenology of the experiential field, then one is going to need to introduce corrective factors into the classical Kantian model of epistemology in order to be able to reflect the fluctuations of the noumena as they intrude into phenomenological and hermeneutical space.

The hermeneutical counterpart to the idea of perturbative expansion would mean one has a methodology that only is capable of handling relatively small fluctuating intrusions of the noumena into one's hermeneutical framework. Furthermore, hermeneutical perturbative expansion methods would tend to assume that progressively more complex treatments would converge on a single answer that becomes increasingly clear cut and refined as one proceeds.

Hermeneutical non-perturbative methods, on the other hand, would refer to approaches permitting a rather free interplay between noumena and phenomena and that do not necessarily converge toward one answer. This does not mean there is no correct answer or that things are arbitrarily relative.

A non-perturbative approach means, instead, that the structural character of any given aspect of reality tends to be nonlinear in the sense that one might observe self-similar behavior but not necessarily self-same behavior. Therefore, there might be a limit to the convergence aspect of a methodology.

There is a second way in which the convergence of a hermeneutical counterpart to a perturbative expansion approach could breakdown. This could occur when a given aspect of reality had a number or multiplicity of significances, all of which had to be taken into account in order to have a proper grasp of the structural character of the phenomenon under consideration.

In other words, ontological structural character consists of a spectrum of ratios of constraints and degrees of freedom. One's methodology cannot converge on any one of these ratios if one hopes to reflect the character of the whole phenomenon in an accurate fashion.

In addition, any given point-structure is a gateway or window to further levels of scale that place the point-structure in a broader, more complex, less convergent hermeneutical, phenomenological and/or ontological framework. Therefore, under such circumstances, one might have difficulty generating a hermeneutical counterpart to perturbative expansion that resulted in convergence toward a single answer or solution.

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<u>Lattice gauge theory in relation to hermeneutical theory</u>

In his paper: "The Lattice Theory of Quark Confinement", Claudio Rebbi proposes a lattice gauge theory that he believes is capable of handling the problem of quark confinement outlined previously. His theory is based on the earlier work of Kenneth Wilson who, in the mid-1970s, had proposed that quantum chromodynamics be construed in terms of a cubic lattice.

A cubic lattice is a methodological device for separating time and space into sets of discrete points. As such, it provides one with a means of representing a variety of events that occur in time and space in a way that permits one to make calculations that could not be made otherwise.

In general terms, as the mesh of this lattice is refined over time, the calculated values for different, physical variables that have been defined in terms of the structural character of the lattice, will approach, more and more closely, those values that would be predicted by QCD in the context of continuous time and space (as opposed to the discrete representation of space and time of cubic lattice theory). Rebbi contends that if one makes the mesh of the lattice sufficiently fine, one can demonstrate that the property of confinement is a function of quantum chromodynamics. Rebbi refers to the methodology that is employed to refine the lattice and to make calculations under those conditions as lattice gauge theory.

Lattice gauge field works on the assumption that there exists a field that gives expression to the confinement property. This field is known as a chromoelectric field. Mathematically, it exhibits the characteristics of a gauge field.

In the context of Rebbi's paper, a gauge provides a means of comparing the values for various physical quantities at different points in a given lattice. The gauge is like a measuring device capable of determining, for example, the orientation or length of different variables at different locations in the lattice. The gauge uses these measured values as a basis for comparison.

As previously indicated, one of the peculiar properties of a gauge is that the structural character of the measuring device to which the gauge gives expression can change as it is moved about from one location to another location. Thus, the orientation of the gauge might be altered with movement, and, so too, movement of the gauge might alter the character of the gauge's ruler-like aspect.

Usually, when lattice theory is applied to QCD, the variables that are defined on the lattice constitute various states of certain particles in which one is interested. For instance, a particle might be able to have several possible orientations. Thus, descriptions of a given variable might indicate that the particle has orientation 'A' at a given point in the lattice and orientation 'B' at some other point in the lattice.

If one wishes to compare, say, the orientations of two variables in the lattice, then the representation for one of the two variables will have to be transported or moved next to the variable with which one wishes to compare it. Consequently, one will have to define a set of rules capable of describing, and keeping track of, whatever changes occur during the process of transportation ( in the present case, these changes involve orientation). This set of rules gives expression to what is known as a gauge field.

Lattices can be conceived of as being built up from the edges and vertexes of a set of cubes that are stacked tightly together. In physics, each point of a lattice is considered to give representational expression to spatial and temporal coordinates.

Consequently, a lattice is a four-dimensional array consisting of three spatial coordinates and one temporal coordinate. A link exists between any two neighboring vertexes of the lattice.

A square area that is bounded by four links is known as a plaquette. The links and plaquettes of a lattice are considered to be discrete in the sense that they do not consist of an infinite set of points between the vertexes that establish boundary points for both links and plaquettes.

In the context of hermeneutical gauge field theory, a plaquette gives expression to a certain spectrum of ratios of constraints and degrees of freedom. Depending on the level of scale on which one engages a given latticework, the plaquette could refer to: (1) a point-structure (which consists of a single ratio of constraints and degrees of freedom); or, (2) a neighborhood (which consists of n-ratios of constraints and degrees of freedom, depending on how many points are in the neighborhood); or, (3) a lattice (which consists of a spectrum of the ratios of constraints and degrees of freedom of the neighborhoods and point-structures that give expression to the lattice); or, (4) a latticework (which consists of a set of lattices linked together to form a perspective, theory, model, value system, methodology, etc.).

The hermeneutical counterparts to the links that tie together the vertexes that, together, give expression to a particular plaquette are phase relationships. Although the lattice described in Rebbi's paper is fairly linear in character, with the links being relatively simple, the hermeneutical latticework is oftentimes (though not always or necessarily so) nonlinear in character, and the links or phase relationships can be quite complex. As such, the idea of a link can refer either to a single phase relationship, or to a set or fiber-bundles or sheaves of such phase relationships.

Given that a plaquette is the structure that is manifested as a function of the way neighboring vertexes of the lattice are tied together by links, when one transposes this idea to the hermeneutical context, a plaquette might not be (and, usually, will not be) just a four-sided figure. A hermeneutical plaquette will be, instead, a complex manifold of irregular, dimensional shape.

The vertexes, links and plaquettes that give expression to the structural character of a lattice are abstract, discrete representations of some ontological counterpart that is assumed to be concrete (i.e., it has actual spatial and temporal properties) and continuous. In the terminology of theoretical physicists, a lattice is an instance of a regularization. This is a mathematical construct that is designed to provide a means of making certain kinds of calculations that could not be made if such a regularization were not introduced to model some aspect of reality.

In the chromoelectric field approach to quark interactions, the vertexes of the lattice are used to represent the probability that a given particle will be found at such points. The links that run between neighboring vertexes are used to give representational expression to the strength or intensity of a field between neighboring vertexes (i.e., particles).

Fields are manifestations of forces that have magnitude as well as orientation. Consequently, they satisfy the conditions for being vector quantities. However, the vector quantities that constitute a field can point in any number of directions. Thus, the links of the lattice representing the strength of a field between any two given neighboring vertexes can assume an orientation value that is directed toward either vertex.

The idea behind the lattice method is this: as one makes the lattice mesh smaller and smaller, by moving the vertexes of the lattice closer and closer together, one will begin to approach the continuous conditions that are assumed to characterize the structure of ontological space and time. Presumably, at the limit value for reducing the size of the lattice mesh, one will have derived a mean value for the strength of the field.

This mean value would take into consideration all the possible quantum fluctuations of such a field. Consequently, the mean value would be capable of reflecting predicted or observed values for an actual chromodynamic field.

In the context of the lattice approach to chromoelectric fields, renormalization refers to the process of making the lattice mesh progressively smaller until one is able to eliminate the lattice altogether, thereby recovering the supposed continuity (in the sense of an infinite set of points) of space-time. Rebbi admits that reducing the lattice mesh to zero is not really possible, and, therefore, complete renormalization has not been achieved at the present time.

When the characteristics of a gauge field are explored by means of the lattice method, investigators usually employ what is known as a Monte Carlo simulation. Rebbi and others have shown that when they employed Monte Carlo simulation to study QED in order to determine if the property of confinement (observed at large values of the coupling constant in such systems) disappears as one approaches the limit of the lattice mesh, they discovered that deconfinement occurs. That is, at a certain point in the reduction of the lattice mesh toward its limit, the lines of force that previously had been confined to the links between two vertexes on the lattice, undergo a phase transition and spread out beyond the links to which they had been confined.

Rebbi also notes that when the same sort of Monte Carlo simulation was done in relation to a quantum chromodynamic system, the investigators who did the study found that the system undergoes no phase transition as the value of the coupling constant is lowered during the process of reducing the size of the lattice mesh toward its limit. In other words, the charges in the chromoelectric gauge field remained confined in accordance with the observed properties of quarks within hadrons.

The idea of making a lattice mesh progressively smaller as one approaches the limit reminds me, in a way, of the manner in which Galois used the idea of groups. In each case, it seems that one is working toward a limit by refining the methodological mesh one is using in order to isolate the solution to a problem.

Similarly, part of the purpose underlying hermeneutical methodology is to generate a progressively refined meshwork to work toward generating or isolating a resolution to a given hermeneutical/phenomenological problem or issue. The other purpose underlying hermeneutical methodology is to provide a cohomological analog. Through this sort of analog one gathers together a variety of different lattice-like solutions and arranges these solutions in a way that 'covers' the phenomenological manifold in the sense that the arrangement might be hermeneutically capable of accounting for why various aspects of the phenomenology of the experiential field have the structural character they do.

In the lattice model, the vertexes are said to represent the state of a given particle at a certain point in the field. Usually, some sort of simplifying assumptions are made, such as: at any given vertex, a particle can have one of two possible states.

If one further assumes the pointer on a gauge can form any angle, across a continuous range of angles, with respect to a vertical reference point, then, one can compare the angles that are formed under the influence of the field at different points of that field. However, the angle of rotation takes place in the complex plane that means there is an imaginary component, as well as a real component, involved in the rotation of the pointer of the gauge.

Unlike the electromagnetic gauge field that can be represented by a gauge consisting of but a single pointer, the chromodynamic gauge field must be represented by a gauge consisting of three pointers. This is necessary in order to be able to describe, and keep track of, the three color properties believed to be responsible for generating the chromodynamic field by means of their interaction.

In the context of hermeneutical gauge field theory, the mode of gauge measurement to be employed will have to consist of 6 pointers in order to be able to describe, and keep track of, the various components of the semiotic quantum that is the carrier of the hermeneutical force in the phenomenology of the experiential field. Thus, the hermeneutical gauge pointer will be a complex sort of matrix in which each cell is the dialectic product of one of the hermeneutical components taken as focus, and the other five hermeneutical components are taken as horizonal components. The focal/horizonal arrangement will change from cell to cell, with each of the components of the hermeneutical operator taking, in turn, the role of focus.

In Rebbi's lattice model, if the pointer on the gauge does not return to its initial angle of orientation after being transported about a given plaquette (one should remember that the gauge is moving not only through space but through time as well), the difference in the angle reading taken at the beginning of the transport process and the angle reading taken at the end of the transport process (i.e., when it has arrived back at the point where the first reading was taken) is known as the phase angle. The phase angle provides an indication of what is referred to as the frustration of the plaquette in question. The frustration of a plaquette gives representational expression to the directional-strength of the field (i.e., its vectored property) at a given point in that field.

If the phase angle is zero after being transported through a complete cycle of the plaquette, the strength of the field is considered to be zero. With each increase in the phase angle, the strength of the field in a given spatial direction is correspondingly greater.

From the perspective of hermeneutical gauge field theory, phase angle refers to differences in readings of hermeneutical orientation between some arbitrary initial starting point and some terminal point arrived at after making a complete circuit (i.e., one has run through a spectrum of ratios of constraints and degrees of freedom) of some given structural character or plaquette. In other words, a given attitude, idea, view, belief, or value, constitutes a hermeneutical orientation. Each of these also represents an initial reading of the hermeneutical gauge field as a function of the dialectic of the six components of the hermeneutical operator.

When one explores, reviews or analyzes this attitude, etc., over time (which is comparable to making a circuit around a lattice's plaquette), this represents a second reading of the hermeneutical gauge field as a function of the dialectic of the six component carrier of the hermeneutical force. By comparing the differences in orientation between the first and second readings of the hermeneutical gauge field, one has an index of a hermeneutical counterpart to the idea of a phase angle.

If the hermeneutical phase angle is zero after making a circuit of a given plaquette, then there has been no change in the strength or intensity properties of the hermeneutical field. As a result, the structural character of the attitude, idea, etc., with which one initially started remains the same.

If, on the other hand, there is a phase angle difference, then the bigger the change in the angle, the greater is the frustration, tension or stress in the hermeneutical counterpart to the plaquette. Therefore, the strength of the vector or tensor force of the hermeneutical field that is operating through that plaquette over time also will be proportionately greater.

As previously indicated, in a gauge field, as long as one, simultaneously, changes the rest of the character of the gauge field in a corresponding manner, one can arbitrarily change the state of a particle without this affecting one's physical description of the field. Moreover, if both the state of a given particle and the rest of the field are altered in an appropriate fashion, one can continue to make comparisons of the strength of the field at different points without affecting the legitimacy of those comparisons. The quality of a gauge field that enables one to compensate for changes in, say, the orientation of a given field variable that is being transported, for purposes of comparison with some other point in a given field, is known as local gauge invariance.

In hermeneutical gauge field theory, the idea of local gauge invariance might have a variety of possible applications. For example, there is a sense in which local gauge invariance refers to the property of reversibility, comparable to the sorts of mental operations about which Piaget spoke. One can reverse the character of a given field variable as long as one introduces appropriate adjustments into the rest of the gauge field in order to compensate for the reversal of that field variable.

Another possibility for applying the local gauge invariance idea to the context of hermeneutics concerns the relationship among ontology, phenomenology and hermeneutics. The process of transduction alters the state-character of some given aspect of ontology.

By making appropriate hermeneutical adjustments in the gauge field through activation of the hermeneutical operator, one can compensate for the changes introduced by transduction and, thereby, not necessarily lose any information concerning the structural character of what makes a transduction of such character possible. Furthermore, one can continue to make comparisons of changes in the strength of the field at different points in the field as a means of deriving information on phase angle or orientation. This would permit one to gain understanding of certain aspects of the structural character of the ontology that make such phase angles or transitions in orientation possible.

Quite conceivably, theories, models and belief systems might operate on the basis of some sort of principle of local gauge invariance. More specifically, when one encounters an aspect of the phenomenology of the experiential field which changes, one attempts to account for this change by selecting an appropriate ratio from amongst the spectrum of ratios of constraints and degrees of freedom that make up the hermeneutical properties of a given theory or model or belief system.

The ratio(s) which is(are) selected attempts to compensate for the changes in the phenomenology of the experiential field without altering the character of one's understanding of how that field variable fits into the scheme of one's theory or model or belief system. Moreover, the compensations that are made, are done so in a way that will permit one to continue to make comparisons about changing field strengths as one moves one's hermeneutical gauge from point to point in the phenomenological field or as one encounters a succession of points of differential field strength during the course of hermeneutically probing experience.

Sometimes one is not able to make the necessary adjustments in one's theory, model or belief system to compensate for the changes that have occurred in relation to some field variable. When this occurs, one has lost the property of local gauge invariance.

Under such circumstances, the understanding to which the theory, model or belief system gives expression has encountered a crisis, lacunae, unanswered question or problem. As a result, that understanding needs to be modified, changed, or abandoned if symmetry is to be preserved with respect to some aspect of ontology.

Furthermore, when symmetry is lost, one might no longer be able to make meaningful, heuristically valuable or defensible comparisons about the changing character of field strengths as one moves about (or through) the phenomenology of the experiential field. This is so because questions have been raised about, or problems have emerged in relation to, the hermeneutical field equations that serve as the set of rules that permits one to understand what the effects are of the process of transporting the gauge through or about the phenomenological field. In other words, the very basis of comparison by means of a given mode of hermeneutical gauge has been brought into question or become problematic.

A plaquette consists of the square formed by four neighboring vertexes connected by a gauge field that runs along the lattice links between the various vertexes. If one introduces a twist into the gauge field running along one side of the plaquette, no matter what combination of local gauge operations are performed, one will not be able to get rid of the twist in the gauge field. One can relocate where the twist occurs, but one cannot eliminate the twist.

In addition, if one transports an oriented arrow around a twisted plaquette, the orientation of the arrow will not be the same after traveling through the twist as it was before being transported through that twist. Such a plaquette (namely, one in which all the twists that have been introduced cannot be removed and in which, therefore, there will be a transition in orientation of a directed arrow that is transported about the plaquette) is referred to, as indicated earlier, as a 'frustrated plaquette'.

Frustrated plaquettes are used to represent the locus of quantum energy fluctuations in a vacuum. The degree of a plaquettes frustration is said to be an index of that plaquette's action. Consequently, if one calculates the sum of the actions of all the frustrated plaquettes of a given lattice, one will have an index for the action of the lattice as a whole.

Moreover, the degree of the change of orientation of a vector quantity that is transported about such a frustrated plaquette is known as the phase angle, and the phase angle can be used as a reflection of the amount of quantum fluctuation that occurs at a given point in the field. In a sense, a plaquette represents a twist or loop or knot in the fabric of space-time ... at least from the perspective of the mathematical framework that is being used to describe the possible ontology of space and time.

Plaquettes that are not frustrated, on the other hand, can be used to represent the classical vacuum. In other words, there is supposed to be no energy in the classical vacuum. Since the presence of energy can be represented in terms of twists in a plaquette that cannot be eliminated or by arrows that undergo transitions in orientation, a plaquette that does not exhibit either of these characteristics can considered to be devoid of energy. Obviously, such a plaquette will have no action associated with it.

The general structural properties of the lattice/gauge approach that is used in the quark confinement paper might have application to certain aspects of the process of modeling language. For example, instead of using the vertexes to represent particles that have different state-characters, one could use the vertexes to represent words that have different state-characters (either semantic or syntactic or both). Thus, the same word could assume different state-characters depending on circumstances.

The links running between vertexes could be used to represent the phase relationships that link words together to form noun phrases, adverbial phrases, adjectival phrases, prepositional phrases, gerunds, and so on. A plaquette or a group of plaquettes could represent various kinds of propositions or sentences.

A frustrated plaquette might be thought of as giving expression to a particular kind of orientation. In other words, just as the word at the vertexes can assume different state-characters, so too, a plaquette can assume different field state-characters depending on the degree of twisting that exists in the plaquette. However, unlike the limited dimensionality of physical plaquettes, hermeneutical plaquettes can involve, or make reference to, many more dimensional components.

The action of a frustrated hermeneutical plaquette would be the total meaning or understanding to which a plaquette or the lattice as a whole gives expression. One could determine the action character of any given lattice or plaquette by summing up the individual plaquettes that make up a given hermeneutical lattice. However, one would probably have to work in some kind of dialectical interaction component to take into account the manner in which different hermeneutical plaquettes are capable of playing off against one another.

Consequently, in addition to the links that connect the vertexes of a given hermeneutical plaquette, one will have to postulate links connecting different plaquettes. The identity of these links between plaquettes might be a function of the hermeneutical gauge field itself. This could be the result either of: (a) the individual generating the meaning structure; (b) the individual interpreting the meaning structure, (c) an individual learning the meaning structure, or (d) some combination of (a), (b) and (c).

The bottom line with respect to the above suggestions is that meaning in language and understanding in hermeneutics are being made analogs for the notion of action in physics, Just as the energy characteristics of a given physical system can be summarized by calculating the action for that system, so too, the hermeneutical characteristics of a given meaning system or system of understanding can be summarized by calculating (in a qualitative sense) the hermeneutical analog for the action of that system. The action of a system, whether physical or hermeneutical, establishes the spectrum of ratios of constraints and degrees of currents, themes, properties, waveforms and so on, which manifest themselves -- actively and potentially -- in such a system.

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<u>The spectral character of structure</u>

Phase angle rotations constitute the basic group operation of quantum electrodynamics. Moreover, since the phase angle rotation operations of QED form an Abelian group, the order in which the rotations occur does not affect the final phase state that results from those rotations. Consequently, the rotations of phase angles generate the phase space of quantum fluctuations for the phenomena of QED.

Phase angle rotations also constitute the basic group operation of quantum chromodynamics. However, there are fundamental differences between the group operations of QCD and QED.

To begin with – and as previously indicated -- instead of transporting a gauge with one vectored arrow (which represents electric charge) as is the case in QED, the gauge fields of QCD involve transporting a gauge with three vectored arrows -- one arrow for each of the color charges that is possible. Secondly, unlike QED, where the order in which a sequence of rotations takes place does not matter to the character of the resultant phase state, in QCD, the order in which a sequence of phase angle rotations takes place is important. The phase angle rotations of QCD are not commutative, and, consequently, the gauge fields of QCD are non-Abelian.

Because the gauge fields of QCD incorporate more degrees of freedom than do the gauge fields of QED, it opens up the possibility that the plaquettes of the lattices representing QCD gauge fields can manifest more varieties of twists than are exhibited in the plaquettes of QED gauge fields. In other words, there might be more kinds of frustrated plaquettes that are possible in QCD than are possible in QED.

Rebbi believes one might be able to trace the confinement property of the quarks within hadrons to two factors. The first concerns the greater range of frustrated plaquettes that are postulated for QCD ... and the second factor is the fact that QCD involve non-Abelian gauge fields.

When one measures the strength of a chromodynamic field, one is actually calculating an average for all the various phase state fluctuation configurations that are possible for the field in question. However, since these possible configurations do not all contribute in the same way to shaping the structural character of the average for the field, one has to weight these configurations.

The process of weighting is usually accomplished by multiplying each configuration by the probability that such a configuration will actually manifest itself in a given field. However, since, in point of fact, there are too many configurations to take into consideration in even a very small volume of phase space, one must employ some form of statistical sampling in order to come up with a quantum expectation value for the strength of a chromodynamic field.

The weighting factor that is to be associated with any given configuration is a function of the action of that configuration. More specifically, the greater the action of a configuration, the less that configuration will be weighted during the process of determining the average for the quantum expectation value in a given field.

In hermeneutical gauge field theory the various ratios of constraints and degrees of freedom that make up a structure's spectrum constitute configurations. However, unlike the configurations of quantum theory that are considered to be infinite in number (and this might be more a reflection of the methodology of quantum mechanics than it is a reflection of the ontology of the phenomena that are being modeled by such methodology), the configurations or ratios of constraints and degrees of freedom that give expression to a structure on a given level of scale are finite since they are generated in finite periods of time and by means of delimited hermeneutical operations.

The ratios of constraints and degrees of freedom that constitute a structure's spectral character represent the attractor themes, currents, or principles on different levels of scale of that structure. These attractors can be designated as primary, secondary, tertiary and so on, in relation to whatever level of scale one is currently engaging.

Not all levels of scale will necessarily be equally important when considering a particular hermeneutical issue, problem, or event, on some level of scale currently being engaged. Therefore, the levels of scale one considers to be secondary, tertiary and so on will depend on the individual's purposes, needs, goals, desires, values, and so on.

In other words, even if the hermeneutical character of the ratios of a structure might vary, these ratios will never be zero as long as the structure of which they are a part remains intact. Such themes or principles are the configurations of a given level of scale of the structure, and the range of values that such configurations might have refers to the phase states of that configuration. These different phase states are the result of various transitions in the phase relationships that govern or shape or organize the ratio of constraints and degrees of freedom that constitute the theme or principle in question on a given level of scale.

When engaged on a certain level of scale, each structure consists of a spectrum of thematic ratios of constraints and degrees of freedom. This spectrum sets the parameters within which, and through which, the structure as a whole will manifest its character on that level of scale.

When one changes the level of scale of one's engagement of a given structure, one finds, in turn, a further spectrum of ratios of constraints and degrees of freedom that establish the parameters through which any given theme or principle on the new level of scale will manifest itself. In addition, themes and principles encountered on previous levels of scale might or might not manifest themselves on the new level of scale. Yet, if such previously engaged themes/principles do manifest themselves, they will do so as an expression of one or more of the ratios of the spectrum of constraints and degrees of freedom on the new level of scale.

The number of levels of scale that exist in relation to any given structure might be indefinite, but they are not necessarily infinite in character. In any event, one does not have to take into consideration all the phase states of all configurations on all levels of scale in order to be able to grasp the general character of the manner in which a given structure is manifested on a given level of scale. Obviously, the more detail one wants, then the more data one is likely to seek in relation to various phase state configurations on different levels of scale.

In a sense, one seeks as much information and understanding as is necessary to meet one's needs or solve one's problems or satisfy one's interests or resolve various issues under a given set of circumstances. Thus, like the methodological techniques of quantum chromodynamics, hermeneutical gauge field uses a process of sampling to select data from one or more levels of scale. Unlike the methods of QCD, however, hermeneutical gauge field theory does not presuppose that either the spectrum of ratios or the configurations or the phase states or the levels of scale are infinite in number.

More importantly, even if one were to suppose that there were infinite configurations or phase states or levels of scale associated with a given structure's spectrum of ratios of constraints and degrees of freedom, hermeneutical gauge field is able to work on a sort of need to-know basis, taking into account only what is believed to be necessary to get on with things in a given set of circumstances. The accuracy, competency, proficiency, efficiency or aesthetics of how one decides to get on with things will depend on the individual and the circumstances. Therefore, different circumstances might require one to employ different methods of weighting configurations in order to grasp the character of the way in which a given structure's spectrum of ratios of constraints and degrees of freedom manifests itself on a given level of scale.

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Fundamental forces: physical and hermeneutical

A worthwhile exercise, at this point, might be to develop, in analog fashion, the parallels between, on the one hand, various collections, groupings or categories of semiotic quanta, and, on the other hand, the four physical forces: namely, electromagnetism, gravitation as well as the strong and weak forces. For example, one might consider the realm of dialectical reactivity involving phase relationships to be the hermeneutical counterpart to electromagnetism.

Like the electrons of atoms and molecules, such dialectically reactive groupings of semiotic quanta might determine the structural character of the kinds of hermeneutical reactions (comparable to chemical reactions) which are possible between, or among, various hermeneutical reactants or structures. One might even work out a hermeneutical counterpart to thermodynamics in terms of hermeneutical stability, equilibrium, dissipative structures and so on.

The hermeneutical counterpart to gravitational forces, on the other hand, might focus on the way certain groupings or arrangements of semiotic quanta form attractors that have spheres of influence comparable to gravitational pull. One might even suppose there is an inverse square law concerning the strength of such attractors across emotional, experiential, phenomenological or hermeneutical 'distance'.

The hermeneutical counterpart to the strong force might involve the spectrum of ratios of constraints and degrees of freedom that set the tone, so to speak, for the character of a given structure. This grouping of semiotic quanta would be comparable to the combination of neutrons and protons in the atomic nucleus. Consequently, such groupings would establish the parameters of phase relationship activity within a given structure.

In addition, these hermeneutical nucleon groupings also would serve as a countervailing force to the hermeneutical counterpart to electromagnetic dialectical reactivity. In other words, the former groupings might play a fundamental role in maintaining the integrity of a structure's identity over time, despite the shifts and transitions in phase relationships and ratio arrangements that occur as a result of the structure's exchange of semiotic quanta with other structures during their dialectical interaction.

Finally, the hermeneutical counterpart to the weak force might concern either of two possibilities. One possibility could be the tendency of an organized grouping of semiotic quanta (e.g., beliefs, values, theories, models, systems, networks and so on) to disintegrate or dissipate, over time, due to the weaknesses of certain ratios of constraints and degrees of freedom. As these ratios unravel, so to speak, and become less capable of giving expression to a normal complement of phase transitions or phase shifts, the belief, or theory or whatever, decays with time.

This suggests, at least in the hermeneutical context, there might be an intrinsic relationship of tension between the strong and weak forces present in any given organized grouping of semiotic quanta. In other words, the central binding force (i.e., the hermeneutical strong force analog) or coupling constant giving expression to the basic ratios of constraints and degrees of freedom that constitutes a given phenomenological or hermeneutical object's or event's structural identity might be engaged constantly in a dialectical relationship with a force (i.e., the hermeneutical weak force) that undermines or weakens the hermeneutical counterpart to the strong force.

Presumably, some hermeneutical structures have a higher tendency toward dissolution or dissipation than do other such structures (e.g., theories or hypotheses that are quickly proven to be problematic versus those theories or hypotheses that appear to have greater heuristic value or predictive power), just as different elements have different rates of radioactive decay. However, irrespective of such intrinsic rates, when the strength of the weak force, relative to the strength of the strong force, is greater, then there will be an accelerated trend toward complete breakdown of the given grouping of semiotic quanta.

Another possibility concerning the hermeneutical counterpart to the weak force has to do with the idea of commitment. In other words, over time there might be a lessening of commitment to some given organized grouping of semiotic quanta (such as a belief or an idea or a value, etc.). This tendency for commitment to spontaneously decay or disintegrate over time might be due to the nature of the structural character of the set of semiotic quanta that give expression to such commitment and that shape how that mode of commitment dialectically interacts with a given belief or value structure.

One of the most salient features of the weak force involves its extremely limited range (approximately $10^{-18}$ centimeters that is, less than 1/100 of the size of a proton's radius). The shortness of the range of the weak force suggests the boson or force carrying particles probably quite massive ... with current calculations putting the mass of this particle at around 100 times the mass of a proton.

In order to extend the analogy of the hermeneutical counterpart to the weak force, one would have to postulate that the hermeneutical weak force is extremely limited in its range and that the semiotic quantum that is responsible for carrying the hermeneutical weak force might be quite large.

One possibility that suggests itself in this respect is that, for the most part, beliefs, values and theories tend to be fairly resistant to dissolution, dissipation or disintegration. One of the reasons for this is due to the numerous, reinforcing phase relationships that exist within the neighborhood or latticework that gives expression to such a belief, value or theory.

Altering a few, or even a sizable number, of these phase relationships might do little to cause the neighborhood or latticework to breakdown. This means, in effect, the tendency toward, or force of, disintegration will be relatively small when one considers how the hermeneutical weak force tends to manifest itself through, relatively speaking, only a few phase relationships compared to the far greater number and strength of the surrounding manifestations of the hermeneutical strong force.

Moreover, the range of the hermeneutical weak force might be- in many, if not most, cases-quite limited since it would tend to be restricted (although there will, undoubtedly, be exceptions to this) to, or affect, only those phase relationships that are sensitive to, or receptive, to its decay character. Thus, even though any given phase relationship is intertwined with a variety of other reinforcing phase relationships, the spontaneous decay of a particular phase relationship wouldn't necessarily affect these other phase relationships with which it is linked since the other phase relationships might be stabilized, to a certain extent, by the way they are rooted in the neighborhood or latticework of a set of beliefs considered as a whole.

Of course, such an explanation would raise, in turn, a question about why any phase relationship would decay if it exists in the midst of such a stabilizing environment. The only chance one would have of answering this question is to take a look at the specific phase relationship that decayed and attempt to determine what permitted it to break loose from the support network. In principle, however, there is nothing to prevent isolated cases of phase relationship decay despite the presence of a supporting network of phase relationships. Indeed, the isolated, anomalous character of such decay events conforms to the most salient characteristic of the weak force -- namely, its limited range.

On the other hand, if the decay of phase relationships occurs at a high rate, then the size of the set of phase relationships that serves to carry this force becomes increasingly massive. So, when the rate of hermeneutical decay becomes large it is because more phase relationships are becoming involved. Although the range of any given phase relationship expression of the weak force might still be relatively limited, the combined effect of a set of decaying relationships makes for a fairly massive source of the hermeneutical weak force.

Under such circumstances, the structure would have a hermeneutically "radioactive" character. Conceivably, each kind of hermeneutical structure has its own unique, radioactive (or decay) signature.

Thus, the size of the carrier of the hermeneutical weak force will range all the way from a single phase relationship up to one or more latticeworks. However, the range of the weak force will still be very limited, no matter what the size of the carrier is, because the weak force is communicated or conveyed or transmitted only through individual phase relationships in the context of integrated neighborhoods and latticeworks that are coupled together by manifestations of the hermeneutical strong force.

In a sense, the foregoing provides for a unified approach to hermeneutical gauge field theory. In other words, the carrier of hermeneutic force across all levels of scale is the semiotic quantum. However, although the general structural character of all semiotic quanta is the same (in terms of the six components of the hermeneutical operator), nonetheless, semiotic quanta are carriers of variable force.

In other words, because the various combinatorial possibilities of isotopic-spin states of the semiotic quantum are huge, the structural character of the force carried by a given instance of semiotic quantum in a given set of circumstances can assume an indefinite variety of gradations of strength, intensity, orientation, shape and so on. Consequently, both hermeneutical unity as well as hermeneutical multiplicity are capable of being given expression through the way semiotic quanta dialectically engage, and are engaged by, the phenomenology of the experiential field, together with the aspects of ontology that make an experiential field of such structural character possible.

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Appendix 1: Mapping Mental Spaces

1. The only point(s) of possible contact between understanding and reality is (are) experience(s).

1.01 Initially, we do not know if this possibility is given expression through an asymptote-like relationship (never quite touching although, in some sense, approaching one another as a limit), a tangential link (touching at only one point), multiple-points of contacts, or if understanding and experience constitute the sum total of reality (with nothing independent of such understanding and experience).

1.0101 The term "manifold" refers to the structural character of such points of contact.

1.0102 Contact constitutes junctures of engagement, interaction, transaction, or contiguity between that aspect of reality that is capable of experience and those facets of what is that makes experience at such junctures possible.

1.0103 Interaction, engagement, transaction and/or contiguity at the junctures of contact between that which is capable of experience and that which makes experience of such structural character possible gives rise to points or clusters of data that are processed by different dimensions of understanding as information of one kind or another concerning the possible nature or structure of such junctures of contact.

1.01031 The term "identifying reference" is a way of alluding to attentional and intentional dimensions of experience. By attending to a dimension or facet of experience and communicating the nature of that attention to another individual, we seek to inform the other person about some aspect of what we are intending in relation to that to which we are attending. The communication that involves conveying the nature of the link between attending and intending gives expression to the process of identifying reference.

1.01032 The process of identifying reference tends to involve pointing toward, or descriptions of, or attempting to draw attention to, the structural character of various kinds of qualities, properties, states of affairs, contexts, experiences, modalities of consciousness, events, objects, phenomena.

1.01033 The idea of “structural character” refers to the nature of the form, logic, framework, format, pattern, figure, latticework, set of relationships, and/or set of degrees of freedom and constraints, through which a given aspect of experience, or that which makes such experience possible, is given expression or is manifested.

1.011 Solipsism is a perspective that maintains that reality is generated as a function of an individual’s states of consciousness and all that can be known are such states and, possibly, the nature of the self that gives rise to them.

1.012 The term “relationship” gives expression to the linkage, connection, interface, association, or affiliation of two or more aspects of experience, understanding, or that which makes experience of a certain structural character possible. There are many kinds of relationships that are possible, ranging from: temporal, to: spatial, logical, dialectical, ecological, moral, causal, conceptual, hierarchical, physical, and spiritual.

1.1 Kant might have been wrong, for, it might be possible, after all, to know things in themselves. However, this might be true, if at all, only to extent that we have the capacity to understand the nature, logic, or structural character of such ‘things’, and only to the extent that these ‘things’ are expressed through manifestations that can be experienced.

1.11 The phenomenology of the ‘manifold’ serves as that realm where understanding, experience, and reality are brought into conjunction with one another. Another way of referring to this ‘manifold’ is by the term: phenomenological field.

1.111 Phenomenology gives expression to a being’s capacity to engage experience in a conscious manner.

1.121 Consciousness is a priori – that is, all experience presupposes its existence. Indeed, consciousness is the ground through which experience is given expression. One cannot deny the existence of consciousness without affirming the very reality that is being denied.

1.122 Consciousness is the awareness of experience.

1.123 Reflexive consciousness is the awareness of such awareness and that such awareness gives expression to different kinds of experience.

1.124 A phenomenological field is a framework whose structural character gives expression to the presence of awareness or consciousness (basic or reflexive) concerning experience at any 'point' (simple or complex) one cares to examine, test, or challenge within the context of that framework. The lines of force that are manifested in such a field are expressions of the dynamics of experience, awareness, understanding, and the impact, if any, of that which lies beyond the horizons of the phenomenological field but that interacts with and affects, in one way or another, the structural character of that field.

1.125 Neither awareness of experience nor reflexive consciousness can guarantee, in and of themselves, that one's understanding of the nature of that of which one is aware, or that which makes possible that of which one is aware, will be correct or accurate.

1.126 Consciousness might, or might not, be shaped by contingencies that lie beyond present or all future modalities of awareness.

1.127 Experience gives expression to the sum total of an individual's interaction with reality.

1.128 Reality is synonymous with whatever is, together with whatever makes being possible, including the being of that which is capable of experience and understanding, on whatever level.

1.1281 Truth refers to an accurate, correct, or non-distorted reflection of one, or another, dimension or facet of reality or what is.

1.1282 Truth might rarely, if ever, be acquired in an ultimate, absolute, definitive, and all-encompassing manner among human beings.

1.1283 For the most part, and at best, human beings tend to acquire truths in tangential, asymptotic, or limited ways. Furthermore, rather than grasping the truth of the entire realm of being, we tend to grasp, within varying degrees, limited aspects of truth involving this or that dimension or this or that facet of experience and/or that which makes experience of such structural character possible.

1.129 Understanding is the process one uses to try to map out the possible relationship between experience(s) and reality.

1.1291 The nature of understanding is to construct mental spaces or possible worlds and compare the logic or structural character of such spaces and worlds with the logic or structural character of experience.

1.13 A possible world gives expression to hermeneutical space.

1.131 Hermeneutical space is a logical form that is generated through understanding.

1.1312 Logic arises through conscious construction, or appears ready made in awareness, or is a combination of conscious construction and ready-made components that arise from beyond the realms of consciousness.

1.13121 Logic concerns: (a) the structural character of a form or process; and/or (b) the relationships of similarity and difference between, or among, structural characters; and/or (c) the causal, temporal, contiguous, dependent, associative (i.e., correlation), and/or theoretical, linkages that are believed to be operative in and/or among different structural forms and processes.

1.131212 Logic is a way of organizing, arranging, relating, valuing, exploring, traveling, and/or generating the structural character of hermeneutical spaces.

1.1312121 Logic gives expression to the degrees of freedom, constraints, operations, functions, rules, principles, relationships, and laws that govern a given hermeneutical space or that are manifested through such a space.

1.312122 Thinking, reflection, inference, interpolation, extrapolation, implication, induction, deduction, abduction, analogy, insight, conceptualization, abstraction, mapping, questioning, believing, assuming, creativity, language, interpretation, hypothesizing, fantasizing, dreaming, feeling, judgment, analysis, evaluation, critical inquiry, and understanding each gives expression to hermeneutical spaces of one kind or another, and logic seeks to chart the structural character (both static and dynamic) of such spaces.

1.322 An idea or concept is a particular kind of hermeneutical space. The structural character of such a space reflects the nature of the idea or concept. Larger hermeneutical spaces are often constructed or generated using various ideas and concepts as 'points', somewhat akin to the manner in which geometric points are said to give expression to, say, a line.

1.3221 The structural character of ideas and concepts tend to be far more complex than the points of geometry -- even the curved points of Riemann geometry -- but are closer in nature to the latter than the former, since the idea of 'curvature' in Riemann's geometry suggests the possibility of an internal structure of varying degrees of complexity that might alter with circumstances and conditions.

1.3222 Reason is the capacity to grasp the structural character of a given hermeneutical space or to follow and/or predict the flow of artificial and/or natural systems of logic as these are given expression through the structural character of such a system being manifested.

1.3223 What cannot be followed through rational means is either irrational (without logical form or unintelligible or trans-rational (that is, beyond the capacity of reason to grasp but not necessarily without logical form, truth, and/or intelligibility).

1.3224 Methodology is a process of evaluation concerning the nature of understanding, experience, and/or that which makes experience of such structural character possible.

1.32241 Evaluation involves the use of reason, hermeneutical spaces, and various systems of logic to establish the value of various aspects of experience or that which makes experience of such structural character possible.

1.32242 The value of an experience or that which makes an experience of such structural character possible is an expression of the way an individual is assisted to understand, adapt, or benefit, in some manner, through such an experience or through that which makes an experience of such structural character possible.

1.32243 The significance of 'value' might be relative to: a given perspective, an individual, a community, or a reflection of the possibilities inherent in a given facet or dimension of the way things are.

1.133 One of the essential questions at the heart of seeking an understanding is to ask: what might give rise to experience(s) of the structural character that are experienced through consciousness.

1.134 One form of mapping gives expression to operations and processes that seek to chart the structural character of one, or more, hermeneutical spaces.

1.1341 Another form of mapping gives expression to those attempts of understanding to establish relationships of congruence, matching, resonance, reflection, and/or similarity between (among) the logical character of possible worlds being constructed and the logical character of experience(s).

1.1342 A third form of mapping gives expression to operations and processes that seek to establish relationships, connections, and links among the structural character of a given hermeneutical space, a given set of experiences, and various aspects of that which makes experiences of such character possible.

2. Facts constitute a logical space that gives expression to and/or represents and/or describes various dimensions of the character of experience.

2.01 Different kinds of experience might, or might not, give rise to different kinds of facts.

2.1 Facts might accurately reflect the structural character of some facet of experience, but this need not entail their accurately reflecting the structural character of that which makes experience of such character possible.

2.2 Facts require context and interpretation in order for their significance to be evaluated.

2.3 The context of facts is the catalog of experiences out of which such facts arise.

2.4 A fact might be a feeling concerning, a belief about, a reflection on, a description of, a reference to, and/or an insight into some aspect of experience.

2.41 Feelings are certain kinds of modality of relating to, and interacting with, various aspects of experience and/or that which makes experiences of such structural character possible. These modalities are non-rational in nature (which does not necessarily mean they are irrational), varying in intensity with circumstances and conditions, and often underwrite, orient, shape, and direct one's commitments and actions.

2.411 Feelings (emotions) must be tasted or experienced in order to grasp something of the structural character of their nature. Just as one can have only very limited understanding concerning the nature of an orange if one has never seen, touched, smelled, or tasted such a fruit, so, too, one can have only very limited understanding concerning the nature of any given emotion, if one has not experienced that emotion from the inside out, as it were.

2.412 Feelings can both help one to better understand the nature of experience, as well as interfere with one's attempt to understand the nature of experience. In the former case, they are complementary to the use of reason and help bring balance to hermeneutical activities. In the latter case, they are antagonistic to and obstacles for, one's attempt to seek understanding.

2.413 When the presence, or expression, of certain kinds of feelings (emotions) dominates or orients hermeneutical activity in a destructive, problematic, or distorting manner, then, one of the biggest challenges to generating hermeneutical spaces that are congruent with, reflect, or mirror the structural character of various dimensions of reality is to find ways of eliminating, containing, or modulating the presence of such feelings in order to limit the extent of bias and error that affects the construction of heuristically valuable hermeneutical spaces.

2.414 A methodology, belief, idea, or activity has heuristic value when it aids the process of discovery with respect to coming to understand the structural character of some aspect or dimension of experience or that which makes experience of such structural character possible.

2.421 Beliefs give expression to hermeneutical spaces that often are not amenable to proofs but, nonetheless, tend to be concerned with the relationship among understanding, experience, and the nature of that which makes experience of such structural character possible. Beliefs are a way of orienting oneself within phenomenological and hermeneutical space.

2.4211 Beliefs are ideas and/or values to which a hermeneutical commitment, of some kind, has been made - the nature of this commitment is to accept or treat the focus of this commitment as if it were true.

2.42112 Beliefs involve commitments that are considered to have some sort of value to the one holding the commitment.

2.42113 Discussions concerning belief frequently involve descriptions of the structural character of the nature of a given belief, or belief system, together with explorations of the assumptions, evidence, arguments, explanations, consistency, coherency, validity, heuristic value, strengths, lacunae, problems, and questions that are, or might be, associated with such a belief or belief system.

2.42114 The use of data, evidence, arguments, demonstrations, and proofs in conjunction with beliefs or belief systems is often, at best, suggestive or leads to inconclusive results as far as verification of the belief or belief system is concerned.

2.42115 In general, showing a belief or belief system to be untenable or problematic tends to be easier to accomplish than showing either of the foregoing possibilities to be plausible, probable, or true.

2.431 Insight is the capacity of intelligence to understand, to varying degrees, the structural character of some aspect, facet or dimension of experience and/or that which makes experience of such structural character possible.

2.5 The possible worlds of hermeneutical space consist of a series of facts, assumptions, interpretations, beliefs, values, and relationships that are arranged into a structure that give expression to both form and process of a given character - namely, the logical character of that hermeneutical space.

2.6 The logical character of a hermeneutical space gives expression to the principles, rules, laws, possibilities, forces, processes, and/or limitations inherent in such a space.

2.7 Objects are forms of a given logical kind that populate a hermeneutical space.

2.8 The logical kind to which an object gives expression is a reflection of the structural character of the role that such an object plays in a given hermeneutical space.

2.81 The role played by an object is an expression of the principles, rules, laws, possibilities, forces, processes and limitations that are operative in a given hermeneutical space.

2.82 The role played by an object is the locus of manifestation through which the logical character of the hermeneutical space is given expression by means of the convergent interaction of the principles, forces, forms, processes, rules, laws, and so that are inherent in that hermeneutical space at a given point in time and at a given location within that space.

2.83 Time and location are a function of the logical character of a given hermeneutical space.

2.9 Language is a species of hermeneutical space.

2.91 Hermeneutical space might not be coextensive with language.

2.92 Emotion, sensation, dreaming, aptitude, interests, motivation, movement, fantasy, creativity, insight, thinking, and spiritual knowledge might, or might not, be expressible, to varying degrees, in terms of language, but the former are not necessarily reducible to the latter.

2.921 Feeling, sensation, dreaming, aptitude, interests, motivation, movement, fantasy, creativity, insight, thinking, and spiritual knowledge might all take place quite independently of language and, in most cases, predate the appearance of language.

2.922 Making experience a function of, and dependent on, language, is to render the process of language completely amorphous and, therefore, oblique to understanding.

2.923 Sometimes language determines what we feel, sense, dream, like, do, create, think or understand, but sometimes the use of language is directed and shaped by what we feel, sense, dream, like, do, create, think, or understand.

2.924. Language is a way of giving public expression to certain dimensions of experience and hermeneutical spaces concerning such experience.

2.925 Language is a tool that can assist in the construction of hermeneutical spaces, and, in turn, hermeneutical spaces can inform the way(s) in which language is used as a tool.

2.926 Language is one mapping medium, among many, through which understanding, experience, and reality might be probed.

2.927 Language without a conscious operator does not have the capacity, on its own, to serve as tool for helping to construct or map hermeneutical spaces.

2.9271 The syntax and semantics of a language are static entities until brought alive through use within a context of consciousness and understanding.

2.9272 Language serves as a catalyst for the constructing and mapping of hermeneutical spaces by conscious beings of some minimal level of understanding and hermeneutical capability.

2.9273 Language serves as a medium of public analysis and comparison for different modalities of hermeneutical space.

2.93 Among those beings who are capable of experience, some degree of understanding concerning such experience, and who have developed a certain proficiency with language to be able to describe both experience and understanding, are some beings who say that the propositions or statements of language constitute a picture of experience and/or understanding and/or those facets of reality that are given expression at the junctures of contact where experience, understanding, reality come together.

2.931 This tends to lead to the questions: What is the nature of a picture, and do the descriptions of language constitute a picture, and, if so, what kind of a picture?

2.932 There are many kinds of pictures - photographs, holographs, mental images, magnetic resonance imaging, art works, positron emission tomography, cartography, X-rays, optical illusions, radio wave imaging, sketches, dreams, hallucinations, stills, movies, television, and so on.

2.933 All pictures involve a methodology (well-conceived or otherwise) for engaging the junctures of contact that bring experience, understanding, and reality together.

2.934 Methodology is an ordered process of understanding whose purpose is to engage experience and that which makes experience of such structural character possible in order to probe, within the capacity of the methodology to do so, the nature, structure, or logic of the relationship, if any, between these two dimensions of being.

2.935 Pictures are generated through a process that affects the quality and character of the images that are produced, as well as imposes a limiting context on the mode of engagement to which the methodology underlying the picture gives expression.

2.936 Pictures are an interpretive mapping of some given juncture, or set of junctures, in which experience, understanding, and reality come together.

2.937 Interpretive mapping gives expression to a methodology's manner of constructing hermeneutical spaces.

2.938 Pictures are hermeneutical spaces, the contents of which are filled up by the data that is generated through the way the methodology of the picture taking engages experience and that which makes experience of such structural character possible.

2.94 Language, to the extent it constitutes a modality of generating pictures, does so according to the methodological properties of the language in question.

2.941 The methodology inherent in any given language is an expression of the rules and principles of syntax and semantics that differentiate one language from another.

2.9411 The rules of a language establish the boundary conditions that cannot be violated without removing one from the way the given language permits one to communicate with others who use the same language. Linguistic rules are like the motor vehicle codes that govern the operation of motor vehicles within a given locality in order for traffic to move smoothly with as few problems as possible.

2.9412 The principles of a language establish the degrees of freedom through which an individual can move creatively and hermeneutically within a given language in order to adapt the rules and principles of syntax and semantics of that language to one's individual desires to communicate about issues that are either meta-linguistic or extra-linguistic. Linguistic principles are like road maps that show you places to which travel is possible but do not specify where one has to go or what routes one must take in order to arrive at one's desired destination.

2.9413 The rules and principles of a given language's syntax and semantics serve as mapping tools that enable an individual to translate, to whatever extent possible, between personal, extra-linguistic hermeneutical spaces and public linguistic hermeneutical spaces.

2.942 Different languages have varying degrees of flexibility concerning the extent to which the syntax and semantics of such languages are able to serve as vehicles of transmission for forms of thought, logic, creativity, understanding, and, methodology that are extra-linguistic.

2.943 Languages and pictures are similar to the extent that each uses mapping methodologies to link together junctures of contact among experiences, understandings, and that which makes experiences and understandings of such structural character possible.

2.944 Languages and pictures are dissimilar to the extent that their respective methodologies give expression to different sets of rules and principles for linking together junctures of contact among experiences, understandings, and that which makes experiences and understandings of such character possible.

2.945 Methodology -- whether linguistic, pictorial, or other -- does not create, construct, or understand, in and of itself, per se. Rather, methodology establishes the limits (or boundary conditions) and degrees of freedom for what can be created, constructed and/or understood using that form of methodology.

2.946 The value of a given form of methodology -- linguistic or otherwise -- is in direct proportion to the capacity of the set of rules and principles inherent in that methodology to enable an individual to probe the relationship between experience and that which makes experience of such character possible. Through this process of hermeneutical probing, one seeks to establish an understanding that accurately reflects the structural character of that which makes experience of a certain nature possible. The greater this degree of accurate reflection, the greater the heuristic value of the methodology.

2.95 Methodology, language, understanding, hermeneutical space, logic, and mapping are different ways of making reference to the process of creating and constructing epistemological mirrors that are capable of reflecting, with varying degrees of accuracy, the nature of the relationship between experience and that which makes experience of such structural character possible.

2.96 The medium of measurement for reflective accuracy is congruency.

2.961 In mathematics, two geometric figures that can be precisely superimposed on one another are said to be congruent.

2.962 In hermeneutics, two spaces that are being compared are said to be congruent to the extent that one can establish mapping relationships that link aspects of respective facets of being in a way that does not generate more problems and questions than the congruency is capable of demonstrating in the way of mapping relationships of a reflective nature.

2.9621 The greater the degree of congruency between spaces being compared, then, the greater will be the degree to which those spaces will be said to merge horizons.

2.9622 A horizon is an expression of the logical nature of some facet of manifested structure. Horizons are boundaries that tend to differentiate what is within a structure from that which is external to such a structure.

2.96221 However, frequently, horizons are not static but shift with perspective, experience, interpretation, and understanding. Facets of experience that, at one time, might have been considered to be separate and independent, might be discovered, at a later time, to have a relationship that requires one to re-work one's understanding of how to differentiate between what is within a structure and what is external to that structure. Like the physical horizon of landscapes, hermeneutical horizons tend to move with us and are shaped and influenced by the nature of that movement.

2.96222 Horizons might be simple or complex. In other words, the boundary conditions that are given expression through the way horizons differentiate between what is within a given structure, and what is external to that structure, might consist of relatively few elements and/or forms of transaction between the 'internal' and the 'external' realms. On the other hand, such boundary conditions might consist of many facets and dimensions -- both with respect to the number and character of elements, as well in relation to the extent of the transactions that transpire across the boundaries marked by the horizons, thereby making it difficult to determine on which side of the boundary a given phenomenon (whether event, object, process, and so on) falls.

2.96223 Most of us have a considerable backlog of experience with, information about, understanding of, and insight into the process of establishing congruency. More specifically, whenever an individual seeks to translate feelings, experiences, thoughts, beliefs, states of consciousness, and other facets of the phenomenological field into public discourse via a language (spoken, written, signed, mathematical, coded), one goes through a process of trying to create logical spaces through the way we utilize and weave together the syntax and semantics of a given language so that the structural character of this space is congruent with, or accurately reflective of, or able to mirror the structural character of whatever aspect of the phenomenological field one to which one is making identifying reference by means of the language.

2.96224 When there is a mismatch between the structural character of the two hermeneutical spaces (one being: that which is meant, intended, understood, or experienced, and the other being: the language used to describe or convey what is meant, intended, and so on), then, the one who is communicating with someone else tends to amend the character of the syntax and semantics being used to better reflect the meaning or sense one wishes to convey to the recipient of the communication.

2.96225 Similarly, when someone receives communication from another individual, and the recipient does not understand the sense of what is meant or intended by the other individual, then, the recipient tends to use the modality of the interrogative imperative to query various facets of what has been communicated. Here, again, there is a mismatch between hermeneutical spaces -- namely, the understanding of the recipient and the structural character of the linguistic spaces generated by the one who is seeking to communicate about some aspect of the latter individual's phenomenological field.

2.96226 Most of us do not tend to think of these processes of translating between phenomenology and language as instances of congruence operations, but, this is what is transpiring irrespective of whether, or not, we use this term.

2.963 The notion of "spaces" need not be restricted to geometric, mathematical, physical, or material modalities. A "space" is anything that has a logical or structural form of whatever kind.

2.964 Since we don't, yet, know where or how creative, interpretive, epistemological, and/or linguistic processes take place, we do not know what the precise nature of the space is through which these phenomena are given expression. However, what we do know is that all of these processes have a logical form or structure to them.

3.01 There are multiplicities of logical systems.

3.011 Some logical systems are invented or created and other logical systems are given expression through the structural character or nature inherent in some dimension of reality being the way that it is.

3.012 Whether created or natural, logic gives expression to the structural character of the forms and/or processes governing a given facet, aspect, dimension, level, or plane of being.

3.0121 All created systems of logic constitute hermeneutical spaces.

3.01212 Created systems of logic involve a hermeneutical process of mapping that is governed by a set of assumptions, principles, rules, and propositions that are ordered in accordance with the constraints and degrees of freedom permitted by the set of assumptions, principles and rules that constitute the given system of logic.

3.0122 Natural systems of logic involve the manner in which some facet, aspect, dimension, or plane of being is manifested or unfolds over time.

3.0123 When the structural character of a created system of logic reflects the structural character of a natural system of logic, then, congruency exists between the two systems of logic to the extent that the reflection of the latter by the former can be shown to be accurate.

3.1 'Characterization' refers to the process of placing an aspect or dimension of experience within hermeneutical space. Assumption, abstraction, categorization, definition, description, belief, faith, and modeling all give expression, in one way or another, to the process of characterization.

3.11 How we emotionally respond to experience forms an important dimension of the characterization process. Liking, attraction, repulsion, hostility, fear, pleasure, pain, trust, avoidance, and so on are all expressions of characterization.

3.112 Characterization is something human beings, along with various other species of life, do in order to help orient oneself within hermeneutical space. Characterization relates us to experience through the construction, creation, and/or generation of modalities of classification concerning such experience.

3.1121 Different systems of created logic employ a variety of mapping techniques -- included among these are: induction; deduction; analogy; abstraction; dialectic; implication; inference; entailment; tautology; validity; consistency; necessity; coherency; assumptions; possibility; plausibility; correlation; probability; causality; conjecture; interpolation; extrapolation; hypotheses; theory; law; formulae; equations; arguments; evidence; demonstration; proof; description; explanation; belief; insight; models; world-making; frames of reference; paradigms, and world-views.

3.1122 Some of these mapping techniques are applied to one, or another, created system of logic as a means of analyzing and/or evaluating such systems. Some of these techniques are applied to the data of experience in order to either map out the structural character of such experience or to generate maps that are intended to account for how experience of such structural character is possible.

3.1123 Induction is a process that uses some set of data as a basis for generating a conclusion concerning the proposed character of similar instances of data not yet encountered. For instance, if all the swans one has seen are white, one might use this base set of data about swans to conclude that all future instances of swan-encounters are likely, as well, to involve white swans.

3.11231 The risk one runs in using induction is that the conclusion one has formed on the basis of what has been observed or encountered might not be correct. For example, black swans do exist, and, therefore, the belief that all future instances of swan-encounters will involve white swans will fall with the first black swan that is encountered.

3.113 Deduction focuses on the kinds of conclusion one can draw about some facet of experience or about a system of logic given certain information concerning both the nature of that facet of being as well as a background of information about a variety of experiences in general. Such conclusions usually are limited to unpacking or delineating the set of constraints and degrees of freedom that are inherent in the available information. Thus, if I know that human beings are capable of carrying on a conversation, and if I am carrying on a conversation, via a telephone, with a voice that is located elsewhere, then, I might deduce that this other voice belongs to a human being.

3.1131 Conclusions reached through the exercise of deduction concerning a given set of data, propositions, experiences, and so on aren't always correct. For instance, if the voice with whom I having a conversation is part of a complex and sophisticated system of software and hardware that constitutes a framework of artificial intelligence, then, the deduction that the other voice belongs to the human being with whom I am having a conversation might not be warranted. Among other things, one might have to determine whether one could extend the category of human beings to include systems of artificial intelligence before making such a deduction. Moreover, whether such a deduction would, then, be correct might depend on whether, or not, the determination concerning the relationship between human beings and any given system of artificial intelligence is warranted.

3.1132 Interpolation is a form of mapping that inserts or computes intermediate values within a given sequence, series, or set of events, operations, or calculations. These values are believed to be related to the rest of the series or sequence in the same way as the present set of events are related to one another. Interpolation might give expression to either inductive and/or deductive processes.

3.1133 Extrapolation is a form of mapping that seeks to determine or estimate the identity of values that extend beyond the horizons or range of some given set of data, and, yet, retain the structural character of the relationship that links the elements within the known set of data. Extrapolation might consist of induction, deduction, or some combination of the two.

3.114 Mapping techniques involving analogy use the structural features and/or relationships within one context to direct attention to possible similarities of structural character and/or relationship within a different context. For example, rivers and arteries constitute different contexts, but they share a variety of similarities. More specifically, they both: involve liquids; the flow of materials within a delimited framework; pressure; currents; a possibility for transport; are part of a larger ecological system; and so on. One might key in on one, or more, of the foregoing features to establish a relationship of analogy between rivers and arteries for purposes of description, explanation, analysis, modeling, and the like.

3.1141 The value of an analogy depends on both the strength of the similarity that is being proposed with respect to the contexts that have been selected for comparison in this manner, as well as the nature of the purpose for which such an analogy is being established and whether, or not, the similarities are capable of sustaining the purpose for which the analogy has been drawn.

3.1142 An analog is a logical system that purports to reflect the structural character, in some way, of some other logical system -- either artificial or natural. Often times, an analog focuses on the manner in which some other system operates or on the kind of relationships that tend to govern the other system, and, usually, the form of an analog keys in on the idea of using the continuous modulation of one, or more, variables as its manner of establishing congruency with the structural character of that system to which the analog makes identifying reference.

3.115 Abstraction is a process of stripping away the details of a given event, object, phenomenon, experience, process, or context, and so on in order to focus on a limited aspect, facet or dimension of such an event, object, phenomenon, experience, process, or context - often times such abstractions are embodied within systems of symbols (e.g., linguistic, mathematical, logical) that are said to represent, or give expression to, the properties or qualities that have been pared down or abstracted in one way or another.

3.1151 Although thinking about objects, phenomena, events, and so on, in the simplified way made possible through abstraction often helps make analysis, evaluation, exploration, experimentation, and/or gaining insight into such objects, phenomena, or events easier to do, the value of such a process tends to depend on the nature of the abstraction, how such abstractions are used, and remembering that simplified systems cannot hope to manifest all of the qualities, properties, and possibilities inherent in the more complex context from which the abstraction has been extracted. As a result, various kinds of error might be introduced into one's mapping program when using: data, ideas, information, and so on, that have been generated through processes of abstraction.

3.1152 Symbols are often used to signify the presence of certain modalities of abstraction. A symbol is not the same as, or synonymous with, that to which it makes identifying reference but, instead, is part of a system of logic that gives expression to a set of abstractions through which hermeneutical spaces are generated that are intended to establish varying degrees of congruency with certain aspects or dimensions of the structural character of experience, or that which makes experience of such structural character possible.

3.11521 Symbols do not necessarily remove one from the context being explored. Rather, they give expression to characterizations of such contexts -- characterizations from which certain details, themes, and so on of the original context have been removed. Symbols permit one to simply the ways in which hermeneutical spaces are described.

3.115211 Some forms of the foregoing sort of simplification have heuristic value while other forms do not.

3.116 A dialectic is a process of hermeneutical mapping that gives expression to a form of argument that links ideas, events, objects, processes, propositions, phenomena, and/or situations in accordance with some rule or principle or set of such rules and principles. One cannot know the nature of the dialectic involved until one understands the character of the rules and principles being used to shape the linkages among ideas, events, objects, and so on, but, usually, the linkages of a given form of dialectic have to do with the manner in which structural relationships are said to direct the flow of unfolding or manifestation of some given set of ideas, events, objects, and so on.

3.1161 The Hegelian dialectic is different from that of Marx's dialectical materialism, and both of these are different from the dialectic of a Socratic dialogue. Each of the foregoing forms of dialectic uses different sets of rules and principles to establish linkages within their respective systems of thought.

Furthermore, the epistemological value of a given instance of dialectics depends on the extent to which the set of rules and principles shaping the flow of hermeneutical linkages within a given kind of dialectic is capable of reflecting the structural character of the way some aspect, facet, dimension, or plane of being actually operates or is manifested and with respect to which the dialectic is being used as a means of explicating the structural character of the aspect or dimension to which the dialectic is giving reference.

3.117 Implication is a process of mapping that points in the direction of other possibilities being connected or related, in some way, to the context out of which the indication of implication arises. The extent and character of such a connection or relationship depends on the nature of the implication and the possibilities to which the implication is being juxtaposed.

3.1171 For example, if one were to enter into a house and find dinnerware and food on the dining room table, then, this information implies there might be a group of people somewhere, nearby, who are preparing to eat. On the other hand, one might have wandered into a nuclear test site in which an atomic bomb is about to be exploded and the table has been set to see what, if any, effects (both short-term and long-term) might result with respect to such a house that contains a dining room with a table set with food and dinnerware.

3.11711 Implications might be strong, weak, or unwarranted. In the latter case, although someone has proposed that a relationship or connection exists between two contexts, events, processes, and so on, in reality, no such relationship or connection exists.

3.118 Inferences are conclusions drawn by an individual concerning some given set of data or body of information or array of propositions. Such conclusions might be causal, relational, hierarchical, or associational in nature.

3.1181 Inferential conclusions are not always correct or warranted.

3.119 Entailment refers to mapping processes that purport to establish that one fact, proposition, event, phenomenon, idea, context, object, or process supports the truth, validity, reality, or existence of some other fact, proposition, event, phenomenon, idea, context, object or process. The nature and strength of such support will depend on the structural character of the entailment relationship that is being proposed.

3.1191 Similar to mappings that involve processes of inference, implication, dialectic, abstraction, analogy, deduction, and induction, so too, entailment proposals might, or might not, be warranted.

3.120 A tautology is a special form of entailment proposal. According to this kind of mapping technique, if one unpacks or delineates the structural character of some given fact, proposition, state of affairs, context, process, event, phenomenon, or object, then, the truth of a given tautology is contained within the structural character being unpacked or delineated. Tautologies are merely re-statements, in altered form, of what is already known about the structural character of some fact, proposition, or issue.

3.1201 Thus, one might say that a tennis ball is yellow, and, then, go on to say that the ball is round and colored. The latter statement is entailed by the first statement – once one understands the nature of tennis balls in general -- because the latter statement is merely re-stating, in altered form, what is known by means of the first statement, and, therefore, is tautological with respect to the first statement.

3.1202 Tautologies are not necessarily about the nature of what makes the structural character of some given experience possible. Tautologies might be part of artificially constructed logical systems (e.g., models, paradigms, frames of reference, world-view, theories, beliefs) which although true in the context of such logical systems have no reference to anything beyond the horizons of those systems.

3.121 Validity is a mapping operation that focuses on the relationship between a given set of data or information and one, or more, deductions, implications, or entailment proposals that are made in conjunction with that set of data or information. The nature of this relationship concerns the degree to which deductions, conclusions, implications, entailments, and/or inferences are warranted as one moves from a given set of data or information to certain deductions, implications, and so on, involving that set of data. Relationships that are warranted, or follow from, or are evidentially supported tend to be referred to as valid.

3.1211 Determining whether, or not, the aforementioned relationships are warranted, or follow from, or are evidentially supported is not always easy or straightforward.

3.1212 Determining validity within artificially constructed systems of logic tends to be an easier problem to solve than trying to determine the validity of statements involving the relationship between ideas or statements about certain dimensions of experience and that which makes experience of such structural character possible.

3.122 Consistency is one test of validity. In order for a series of ideas, propositions, experiences, understandings and so on, to be consistent with one another, there must not be anything within any of the given ideas, propositions, etc., which contradicts -- in part, or in whole -- any aspect, dimension, or facet of any of the other ideas, experiences, or propositions that are in the set or series being considered. In addition, one must be capable of showing there is some degree of relationship among the ideas, propositions, or experiences that ties together, in some fashion, the various items in the series or set.

3.1221 Unrelated ideas, issues, experiences, events, or propositions are neither consistent nor inconsistent. However, there might be varying degrees of consistency -- depending on how weak or strong the relationship is that is said to tie the set or series of ideas, experiences, events, propositions, and so on, together.

3.123 Coherency is an indication of the internal validity of a system of logic. Coherency refers to the manner in which a hermeneutical space hangs together to serve as an account, story, description, or explanation and, as such, appears to possess few, if any, lacunae or gaps in its structural structure -- gaps that would tend to discredit the possible value of the account, story, description, or explanation.

3.123001 The reliability of a methodology, measurement process, or modality of hermeneutical activity points in several directions. On the one hand, reliability concerns the capacity of, say, a given form of methodology to produce results that are relatively consistent with respect to a given phenomenon under similar conditions of engagement. On the other hand, reliability raises the issue of whether, or not, a given methodology or form of measurement has the capacity to accurately reflect, mirror, or establish congruency with some aspect or dimension of the structural character of some given experience, or that which makes experience of such structural character possible.

3.123002 Replication, confirmation, and verification are all different ways of referring to the issue of reliability in both its inward pointing sense (the first aspect noted above), as well as its outward pointing sense (the second aspect outlined in the foregoing.)

3.124 Necessity gives expression to the way logical systems manifest themselves such that the manifesting could not have been other than what it is. The necessity of artificial and natural systems of logic both are functions of the structural character of such systems.

3.1241 The necessity of artificial systems of logic might not extend beyond the horizons of that system.

3.1241 Necessary conditions refer to those facets of a logical system -- whether artificial or natural -- which, if not present, will impede something within that system from taking place or being manifested or continuing or proceeding, but, if present, might help provide for the possibility of something transpiring without necessarily guaranteeing such an outcome. Thus, with respect to the lighting of a match - oxygen, a match head with the right composition and quality of sulfur and phosphorus, a minimal degree of dryness, a striking surface of the appropriate properties, and the presence of someone or something to strike the match against such a surface. All of the foregoing conditions are considered necessary since if any of them are absent, the lighting of the match might be impeded, and, yet, if they are all present, there is no guarantee that the match will light since the person or device used to strike the match might not be active, or even if active, the match might not strike the surface in the way that is required for the match to light.

3.125 Assumptions are mapping operations that serve as starting points for exploration, analysis, evaluation, measurement, methodology, and, in general, constructing or creating hermeneutical spaces. Initially, assumptions tend to be not provable but provide one with conceptual direction with respect to subsequent hermeneutical activity and one proceeds 'as if' the assumption were true in order to see where -- conceptually or hermeneutically speaking -- one might journey from such a starting point.

3.1251 Assumptions might, or might not, accurately reflect -- partly or wholly -- the structural character of some aspect, facet, or dimension of experience or that which makes experience of such structural character possible. However, assumptions -- even if not true -- might be utilized for their heuristic value in suggesting possible avenues of hermeneutical consideration that, eventually, might lead to results that do bear on some dimension, facet, or aspect of being in an accurately reflective manner. Thus, the idea of a geometric point that is without dimension does not necessarily have any counterpart in reality, but it serves as a starting point of considerable heuristic value in relation to constructing artificial systems of geometric logic.

3.126 Possibility refers to mapping operations that entertain various facets of a logical system and treat these facets as if they might be true because nothing that is known to be true contradicts such a consideration.

3.1261 Just as experience, belief, understanding, and knowledge change, so too the character of what one will entertain as being possible might also change. However, what one considers possible might, or might not, accurately reflect what, in reality, is actually possible.

3.1262 Plausibility is a mapping operation or process that renders a judgment concerning not only the validity, consistency and coherency of a given hermeneutical space, but, as well, maps out a degree of confidence one might have with respect to whether, or not, such a space might serve as a candidate that has congruency with some given aspect of experience and/or that which makes experience of such structural character possible.

3.1263 The foregoing sort of judgment assigns a value that is greater than mere possibility but less than certainty. Consequently, depending on circumstances, there are many values of confidence that might be assigned to such a judgment, and while all such judgments have some degree of reflective capacity or sense to them, not all such judgments are equally plausible.

3.127 Correlation involves mapping operations that seek to establish the degree to which, say, two objects, events, phenomena, processes, or contexts are manifested, occur, or appear together -- either simultaneously, or contiguously, or sequentially.

3.1271 Correlation says nothing about the structural character of the relationship between such objects, events, phenomena, and so on. Rather, it is a measure of the likelihood that if one encounters one of these objects, events, etc, one also will encounter the other object, event, etc -- whether simultaneously, contiguously, or sequentially. Thus, although night and day have a high degree of correlation, night does not cause day, nor does day cause night, but, instead, both are related to a further set of phenomena concerning, among other things, the rotation of the Earth, the movement of the Sun, the propagation of photons across a vacuum, the dispersion of such photons by the atmosphere of the Earth, and the existence of beings capable of discriminating between light and darkness.

3.128 The idea of randomness is an assumption that alludes to the presence of a principle within reality that says there are no dimensions of hidden variables governing a given system and that the structure of such a system is entirely the result of events and processes that, although caused, are not ordered in accordance with any preexisting pattern that is imposed on those events and processes -- other than the fact that such events and processes having the character that they do.

3.1281 An algorithm is a determinate array of operations that are performed on a body or set of data. Although the array of operations is determinate, the outcome might not be predictable (as in non-linear and chaotic systems) because of the synergy -- both negative and positive -- with which the operations feedback into themselves and the data on which they operate.

3.1282 Randomness is an assumption that can never be proved since there is always the possibility that the series or array or set of events that are being called random is a function of an algorithm whose presence and nature has not, yet, been detected.

3.129 Probability encompasses a variety of artificial systems of logic that seek to assign degrees of likelihood to expectations concerning the way a given system or hermeneutical space will be manifested over time. The manner in which these degrees of likelihood are determined and assigned depends on the structural character of the methodology governing a given framework of probability. Irrespective of the method used, the assumption of randomness is often used to establish base lines against which expectations and outcomes might be compared for purposes of analysis.

3.1291 Probability is a way of modeling certain dimensions of a system -- for example, the likelihood that various kinds of event or process will be given expression at different junctures as the system is manifested during its operations or functioning.

3.1292 As is the case with all models, the value of a given probability framework depends on the tenability of mapping processes such as assumptions, abstractions, deductions, analogs, and so on, which are being used to create the structural character of the hermeneutical space that constitutes a probability model.

3.1293 Statistics is a form of mapping that seeks to quantitatively describe, analyze, organize, and interpret a given body of data and/or information, especially in relation to issues of average, frequency, distribution, distance from some standard feature, correlation, trends, and reliability of such quantitative treatments. Statistics is often used as basis for informing, shaping, and directing various kinds of inductive, deductive, and modeling processes, as well as serving as a possible approach to the interpretation and evaluation of experimental data.

3.1294 Although related, in various ways, to probability frameworks, statistics is a different kind of quantitative description than the latter. However, statistics shares many of the same strengths and weaknesses as do mapping operations involving probability.

3.130 Information refers to the ways in which the structural character of experience is characterized, analyzed, interpreted, and organized. Information does not exist in that which is being characterized, rather the structural nature of the logical form of that which is being explored and delineated through the process of characterization serves as the focus of engagement for various processes, operations, functions, and methods that are artificially generated. Each of the foregoing has its own modality for creating the data that become the points -- simple or complex -- from which the hermeneutical space of some system of logic is constructed.

3.131 Information might, or might not, be accurately reflective -- in part or in whole -- of that to which the information makes identifying reference.

3.132 Objectivity is a process that seeks to eliminate as many possible sources of bias, prejudice, distortion, undue influence, obfuscation, corruption, misunderstanding, and error from the construction, creation, or generation of hermeneutical spaces in conjunction with both experience, as well as that which makes experience of such structural character possible.

3.1321 Hermeneutical filters are used to process experience, data, information, and so on in a way that emphasizes, or brings out, some features of that experience, etc., while eliminating other facets of such experience. Photographers use various kinds of lenses to filter out certain wavelengths or conditions of lighting. In chemistry, one uses filters to eliminate certain ingredients whose size is larger than the holes of the filter. Audio technicians filter out noise to enhance the quality of sound.

3.13211 All filters have a bias to them that is inclined to some forms, or aspects, of experience, to the exclusion of others, according to the structural character of a filter.

3.13212 Sometimes such biases serve a useful function in conjunction with the quest for objectivity, and sometimes they do not. In either case, one needs to make note of the filters in use and how they shape, color, and orient experience.

3.132121 Calibration is a process that is intended to enable some form of methodology, instrumentation, or hermeneutical activity to function in an optimal way. Being 'optimal' is a function of the capabilities inherent in the given methodology, instrumentation, or hermeneutical activity, together with the skill and artistry of the individuals who are using such methodology, etc..

3.132122 Part of the process of calibration involves establishing, under specified conditions, base lines of performance and outcomes against which subsequent performance and outcomes generated through such methodology, instrumentation and hermeneutical activity can be compared and assigned meaning and significance.

3.132123 A given base line is not necessarily a reflection of the structural character of some aspect or dimension of experience, or that which makes experience possible, which is independent of the base line. Rather, base lines are established in order to give one a place of known properties and conditions from which to operate and through which one can explore, probe, and experiment with various facets of experience.

3.132124 Base lines and calibration are part of a filtering process.

3.132125 Measurement is a process that seeks to quantify the extent to which some aspect or dimension of experience, or that which makes experience of such structural character possible, gives expression to some quality, property, state, activity, value, or feature in which one is interested. Generally speaking, measurement depends on the existence of some kind of standard unit that either remains consistent over time and across conditions, or fluctuates in known, regular ways according to circumstances.

3.132126 Measurement is another kind of filtering process. The properties of this filter will vary with: (a) the modality of measurement; (b) the nature of, and the problems surrounding, the 'standard unit used by a given form of measurement; (c) the extent to which such a modality interferes with the way in which that which is being measured is manifested; (d) the capacity of the modality of measurement to generate relevant data that serve as hermeneutical entry points through which one might gain insight into the structural character of that which is being measured; (e) the degree of resistance inherent in the structural character of that which is to be measured to the modality of measurement being employed (i.e., some modes of measurement are more compatible with certain dimensions of experience, or that which makes experience possible, than are other modes of measurement.

3.132127 Unobtrusive measures are those forms of measurement that do not interfere with, or influence, the way some given phenomenon, event, process, object, condition, state, or the like, is manifested during the time in which the modality of measurement engages such a phenomenon, event, etc..

3.132128 At least since the work of Heisenberg, there has been an awareness that the very act of observing a system, phenomenon, and so on, can alter the way in which the system, phenomenon, etc., is given expression during the process of observation. The nature of such alterations might mask, to varying degrees, the actual character of certain dimensions or facets of the system being observed, and, as a result, affect the quality and accuracy of the hermeneutical spaces generated with the assistance of such processes of observation.

3.132129 Quantifying a given property has at least two aspects. The first aspect is to establish a modality of measurement that is capable of reflecting relevant data concerning such a property. The second aspect involves the mathematical treatment of that data.

3.13212901 Methodology, measurement, quantification, and mathematics do not guarantee that the experience or data that is processed through such means will be understood. As Richard Feynman is reported to have once told a student who was anguishing over the nature, meaning and significance of quantum mechanics - 'Look, no one understands it, just do the calculations."

3.1321291 Relevancy is not a matter of what is of value to a given form of methodology, measurement, or hermeneutical activity. Relevancy is determined by the actual nature, logic, or structural character of that which is being explored.

3.13212911 The ultimate baseline for all methodology and measurement is reality itself.

3.132130 Not all facets or dimensions of experience, and/or that which makes experience of such structural character possible, are amenable to processes of measurement and/or mathematically tractable.

3.133 The interrogative imperative refers to a dimension of human existence that is, on the one hand, rooted in curiosity and the desire to know the truth concerning the nature of experience and/or that which makes experience of such structural character possible. On the other hand, the interrogative imperative is rooted in the awareness that there are many ways in which objectivity can be compromised during the process of engaging, exploring, characterizing, analyzing, interpreting, evaluating, modeling, understanding, and applying experience - such awareness contains the desire to eliminate as many of these kinds of problems as possible.

3.1331 Much of the focus of the interrogative imperative is to determine the extent, if any, to which a claimed insight is possible, plausible, probable, or accurately reflective with respect to that to which the alleged insight makes identifying reference.

3.134 Ockham's razor stipulates that one should not multiply terms, concepts, and assumptions beyond what is necessary to explain or account for a given phenomena. An alternative way of alluding to the same sort of principle is that when comparing two explanations, ideas, assumptions, etc., then, all other things being equal, the simpler of the two is to be preferred.

3.1341 Some of the problems with the foregoing are as follows: what is necessary is often at issue; moreover, 'all other things' often are not equal and how such inequalities affect the process of identifying what is necessary or simpler is not always easily, if at all, capable of being sorted out; in addition, finding reliable measures of simplicity that are independent of the eye of the beholder (i.e., some artificially constructed system of logic) is a complex and difficult process.

3.135 Evidence refers to the set of assumptions, data, information, facts, beliefs, values, judgments, interpretations, understandings, methodologies, mappings, questions, and so on, that have been woven into a framework of reference through which certain kinds of experiences are considered to have some degree of congruency with either an aspect of experience or an aspect of that which makes experience of such structural character possible.

3.136 The manner or modality of weaving together such evidence is often given expression in the form of a mathematical, logical, or rigorous argument, demonstration, proof, or explanation, of some kind. These 'forms' are ways of ordering, structuring, arranging, and/or relating the elements of evidence so that the structural character of such a form might be seen, or understood, to have a certain degree of congruency with the structural character of that to which the form of evidence makes identifying reference.

3.137 Forms of tenable argument, demonstration, proof, or explanation are ones that is capable of standing up under the scrutiny of the interrogative imperative over time.

3.1371 Allegedly tenable arguments, and the like, are not necessarily true, for the value and strength of a given judgment of tenability is dependent on the strength and value of the questions that are asked. If the right questions are not asked, then, a given argument or explanation is only as good as the quality and rigor of the questions that have been raised concerning it ... which might, or might not, be all that good depending on circumstances.

3.1372 Proof can be a relative thing that depends on an individual's acceptance of the assumptions, evidence, arguments, propositions, mapping operations, and conclusions contained in the proof.

3.13721 The fact someone accepts a proof as valid, adequate, consistent, coherent, and so on does not, in and of itself, confirm the proof as true, logical, substantiated, and/or legitimate.

3.137211 Before Riemann and Lobachevski, people generally accepted Euclid's geometric proofs and made the latter the cornerstone of a great deal of subsequent work in both mathematics and science. After the work of the two aforementioned mathematicians, people approached the idea of geometric proof differently.

3.137212 Prior to the time when Gödel's notions of incompleteness and inconsistency arrived on the scene, many people regarded the proofs of mathematics as certain and reliable. After Gödel, people looked at the idea of proof very differently.

3.13722 The fact most people believe something to have been proven does not, in and of itself, mean the proof is beyond warranted criticism. Similarly, the fact few people believe in a given proof, does not, in and of itself, negate the value of such a proof.

3.137221 Some proofs are entirely about the internal properties of a given system of artificial logic, and have little, if anything, to do with reality beyond the horizons of such a system.

3.137222 Some proofs focus on seeking to determine the structural character of various facets, aspects, or dimensions of experience.

3.137223 Some proofs are concerned with the relationship among understanding, experience, and the nature of that which makes experience of such structural character possible.

3.138 Falsification is an idea introduced by Karl Popper that, in simplified terms, stipulates that while only one contraindication with respect to some given conjecture, hypothesis, principle, or the like, is enough to falsify claims concerning the correctness or truth of such a conjecture or hypothesis, no amount of positive evidence is sufficient to prove the truth of a given conjecture or hypothesis because there is always the possibility that some form of contraindication with respect to such a conjecture or hypothesis might arise in the future.

3.139 Human beings seek out certainty, but, in general, are immersed in uncertainty, unanswered questions, inconclusive evidence, and problematic proofs.

3.140 Hermeneutical spaces can be divided up into linear and nonlinear systems. Linear systems are those that tend to be tractable to mathematical treatment because of the regularity or repetitive nature of the patterns and features to which such a system gives expression The task, then, becomes one of trying to establish some degree of congruency between the structural character of some form of mathematical system of logic and the structural character of the facets of hermeneutical space and/or phenomenology of experience that one seeks to understand. One uses such congruency as the manifold of commonality through which one generates abstractions, models, logical frameworks, and so on, as a basis for mirroring the properties, structure, and logical nature of a given linear system.

3.141 Non-linear systems refer to contexts in which the forms, patterns, and structures to which such systems give expression tend to be irregular in character and oftentimes exhibit anomalous behavior of one kind or another. The properties manifested by such systems over time are said to be self-similar rather than self-same (as in the case of linear systems), and, consequently, such systems are not easily, if at all, tractable through most mathematical systems.

3.142 Non-linear systems are determinate in nature. This means that such systems are governed by a set of principles of identifiable nature, but the systems in question tend to be unpredictable because of the manner in which the various dimensions of the system are extremely sensitive to fluctuations taking place within that system (as well as around the system). Therefore, such systems exhibit complex forms of feed-back loops that are not readily amenable to mathematical treatment, and even when such treatments are available, the latter tend to be limited to very specific contexts and subject to a considerable amount of constant manual adjustments in the formulae and equations of such treatments in order to keep up, somewhat, with the changes being manifested in nonlinear systems.

3.1421 Most of life consists of non-linear phenomena.

3.15 Mathematical formulae and equations are expressions of different facets and dimensions of the structural character of the artificial systems of logic to which they give expression.

3.151 The value of a formula, equation, or set of formulae and equations, lies in the degree of congruency that can be established or exists between the structural character of a formula or equation (or set of them) and the structural character of the aspect of experience to which such mathematical forms make identifying reference in a given context.

3.1511 Mathematical and non-mathematical languages, alike, seek to establish congruency among understanding, experience, and that which makes such experience possible.

3.1512 In some cases mathematical language accomplishes the task of establishing congruency far more precisely and rigorously than non-mathematical languages do. In other instances, the reverse might be true (e.g., in the realms of, say, creativity, love, emotion, morality, spirituality, poetry, identity, justice, faith, art, community, belief, purpose, parenting, psychological therapy, and so on).

3.16 All methodologies are subject to the limitations of incompleteness. In other words, no methodology is self-contained and self-sufficient, but, instead, one must journey beyond the horizons of any given methodology in order to discover the value of that methodology.

3.161 Methodology tends to stand in need of, and presupposes, experience and/or that which makes experience of such structural character possible.

3.162 Although methodology arises out of experience, not all experience is necessarily reducible to such a methodology or capable of being grasped through such a methodology.

3.163 Methodology, like language, and systems of logic in general, does not move itself. They require the presence of consciousness (basic as well as reflexive) and intelligence to invent, generate, create, construct, apply, understand, and critique them.

3.17 Frames of reference, belief systems, hypotheses, theories, models, paradigms, and world-views are the hermeneutical spaces created or constructed by intelligence as it engages experience through the phenomenological field -- which is the point of conjunction of understanding, experience, and that which makes experience of such structural character possible.

3.171 A hypothesis is a conjecture concerning the way in which certain facets of experience, or that which makes experiences of such structural character possible, are related.

3.1712 Oftentimes, the nature of this relationship is expressed in terms of independent and dependent variables.

3.17121 Something is considered an independent variable when: (a) it can change in value under different circumstances, and (b) the value is not affected by changes to the dependent variable with which it is associated by means of the hypothesis.

3.171211 Among various possibilities one might cite, global economics, chaotic systems, and mysticism as tending to suggest that few things in the universe might actually be fully independent of changes elsewhere in a given context or system. As such, there are degrees of relative independence and relative dependence.

3.171212 Causation refers to the idea that the relationship between two events, objects, contexts, states, and so on is governed by the manner in which one pole of the relationship is prior to (both logically and physically), as well as, directs, shapes, orients, alters, transforms, changes, and/or helps give rise to the other pole of the relationship.

3.171213 The interdependent nature of many facets and dimensions of experience and/or that which makes experience of such structural character possible - as is suggested by, among other things: life, Bell's theorem, quantum physics, the stock market, politics, gravitation, education, peace, cybernetics, ecology, jurisprudence, consciousness, intelligence, understanding, illness, and happiness - indicates that isolating something as 'the', or even 'a' cause, might not be a straightforward matter, and might be, in many instances, quite arbitrary.

3.1713 A theory is a belief or set of beliefs concerning the structural character of some facet of experience and/or that which makes experience of such structural character possible.

3.17131 Some theories are more rigorous than others in the sense that the former: (a) tend to be supported by more well-considered evidence than the latter; (b) might be more coherent and consistent; (c) might have been subjected to closer and more exacting scrutiny through the interrogative imperative than have weaker theories; (d) are more likely to be accepted as heuristically valuable guides to subsequent exploration by the prevailing community of experts who deal with such matters; (e) tend to have a more precise, and less problematic, ability to describe and/or account for certain phenomena than do weaker theories.

3.17132 However, rigorously developed, a theory is still a belief system that embodies a certain amount of knowledge and has, within limits, a capacity to accurately reflect various facets of experience and/or that which makes experience of such structural character possible.

3.17133 Hypotheses are used to help confirm or refute various dimensions of a theory by stating issues in a narrow fashion that is both capable of becoming actively operational in the form of testable proposition (or set of them), and, as well, is likely to lead to results that provide data that can serve as evidence to help confirm or refute some aspect of a given theory.

3.17134 Theories rarely stand or fall due to the outcome of a single experiment that is devised to test a given hypothesis. Oftentimes, if experimental results are inconsistent with a particular theory, the theory might be revised or re interpreted in order to accommodate the new data.

3.17135 Theories, however, might come into disfavor as the result of a series of contraindications that arise from experimental data. A certain theory also might come into disfavor because there some other theory, seeking to account for similar phenomena and/or data, which is considered, rightly or wrongly, to be more heuristically valuable, in some sense, than is the previously accepted theory. One theory might gain in general acceptance over a competing theory because of the influence of certain centers of learning in setting hermeneutical trends that tend to propagate such perspectives to the next generation of researchers. The popularity of one theory might increase at the expense of a competing theory due to the politics of hiring and publishing. Finally, one theory might gain in ascendency relative to a competing theory because the proponents of one theory die off, leaving the field relatively clear for another theory to establish itself and begin to flourish through the activity of its still living proponents.

3.17136 A paradigm is a theoretical framework that serves as a work in progress that shapes the methodology, experimentation, interpretation, understanding, politics, and education of those who come under its influence. A paradigm is the hermeneutical filter through which certain facets of experience -- and/or that which makes experience of such structural character possible -- are engaged, processed, and understood.

3.172 Some people argue that one cannot derive 'ought' from 'is'. In other words, just because some dimension of experience, and/or that which makes experience of such structural character possible, has a certain nature does not, in and of itself, necessarily warrant the inference that one ought to behave in certain ways that are said to follow, or are derivable, from experience or things being the way they are.

3.1721 Whether, or not, the foregoing contention is correct really depends on the extent to which some form of 'ought' is inherent in the logical character of that which makes experience possible.

3.17211 If there is a dimension of 'ought' to what is, then, there is a directional potential that is built into being and existence.

3.17212 In one sense there is such a directional component inherent in being -- namely, reality is what it is. If one wishes to have any hope of understanding various facets and dimensions of that reality, then, one ought to seek generating hermeneutical spaces that have a structural character that has congruency with the structural character of the aspect of experience to which identifying reference is being made through the hermeneutical space and/or the structural character of that which makes such experience possible.

3.17213 If there are one, or more, dimensions of ought to being, then, this, in and of itself, does not necessitate what one will choose to do with respect to such an 'ought'. Ought is a suggestion with a certain degree of moral direction and force (or warrant) with which one complies or ignores at one's own risk - just as truth, knowledge, and understanding (of whatever kind, and on whatever level) are hermeneutical vectors with a certain degree of moral direction and force (warrant) with which one complies or ignores at one's own risk - the risk one runs in the latter case is ignorance, misunderstanding, error, bias, or the like.

3.18 The primary task of education is to provide a means for individuals to explore, gain facility with, learn how to critique, and generate (or adopt) useful applications as a result of the capacity, and inclination, of human beings to generate hermeneutical spaces. The essence of this generation process is a function of the interplay of the following processes: identifying reference; characterization; the interrogative imperative; mapping operations; and establishing congruencies.

3.19 As such, facts, per se, are less important than understanding the processes that gave rise to, shaped, colored, and oriented those facts. Information, per se, is less important than grasping the structural character of the processes that generated data of such structural character. Facts and information, together with their perceived value or reliability, often change over time, but the general features of the structural character of generating and evaluating the nature of hermeneutical spaces do not change with time.

3.21 Logic is an expression of the manner in which the different, aforementioned components involved in generating hermeneutical spaces are employed by a given intelligence within the context of engaging the phenomenology of the experiential field in the attempt to understand that which makes experience of such structural character possible.

3.211 There are many kinds of logic and one of the challenges with which all human beings are confronted -- and with which education ought to be concerned -- is to try to discover that system(s) of logic is (are) most congruent with, or reflective of, the structural character of various realms of experience, together with the nature of that which makes experience of such structural character possible.

3.3 Education is a medium for learning about the possibilities, problems, and methods that are associated with trying to understand the logical nature or structural character of hermeneutical spaces that arise in conjunction with various kinds of experience, together with that which makes experiences of such structural character possible.

Appendix 2: An Overview of Hermeneutical Field Theory

Prolog

The purpose of this Overview is to provide an introduction, within a relatively short framework, to the basic ideas, principles, and logic that are given expression in hermeneutical field theory, and, as such, there will be aspects of this introduction that stand in need of elaboration and clarification.

This overview consists of 2 parts. These are: (1) a prolog and the main overview section (The present Appendix 2); as well as (2) a glossary of terms (Appendix 3) in which key terms are briefly characterized.

Perhaps, the best way to use this Overview is to flip back and forth among its aforementioned sections according to one's needs and interests at any given instance during one's engagement of the Overview. However, although the foregoing procedure will help one to better understand some of what is involved in hermeneutical field theory, by necessity, an overview will not provide all the information one needs in order to be able to fully understand that which is being overviewed. A deeper understanding will require an individual to carefully study of all the material that is contained within Appendix 1 as well as the primary text of the two volumes that give expression to *Mapping Conceptual Dynamics*.

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The themes and concepts being giving expression through hermeneutical field theory do not fit into a tidy, neat, linear package. These principles form strange attractors.

As such, they are ordered and determinate in character. However, strange attractors generate self-similar determinate processes rather than self-same determinate processes.

The structural character of such self-similarity is often recognizable when encountered, but that structure is, for the most part, not reducible to a convenient set of rules or methodological steps. Consequently, the principles of hermeneutical attractors do not easily lend themselves to being summarized.

One can provide, nonetheless, something akin to the sort of photograph album one puts together after one has taken a trip. The pictures one takes on the trip do not give an accurate, running account of everything that happened on the trip. Furthermore, these pictures do not constitute a record of each of the places one visited.

On the other hand, such photographs do give one a sampling of certain aspects of the trip. Therefore, the photographs can serve as a series of focal points around which a more extended and detailed discussion can take place.

In line with the foregoing comments, the following statements constitute a sort of photographic album. The conceptual snapshots contained in this overview provide one with a sampling of some of the essential themes, issues, questions, and ideas within various aspects of hermeneutical field theory. While the following statements do not exhaust what can be said about this approach to the problems of learning, 'knowledge', and 'understanding', they do provide some guidelines an individual can use as a reference map with respect to some of the conceptual terrain covered during the overview's excursion through the hermeneutics of experience.

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(a) The fundamental text or work with which everyone is preoccupied, either knowingly or unknowingly, is that of individual experience or the phenomenology of the experiential field. The works, intentions and meanings of all human beings reflect, as well as presuppose, the reality of that field. When one attempts to understand the nature and meaning of the contents of experience, one is engaging in the hermeneutics of experience in order to journey toward the absolute metaphysical reality that surrounds, underlies, permeates and extends beyond the realm of individual experience.

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(b) The central issue of hermeneutics is about making sense of experience. One seeks to determine the significance of something in someone else's eyes in order to be in a position to ask the following sort of questions: (1) What is the significance that a work in question has for a given individual? (2) To what extent do individual conceptions of significance (whether one's own conception of that of other individuals) reflect the structural character of that to which such conceptions attempt to give identifying reference? (3) What relevance do individual conceptions of significance have for helping one to understand the structural character, or portions thereof, of the reality that makes possible the sort of experiences through which conceptions of significance are generated?

In order to ask these kinds of questions, one necessarily must be concerned about the extent to which one can understand 'understanding'. One also must be concerned with the extent to which understanding is capable, under the right sort of circumstances, of accurately reflecting or grasping some aspect of absolute metaphysical reality- i.e., that which defines the parameters not only of understanding but of that which engages, or is engaged by, understanding.

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(c) The ultimate goal of hermeneutics is one of seeking to merge -- as much as is possible -- the horizons of an individual's understanding in relation to the horizons of whatever aspect of reality is being engaged.

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(d) Learning is a process through which memories are generated or constructed. Unless the structural character of such memories represents a total fabrication of a given dialectical engagement, memory contains traces of previously encountered horizons. So although, in one sense, horizons are fleeting in character and disappear or recede as soon as one approaches them, in another sense, we, continually, are recording bits and pieces of the horizonal relationships that are being encountered.

Indeed, these bits and pieces of previously encountered aspects of the phenomenology of the experiential field that have been recorded as memory, become part of the ongoing horizonal dialectical relationship. Through recall, one actually can extract horizonal elements, examine them through focal analysis, and, then, by switching focus to some other aspect of experience, return the previous elements to a horizonal status where they will continue to exert a certain pressure or force with respect to on-going focal activity.

Considered as a whole, the horizon is always receding and being displaced. Nonetheless, there is a way for certain aspects of previously encountered horizonal relationships to be temporally deactivated as horizonal components.

When this occurs, these deactivated horizonal components sometimes emerge as components of focal activity. As aspects of focal activity, they can be explored, probed, analyzed, queried, altered, and shaped, before being returned to active duty as horizonal components.

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(e) A further aspect of the interactional dialectic between focus and horizon concerns inferential activity or inferential mapping. In this dialectic, phase relationships are established between, and among, various aspects of the constraints and degrees of freedom of focus and horizon.

During such states of phase relationship, semiotic quanta, sensory quanta and phenomenological quanta are exchanged. These quanta give expression to inferential currents linking focus and horizon in the form of entailment relationships, implicational relationships and inferential relationships.

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(f) The horizon forms one part of a complex, multi-dimensional phenomenological and hermeneutical membrane-manifold. This manifold dialectically links the individual with ontology. This membrane-manifold consists of a spectrum of ratios of constraints and degrees of freedom on a variety of levels of scale.

Furthermore, the hermeneutical membrane-manifold marks the boundary through which focus and horizon together enter into shifting phase relationships with various aspects of the world or with various aspects of the phenomenology of the experiential field. The phenomenological/hermeneutical membrane-manifold is the boundary across which, and through which, there is an exchange of quanta of various kinds (such as: chemical, biological, sensory, emotional, spiritual, behavioral, and semiotic quanta).

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(g) Reflexive awareness does not seem to be reducible to being a function of any of the other components of the hermeneutical operator (consisting of identifying reference, characterization, interrogative imperative, inferential mapping, congruence functions and the already mentioned dimension of reflexive awareness) -- taken either individually or collectively. Reflexive awareness seems, simultaneously, to accompany the other components as it illuminates them, joins them, surrounds them, permeates them, and so on.

Indeed, there is a sense in which reflexive awareness is sort of a glue holding the hermeneutical operator together. In addition, it is a medium through which the various components of the hermeneutical operator communicate with one another or exchange semiotic quanta with one another.

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(h) The various sensory modalities perform different sorts of transform operations by way of the transduction process with respect to the waveforms of incoming stimuli. However, one cannot necessarily argue that the structural character of the post-transformation, transduced form is purely a function of what the transduction transforms bring to the situation. The post-transformation, transduced forms are also a function of the spectrum of ratios of constraints and degrees of freedom that the incoming waveform stimuli bring to the transduction process.

Seen from this perspective, the task of hermeneutical field theory becomes two-fold: (1) to develop a set of qualitative 'equations' that are capable of translating from one inertial framework to another with respect to a given event. This ensures that certain basic principles, laws and so on, are preserved from system to system; (2) to determine whether or not one can make contact with aspects of noumena. If one can accomplish this second aspect, one might be able to use methodology to preserve certain law-like relationships that are not entirely dependent on, or merely a reflection of, methodology.

The idea behind this second aspect is that although methodology puts one in contact with the structural character of a given object, state, event, condition, process, and so on, once one has made contact, there is an exchange of phase quanta. This exchange has the potential for opening one up to an understanding capable of transcending the constraints and degrees of freedom of the methodology that provided one with an opportunity for such access. As a result, one would be in ‘contact’ with, in some sense of this word, at least an aspect of the structural character of noumena in itself.

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(i) Any understanding that is restricted to the confines of the parameters of the horizon and that does not reflect something of that which makes possible a horizon of such structural character is, at the very best, extremely limited in the amount of truth to which it gives expression. In fact, only by gaining access to the truth lying beyond the limits of present horizons can one be said to be expanding one's horizons in any non-arbitrary and legitimate sense.

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(j) Phase transitions and morphogenetic transformations constitute a selection from, or alteration in, the spectrum of ratios that constitute a given structure. Such transitions or transformations occur by means of phase relationship states in which phase quanta are exchanged.

Phase quanta are the carriers of force that bring about a change in the way a given spectrum of ratios gives expression to itself, or that brings about a change in the very character of the spectrum itself. This is done by adding ratios, or taking away ratios, or by modifying the existing ratios in some new way.

Phase quanta represent vibrational modes of temporality. In other words, they are temporal wave forms whose structural character specifies a ratio of constraints and degrees of freedom but that is coded for in terms of phase relationships.

The order field acts on structures by – along with other dimensional means – transmitting its effects through the phase quanta that are the carriers of temporal force. As such, temporal force becomes a transmitter of certain aspects of the underlying order-field (i.e., the structural character of ontology or Being).

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(k) A field manifests itself continuously, but not necessarily in the sense that every point of a given space is under the sphere of influence of that field. The field is continuous because one, or more, of the ratios of constraint and degrees of freedom characterizing that field's structure is (are) being manifested at any given instance of time.

The continuity is a function of how a certain latticework of order manifests itself and preserves itself across time. This does not necessarily require the latticework to be able to express itself at any given point of space.

Inference is not necessarily about truth. Essentially, it is about the issue of continuity. That is, inference is about: (a) what links one idea with another; (b) the way this continuity manifests itself, and (c) the degree to which it manifests itself. Consequently, inference really is about the process of proposing, or seeing, mappings that one believes accurately describe the structural character of the phase relationships between one focal/horizonal point and other such points.

Hermeneutical strings, sheafs, and fiber bundles all might be different ways of referring to how inferential mappings operate. A hermeneutical string, for example, might refer to the compressed or focused character of the set of ratios of constraints and degrees of freedom constituting a single phase relationship.

Hermeneutical fiber bundles, on the other hand, might be thought of as a group of phase relationships or hermeneutical strings that have a common focus or common set of linkages. Thus, the fiber bundle represents a set of multiple mappings that interact to strengthen the proposed phase relationships between one point-structure (neighborhood, lattice or latticework) and other such point-structures (neighborhoods, lattices or latticeworks). As such, a fiber bundle, under normal circumstances, constitutes a stronger argument than does a hermeneutical string. Of course, this will not be the case if a hermeneutical string gives expression to a better insight than does a given fiber bundle. The latter might be powerfully coherent but, nonetheless, it could be incorrect or less accurate relative to a given hermeneutical string.

Finally, hermeneutical sheafs might be construed as a way of organizing a variety of hermeneutical strings and fiber bundles in order to 'cover', or account for, the structural character of a given aspect of the manifold of the phenomenology of the experiential field. In this sense, hermeneutical sheafs give expression to models or theories.

However, the perspective of hermeneutical sheafs is in terms of the way that a model or theory is held together by a set of phase relationships between, and among, a variety of point-structures, neighborhoods, lattices and latticeworks with the purpose of 'covering' the phenomenological manifold. Therefore, the perspective of hermeneutical sheafs looks at a model or theory in terms of the inferential mappings that lend a theory or model its structural character or logical qualities.

Seen from the foregoing perspective, entailment exists when one can show that the structural character of the continuity that links two (or more) point-structures, neighborhoods, or latticeworks, has a particular kind of vectored mapping character. More specifically, in order for entailment to be present, one must be able to show: (a) the structural character of, say, a given point-structure is largely shaped and determined by the structure(s) with which it is linked through mapping; and (b) the reverse is not the case. Under these circumstances, one would say the point-structure being shaped and determined is entailed by the structure(s) that is doing the shaping and determining Therefore entailment suggests a vectored component to the mapping process.

The last five or six paragraphs all tend to point in the same general direction with respect to the structural character of logic. In effect, logic is the study of continuity, structural form, and mapping relationships.

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(l) If one characterizes entropy in terms of the ratio of constraints to degrees of freedom in a given context, then one can speak of the entropy spectrum for a structure. Such a spectrum constitutes the envelope of ratio values that are possible for that structure under a variety of circumstances ... whether induced or spontaneously manifested.

In general terms, if there is a change in the ratio of constraints to degrees of freedom for a given structure, then there has been a change in the entropy character of that structure. Or, said slightly differently, another aspect of the structure's entropy spectrum has been manifested.

If the nature of the ratio change is to shift the manifestation of the structure's entropy spectrum in the direction of more constraints relative to degrees of freedom, such a change is said to constitute an increase in the entropy of the structure. This is so since -- relative to the entropy state prior to the change in question -- the structure is less able to give expression to its degrees of freedom. This is comparable to the case in traditional thermodynamics when an increase in entropy is marked by a decrease in the free energy of the system, together with an increase in the bound energy of the system.

One should note that neither an increase in entropy, nor a decrease in entropy, affects the 'order' of the structure or system undergoing a transition in the way the entropy spectrum is being manifested. Ordered is a reflection of the fact that there is some kind of ratio of constraints to degrees of freedom.

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(m) One can measure the continuous mapping of the lines of force between oppositely charged poles in an electrical field by inserting into the field a test probe that is connected to one of the poles. This test probe allows one to derive an indication of the electrical potential that has been created at the point of insertion.

Similarly, one can sample something of the flavor or character of the continuous mapping of the lines of force that have been generated between a given focus and horizon by inserting into the phenomenological field a test probe. This probe is rooted in one, or the other, of the poles of focus or horizon. The probe permits one to derive an indication of the hermeneutical or phenomenological potential that has been created at the point of insertion.

In the context of hermeneutics and phenomenology, the character of the test probe will come in a variety of forms. These include: questions; emotionally charged issues; conceptual structures capable of eliciting, evoking or inducing various kinds of response; appropriate sorts of sensory stimuli; language structures; motivational vectoring, and so on.

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(n) Reflexive awareness, identifying reference, characterization, the interrogative imperative, inferential mapping, congruence functions, and emotions are all vector quantities. Experiential intensity is a scalar quantity.

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(o) An order-field is generated through the dialectic of a set of dimensions. The structural character of these dimensions is an expression of a spectrum of various ratios of constraints and degrees of freedom that have been established through that order-field.

An order-field induces different aspects of the spectrum of ratios to engage one another. The ensuing engagement generates a further spectrum of ratios that give expression to the character of the dialectic between, or among, different dimensions. This dialectic of dimensions generates, in turn, a further spectrum of ratios of constraints and degrees of freedom that give expression to point-structures, neighborhoods, and latticeworks on different levels of scale.

At the heart of any field theory (whether it is rooted in: Faraday's idea of a force, or in Maxwell's model of the mechanical ether, or in the geometry of Einstein's general theory of relativity) is an antagonism to the concept of Newton's idea of action-at-a distance. Field theories are all predicated on the principle that the dynamics of the field, the dialectical activity of the field, is a function of contiguous events. Field theories differ from one another in the manner in which they attempt to account for the structural character of the contiguous relationship among various aspects of the field and how effects are propagated through the field by means of such contiguity.

Consequently, an order-field constitutes a field due to the way the order has contact, in some sense, with, or is contiguous with, each aspect of the fundamental dimensions that have been established. The order-field also gives expression to field properties through the way it has contact with the dialectic that it induces in these basic dimensions, and from which emerge various point-structures, neighborhoods, and latticeworks.

All of this contact is accomplished through the spectrum of ratios of constraints and degrees of freedom out of which dimensionality and dialectical activity initially arise. Thus, the order-field is present at each and every point of these spectrums, on whatever level of scale one cares to consider -- from the microcosmic to the macrocosmic. This presence manifests itself as a field that organizes, arranges, shapes, directs, orients and generates all structures and structuring activity.

The order-field is continuous in the sense that a relay race is continuous. In other words, despite the presence of discrete elements (i.e., the runners for the different teams competing in a race), these elements are organized or arranged in such a way that one or more of the runners is always running throughout the race ... although not all the runners will be running at any given instant during the course of the race.

The integrity of the continuity of the race is preserved because of the way the runners, taken as discrete elements, are ordered within the context of the rules governing the running of the race. The primary characteristic of this ordering is that there should be an overlapping of one discrete element with another discrete element at different points of the race. This is the region within which the baton is passed on from one runner to the next.

Similarly, an order-field is continuous because the spectrum of ratios on any given level of scale will always be giving expression to one or more particular instances of the ratios that form that spectrum. Moreover, there is an overlapping of events that occurs between the expression of one ratio and a subsequent expression of another ratio drawn from the same spectrum.

This region of overlap is contained either in the phase relationships linking the two ratios that are being expressed, or it is contained in the mere contiguity of the events. In either event, as one ratio, for whatever reason, ceases manifesting itself, then other ratios will spontaneously, or be induced to, manifest themselves, even though there might be no causal link between, or among, such contiguous events.

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(p) On a given level of scale, a particular ratio of constraints and degrees of freedom expresses itself as a point-structure. A group of related ratios manifest themselves as a structural neighborhood.

In a hermeneutical context, neighborhoods tend to build-up (e.g. through learning and memory) around points of phenomenological engagement to which attention is directed and identifying reference is made. Indeed, attention and identifying reference mark the beachhead landing of the hermeneutical operator with respect to various aspects of the phenomenology of the experiential field. Whether -- and, if so, to what extent -- a neighborhood will bind the hermeneutical operator or whether the hermeneutical operator will remain relatively unbound will be a function of the dialectical engagement between (or among) the hermeneutical operator and a given neighborhood or neighborhoods.

Hermeneutical point-structures are not geometric points. In other words, they are not necessarily simple in character. Thus, unlike geometric points, hermeneutical point- structures cannot be construed as necessarily lacking an internal structure.

A point-structure is a ratio of constraints and degrees of freedom giving expression, when taken all together, to a form that can have multiple facets and themes. This suggests a potential for complexity of structural character.

A further flavor of complexity comes from the fact that what is a point-structure on one level of scale, could, on another level of scale, give rise to a neighborhood of point-structures or even a variety of latticeworks. As such, point-structures have the capacity to manifest fractal-like properties when engaged on different levels of scale.

Latticeworks are the result of a collection of neighborhoods that are held together by a set of phase relationships. These phase relationships establish identifiable patterns of activity, as well as identifiable patterns of horizonal boundaries, within which the collection of neighborhoods interact with one another.

Ratios of constraints and degrees of freedom are related to one another by means of phase relationships. In other words, ratios are linked to one another by a spectrum of constraints and degrees of freedom that establish parameters within which phase quanta are exchanged between interacting ratios. Phase quanta are discrete arrangements of constraints and degrees of freedom that are drawn from the spectrum of arrangements that are possible in the context of interacting point-structures, neighborhoods, and/or latticeworks.

At any given time, if two point-structures, neighborhoods or latticeworks are linked to one another, the structural character of the link is an expression of one aspect of the spectrum of ratios that is generated by the underlying dialectic of dimensions. When such a link manifests itself, this is known as a phase quanta exchange. This exchange gives expression to a state known as a phase relationship.

Thus, the phase relationship state encompasses the following sequence of activity. (a) It begins with first engagement of specific ratios; (b) proceeds through phase quanta exchanges; (c) includes the alteration of the ratio character of the point-structures, neighborhoods and/or latticeworks involved in the engagement process; and, (d) ends with the disengagement of previously interacting ratios.

Both the process of phase quanta exchange, as well as the state of phase relationship in which that exchange is embedded, are subject to the influence of differential, vectored pressure components. Sometimes the structural character of the way these vectored pressure components interact is complex. When this is the case, these components give expression to tensor components that constitute a source of stresses capable of simultaneously pushing, pulling, twisting and stretching any given phase quanta exchange or phase relationship state.

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(q) Suppose one has a set of homeomorphic analog mapping latticeworks that preserve the invariance or symmetry of the laws or principles of understanding independently of the state of dialectical engagement of any given hermeneutical observer with respect to some given event or phenomenon. Such a set constitutes a continuous hermeneutical transformation group.

The methodology of special relativity theory might be a special limiting case of the more general principle of hermeneutical relativity. This principle is directed toward establishing invariance of structural character in the context of dialectical engagement of ontology by a number of different observational frameworks.

One encounters the social community of knowers and interpreters in the context of the continuous hermeneutical transformation group. In order for the invariance or symmetry of a given law of understanding to be preserved, one must establish congruence with that which makes phenomena of such structural character possible.

For the various hermeneutical latticeworks of different observers to be analogs of one another, is not enough. They also must preserve symmetry through generating congruence functions in relation to the structural character of the phenomenon to which all observers are making identifying reference. To demonstrate that these different frameworks are analogs for one another is significant but only in the context of each hermeneutical framework having established defensible congruence functions with respect to some aspect of the structural character of ontology.

At the same time, through the dialectic between, or among, different hermeneutical frameworks, members of the community can work toward uncovering facets of invariance in different aspects of the structural character of reality or ontology. In this sense, the hermeneutical activity of the community -- considered as a whole -- takes on the form of a hermeneutical operator. This operator engages the point-structure products generated by individuals through the activity of the latter's own hermeneutical operator.

In other words, the hermeneutical activity of the community as a whole establishes a latticework in which the hermeneutical activity of individuals forms complex point- structures or neighborhoods (in the case of a number of people whose hermeneutical positions are similar but not entirely the same) within that community latticework. Thus, the hermeneutical activity of the community is an expression of the hermeneutical operator considered from a different level of scale than that of the individual ... and there might be either self-same or self-similar linkages between the two levels of scale (i.e., the individual and the community).

All of the basic components inherent in the individual's hermeneutical operator also are inherent in the community run hermeneutical operator. Furthermore, just as one finds different kinds of attractors on the individual level of scale, one also finds various kinds of attractors on the community level of scale.

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(r) The hermeneutical coupling constant is an index of: (a) the way a given structure's spectrum of ratios of constraints and degrees of freedom holds together as an integral unit; (b) the way a given structure's spectrum of ratios can either spontaneously manifest different aspects of its spectrum of ratios, or be induced to manifest different aspects of its spectrum of ratios. Each structure has its own, unique coupling constant. This constant differentiates that structure's spectrum of ratios from the spectrums of the set of ratios of constraints and degrees of freedom that give expression to other kinds of structures.

If a given structure loses its coupling constant, the integrity of that structure is violated and it will no longer manifest itself in characteristic ways. A structure whose coupling constant has been disrupted will no longer manifest itself in terms of the spectrum of ratios that normally establish the set of parameters within which, and through which, and by which that structure's character is given expression.

Structural character is a function of the following elements or aspects: (a) the ratio of constraints and degrees of freedom; (b) the pattern of the emphasis/de-emphasis format of phase relationships that give expression to a particular ratio of constraints and degrees of freedom; (c) the orientation of a phase relationship as a manifestation of the property of hermeneutical isomerism; (d) the coupling constant that brings together, and maintains, the components of (a), (b) and (c) as a spectral character of one sort, rather than another. The coupling constant is a function of the dialectic of the dimensions that has been set in motion by an order-field.

One of the tasks of hermeneutical field theory will be to identify those spectra of ratios of constraints and degrees of freedom in which, despite undergoing a variety of local gauge transformations, nonetheless, remain invariant with respect to structural character. In other words, some of the phase relationships, which give expression to the various ratios of a particular spectrum, will undergo phase shifts or phase transitions, and such phase shifts will alter the character of the ratio of which they are apart.

Despite these phase transitions and despite the concomitant alteration in some of the ratios of the spectrum being considered, the structural character to which the spectrum gives expression remains, largely, intact and conforms to the law of structural identity. This occurs when one can identify the post-transformational structure as being, effectively, the same structure as existed prior to the transformation.

The more complex a structure is, the more allowances one has to make for the degrees of freedom exhibited by the structure as a result of either spontaneous activity, induced activity or the dialectic between spontaneous and induced activity. Seen from this perspective, the fact certain phase relationships or ratios of constraints and degrees of freedom are not preserved across transformations (whether spontaneous, induced or dialectical) is not evidence that symmetry, with respect to structural character, has not been preserved.

In fact, just the opposite might be the case. Such alterations in ratios might be part of the fluidity or flexibility of a given structure's character.

Consequently, part of the task of hermeneutical field theory is to differentiate between critical instances of symmetry failure and noncritical instances of symmetry failure. In a sense, a given structure can go through a multiplicity of states as various phase relationships undergo phase transitions. As long as these phase transitions are of the non-critical variety, then symmetry is preserved with respect to the structure's coupling constant character.

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(s) The hermeneutical operator or semiotic quantum is an intrinsic part of the phenomenology of the experiential field. Indeed, it gives expression to the "curvature" of the different levels of scale of the n-dimensional character of the phenomenological manifold.

When the hermeneutical operator generates a structure that accurately reflects some aspect of the phenomenology of the experiential field or some aspect of ontology that makes an experiential field of such character possible, the hermeneutically-generated structure has zero curvature. That is, the structure does not distort what it reflects.

When the structure that is generated does not accurately reflect the structural character of that to which identifying reference is being made, then, the curvature of the phenomenology of the experiential field, due to the presence of such distorting semiotic quanta, will be some non-zero quantitative and/or qualitative value. The greater the degree of distortion, the greater will be the magnitude of the non-zero curvature value.

A hermeneutical gauge field is unique in the sense that the hermeneutical gauge is itself a field. In fact, a hermeneutical gauge field is a field within a field.

More specifically, the hermeneutical operator is a semiotic quanta that generates a hermeneutical gauge field. The properties, characteristics, strength, orientation, and so on, of the hermeneutical gauge field are a function of how the 6 components of the semiotic quanta (i.e., the 6 dimensions of the hermeneutical operator – namely: identifying reference, reflexive awareness, characterization, interrogative imperative, inferential mapping, and congruence functions) dialectically playoff against not only one another, but with the phenomenology of the experiential field as well.

The depth of penetration of the semiotic quanta as a carrier of force is a function of the focal/horizonal dialectic. Usually, however, this depth of penetration is limited to just one or two levels of scale at any one time. The range of the semiotic quanta depends on the quality, complexity and number of horizonal features that are drawn into, or become projected onto, a given instance of focal activity.

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(t) The various aspects of the semiotic quantum (such as reflexive awareness, identifying reference, characterization, etc.) are comparable to a complex form of isotopic spin. The proton and neutron are alternative versions or states or expressions of a single particle known as a nucleon that, depending on its internal spin characteristics, will manifest itself either as a proton or as a neutron. Similarly, the semiotic quantum is an phenomenon that, depending on its internal spin characteristics, will manifest itself in different ways.

However, the internal spin characteristics of the semiotic quantum are far more complex than is the case for the isotopic spin of the nucleon. The character of hermeneutical isotopic spin is like a tensor matrix in which the individual cells of the matrix weave together covariant, contravariant and transvariant currents from the other five aspects, orientations or spin states of the semiotic quantum.

The term "transvariant tensor" is a term that has been coined in order to be able to refer to multi-dimensional tensions, stresses, and dialectical activity that modulate the ratio of constraints and degrees of freedom of a given orientation of the hermeneutical operator. However, these transvariant tensors do not conform to the characteristics of neither a covariant tensor nor a contravariant tensor or a mixed tensor of the usual sort in mathematics. Among other things, they are nonlinear in character.

This dialectical process of weaving together the different currents of the hermeneutical operator takes place in a context of specific experiences, ideas, values, beliefs, actions, desires, emotions, motivations, needs, sensations, and so on. With the passage of time, there is a stream of semiotic quanta.

Individual semiotic quanta are generated through focal/horizonal dialectical activity. Said in another way, focal/horizonal dialectical activity is the gateway through which semiotic quanta are emitted.

Focal/horizonal dialectical activity is rooted in the phenomenology of the experiential field. However, because the hermeneutical field is embedded in the phenomenological field as a potential for structure, this potential is activated, or turned on, in one of two cases: (a) inducement and (b) spontaneously.

In the former case, semiotic quanta are generated or released when certain thresholds of the phenomenology of the experiential field are surpassed (much as happens with the photoelectric effect when incoming photons sometimes cause electrons to be emitted as a result of raising the energy level of the electron). Such thresholds do not exist just with respect to sensory stimuli, they also exist with respect to issues such as: motivation, memory, fantasy, interests, likes, dislikes, and so on.

On the other hand, when semiotic quanta are spontaneously generated or released, this is an expression of an underlying attractor (whether indigenous or learned) which aperiodically releases semiotic quanta in a self-similar manner. Such spontaneously generated semiotic quanta can lead to shifts in attention as choices are made from among a group of horizonal candidates.

In the spontaneous process of transition in the orientation of intentionality, once the semiotic quantum arises, an investment is made in a given horizonal attractor, while investment is withheld from other horizonal attractor candidates. The selection of investment venue is made on the basis of a series of brief dialectical interludes (a sort of mini-sampling process) with different horizonal attractor candidates.

This interaction brings together a number of dimensions such as: time, space, materiality, energy consciousness, will, and understanding. However, the primary variable of the semiotic quanta concerns the hermeneutical operator that is rooted in the dimension of understanding.

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(u) A gauge, in field theory, refers to a standard of measurement capable of undergoing change as a result of being transported to different points of the field. If the value of measurement of the gauge changes during the process of transportation, such changes are said to be due to the effect of the field on the gauge.

For example, since a field gives expression to a vectored quantity, the strength of the field has the capacity to register on the gauge both with respect to magnitude of intensity as well as with respect to orientation or direction of that intensity. Therefore, if one's measurement gauge is a dial that contains a pointer, then the pointer will take on different orientations -- depending on, say, the varying strength of the field -- as a gauge is moved about the field.

Any field capable of bringing about the foregoing sorts of changes in the gauge, as the latter is transported about the field, is known as a gauge field. A gauge field involves the dialectic between a measuring methodology and a given ontological field.

A gauge field incorporates a set of rules and/or principles permitting one to describe, as well as keep track of, the transitions undergone by the gauge. This property of the gauge field enables one to make comparisons of, for example, the strength of the field at different points in that field.

The hermeneutical operator's dialectical engagement of the phenomenology of the experiential field satisfies the conditions that indicate the presence of a gauge field. In short, the dialectics of this engagement involve a standard of measurement capable of being affected by variations in the strength (both qualitative and quantitative) of the field through which the gauge is moved. Moreover, the hermeneutical gauge operates according to a set of rules or principles that permit one to describe and keep track of changes in field strength as the gauge is transported about the phenomenological field.

However, the hermeneutical gauge is not just a passive recorder of fluctuations of the phenomenological field. The hermeneutical gauge also is capable of actively operating on that field and generating interpretations of the significance or meaning of the changes in field strength that are registered. Consequently, as is the case with any mode of measurement (but especially in light of the active, interpretive, projective character of the hermeneutical operator), the hermeneutical operator is capable of distorting the structural character of that which is being measured.

In line with the foregoing comments, one might suppose there will be something like a Humpty-Dumpty Effect in the context of hermeneutical field theory. In other words, as a result of the impact of ontology on methodology, as well as a result of the impact of methodology on ontology, fracture zones or zones of stress will emerge in the realm of understanding.

More specifically, where the manifold of methodology comes into contact with the manifold of 'reality', the stresses, forces, frictions, limitations, and so on, occurring as a result of the dialectic of these manifolds, will prevent perfect congruencies from being established. Consequently, on one or more levels of scale, there will be lacunae and/or stress bumps that act as obstacles to a total merging of horizons.

In fact, the limitations that, inevitably, are inherent in any given methodology, have a distorting, squeezing, pinching, and/or shearing effect on the congruency process. This is because of the tendency of such methodologies to try to impose a structural character onto an aspect of reality that does not really fit.

This attempt to force-fit reality into preconceived categories -- of whatever description -- causes the hermeneutic of the phenomenology of the experiential field to develop wrinkles, bumps, lacunae, and so on. These get in the way of achieving a complete congruency relationship or merging of horizons.

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(v) During the hermeneutics of experience, dissipative structures arise when problems are generated in relation to: reflexive awareness, characterization, identifying reference, the interrogative imperative, inferential mappings and congruence functions. One of the primary modes of creating conditions conducive to dissipative structures is through the interrogative imperative.

The interrogative imperative has the capacity to push a given hermeneutical context, which previously had exhibited dynamic equilibrium, too far from equilibrium conditions. Dissipative structures might arise out of these far from equilibrium conditions In time, these dissipative structures might serves as seeds for the development, construction, generation or emergence of new hermeneutical attractors.

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(w) An individual's temporal identity gives expression to both biological rhythms, as well as, hermeneutical rhythms. Indeed, temporal identity is a manifestation of the structural character that is generated, in part, by the dialectic of biological and hermeneutical rhythms.

In addition, temporal identity consists of oscillating ratios of constraints and degrees of freedom. These oscillating ratios are generated by the different levels of scale of dimensional dialectics that give expression to a human being.

One way to construe brain activity is in terms of the way such activity helps generate a variety of attractor basins of varying biological rhythms. These basins are capable of shaping behavioral currents involving: motivations, emotions, sensations, dreams and so on.

Thus, early in life, intrinsic or innate attractor basins dominate focal activity and form the primary components of the horizon of focus. As the individual develops, focal activity that is not a strict function of the intrinsic biological attractors begins to take on an increasingly active role across a wide range of issues and situations.

As a result, the hermeneutical operator begins to pick up steam and generate a variety of hermeneutical themes, attractor basins, and so on. These also become part of the horizon.

Consequently, part of the maturational process shows a change in the ratio of purely biological rhythms to hermeneutical rhythms. This change in the ratio of hermeneutical to biological rhythms might be reflected, to some extent, in various stages of development.

By and large, however, these later emerging attractor basins are overshadowed by already existing attractor basins. These already existing attractor basins tend to have a hefty amount of inertia associated with them.

On the other hand, the new attractor basins often have the advantage of improving the heuristic quality of the individual's dialectical interaction with the environment. This is accomplished by extending and deepening the individual's range of competent interaction with the environment. Moreover, these new attractor basins frequently provide the individual with a series of strategies that provide better, faster, as well as more satisfying ways of approaching and resolving a whole host of issues and problems.

Consequently, the old and new attractors compete, in a sense, for the attention of focal activity. The process of transition from one developmental stage to another reflects this competition. In addition, the process of transition reflects the changing character of the way focal activity orients itself toward, as well as permits itself to be influenced by, the aforementioned competing attractor basins.

Ideally, the attractor basins that become dominant will be those that are most efficient, heuristically valuable, and far-reaching in their capacities to solve problems or deal with the world. However, the inertia of already existing attractor systems must be overcome in the process, and this does not always occur, for any number of reasons.

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(x) If one wants to: establish, dialectically engage, preserve, question and/or, eventually, improve upon any given set of ideas or values, one must generate hermeneutical mapping algorithms. These algorithms are capable of arranging or combining the six basic hermeneutical operations into a methodological latticework that can be applied to the phenomenology of the experiential field.

The hermeneutical operator is an analog for Mandelbrot's function: $f(x) = x^2 + c$. As such, it is capable of generating attractors whose boundary properties will depend on: (a) the experiential seed values that are fed into the operator, together with (b) the hermeneutical orientation and character of the algorithm that has been constructed by the individual. The latticework generated by applying the hermeneutical mapping algorithm to the phenomenology of the experiential field is the hermeneutical counterpart to the notion of a path or orbit in dynamical systems.

Hermeneutical mapping algorithms also are recursive. In other words, the products generated by applying hermeneutical operations can be fed back into the hermeneutical algorithm. This recursion process alters the character of the way the algorithm operates on future point-structures in the phenomenology of the experiential field.

Hermeneutical orientation, together with that to which a given orientation is making identifying reference, constitute the two ends of the mapping process that is being constructed through, in part, the operational activity of the algorithm. The mapping itself is an expression of the dialectic between, or among, the phase relationships of the latticeworks involved in the dialectical engagement process.

In the hermeneutical algorithm each of the operational components contributes to the overall structural character of the algorithm by giving expression to envelopes of constraints and degrees of freedom. These envelopes establish a latticework of phase relationships that will engage the 'object', event or condition in a way that is characteristic of that operational component.

Thus, the character of an interrogative latticework is to induce questions about phase relationships and structural themes. On the other hand, the character of the inferential function latticework is to lay down tentative links between, or among, different aspects of one or more point-structures. Each of the other components of the hermeneutical operator has, as well, features that are uniquely characteristic of those components.

However, one must not forget that these operational latticework components cannot really be separated from one another. They are dialectically entangled. As a result, each component forms part of the horizon of the other components. Therefore, they modulate, vector and tensor (in a hermeneutical, not a mathematical, sense) one another on a constant basis.

All of these operational components constitute complex point-structures in the larger, whole, integrated latticework of the hermeneutical mapping algorithm. Thus, one has latticeworks within latticeworks. Indeed, one could discover new point-structures and latticeworks as one went either up or down across various levels of scale.

The basic function of the hermeneutical mapping algorithm is to generate phenomenological structures capable of reflecting, in analog fashion, the structural character of various aspects of ontology being engaged. The hermeneutical mapping algorithm is a methodological means of working toward the unraveling of certain ontological structural themes that are given expression through the phenomenology of the experiential field. A hermeneutical algorithm is successful to the extent it terminates in a merging of structural horizons between: (a) understanding and (b) that to which the understanding is making identifying reference in the phenomenology of the experiential field, as well as that which makes something of such phenomenological structural character possible.

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(y) Any ratio of constraints and degrees of freedom gives expression to an attractor. The dialectical character of such a ratio determines the properties of the attractor basin or sphere of influence that has arisen as a manifestation of the attractor.

Therefore, hermeneutical structures -- which can be constructed in terms of a complex dialectic of various ratios of constraints and degrees of freedom -- give expression to attractors and, therefore, attractor basins. Some hermeneutical structures form fixed-point structures. Other hermeneutical structures form limit-cycle attractors, while still other such structures form chaotic attractors.

In general terms, there is a dynamic dialectic occurring along the boundaries that emerge among two or more hermeneutical attractor systems. Each attractor has a basin.

This basin serves to shape and orient the forces that are characteristic of that attractor. The basin gives expression to the vectored and tensored components that establish the parameters marking the outer limits of the hermeneutical attractor's sphere of influence.

Not all dynamical systems are governed by just one state of equilibrium. Some systems have two equilibrium states, and others might have more than two states of equilibrium. This is especially true in the case of hermeneutical systems.

Each equilibrium state constitutes an attractor, and each attractor gives expression to a set of boundary properties. Where two or more attractors come together, the boundary separating them can be, but might not be, both complicated and turbulent.

Moreover, even if the long-term character of a given instance of dialectical interaction is not chaotic, chaotic properties might surface along the boundary regions separating one hermeneutical attractor basin from another. As a result, predicting the direction in which the system will go can become extremely difficult.

Consequently, the study of hermeneutical attractor fractal basin boundaries is like its counterpart in nonlinear dynamics. Each of these is concerned with the phase transitions occurring at certain threshold values along the boundaries of interacting hermeneutical basin attractors, as one goes from laminar flow to catastrophic behavior to a final, non-chaotic equilibrium state.

In a sense, constraints and degrees of freedom have a sort of yin and yang relationship. Just as there are constraints within a set of degrees of freedom, there are degrees of freedom within a given set of constraints. In this respect, one really cannot separate the ratio of constraints and degrees of freedom. The integrity of a latticework's structural character requires both.

Indeed, the yin/yang relationship of constraints and degrees of freedom is reminiscent of the relationship between information and noise that Mandelbrot discovered in relation to messages communicated over telephone lines. As a result, irrespective of the level of scale through which one engages a given structure, there will be a ratio of constraints and degrees of freedom that gives expression to the character of that structure.

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(z-1) Any methodology involves, as part and parcel of its being a methodology, a means or technique for locating or establishing a point of origin or a reliable point of reference. Such a point of reference is one that is rooted in the structural character of reality or that reflects an aspect of that structural character.

Through this point of reference, one can locate or orient oneself in relation to a wave's or latticework's (considered as a complex or compound waveform structure) current expression of its phase spectrum. As long as one's methodology is unsuccessful in establishing this referential point of engagement, one will have no means of locating, identifying, determining or establishing what the phase spectrum of a latticework is.

Moreover, one will have no means of determining where one is in that phase spectrum when one experientially engages that latticework. In addition, if one selects an incorrect, distortive or problematic point of reference as a basis through which to engage a given latticework, the difficulties surrounding the initial selection process will be transmitted throughout the whole subsequent engagement and orientation process.

Symmetry relationships in a given coordinate system reflect, or are alleged to reflect, the structural character of some aspect of ontology or some aspect of the phenomenology of the experiential field, or both, to which the coordinate system is making identifying reference. Consequently, there will be tensors on each side of the hermeneutical equation that purport to reflect congruence between ontological and hermeneutical/phenomenological structures.

One side of the hermeneutical tensor equation consists of the aspect(s) of ontology that help make possible an experience of a given structural character. The other side of t hermeneutical tensor equation consists of the aspect of understanding/orientation that the individual has with respect to, or has toward, the aspect of the phenomenology of the experiential field to which identifying reference is being made.

The tensors on each side of the equation must have the same structural character. If this is not the case, the equation will have limited epistemological value or meaning. This is so since the equation will not give expression to a tenable, if not accurately reflective, relationship between certain aspects of the ontology and the hermeneutics of the phenomenology of the experiential field that are being linked through the hermeneutical tensor equation.

Thus, hermeneutical applications involving the idea of tensors is a matter of seeking symmetry -- that is, relationships of invariance -- that are preserved across different contexts of change and transformation. In the hermeneutical frame of reference, these contexts do not necessarily represent geometric coordinate-ordinate systems. Nonetheless, one needs to discover tensors with structural characters that remain invariant as one moves from the context of the phenomenology of the experiential field to the context of ontology to which that phenomenology is making reference but that is, to some extent, independent of that phenomenology.

In other words, hermeneutics involves, among other things, a study or exploration of the structural character of the properties of change occurring in, and around, a structural-point expression of, or the neighborhood of an aspect of, the phenomenology of the experiential field. This exploration is done in an attempt to determine the structural character of the forces of stress, strain and so on that are being exchanged with different aspects of ontology.

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(z-2) There are two different kinds of bijective mapping that are possible. One kind of bijective mapping is between: (a) a neighborhood of the experiential/phenomenal field, and (b) a given neighborhood of noumenal points along the boundary structure separating phenomenological neighborhood point-sets from noumenal neighborhood point-sets.

One must keep in mind here, however, that the idea of "separation" is dialectically complex. As a result, one is not always in a position to distinguish where the phenomenal neighborhood leaves off and the noumenal neighborhood begins. This first kind of bijective mapping emphasizes the role of the merging of horizons as well as the removing of methodological veils interfering with the establishing of such bijective mappings.

The other kind of bijective mapping is between two different neighborhoods of experiential or phenomenal points such that one neighborhood is mapped onto the other by means of imagination. In other words, the hermeneutical operator is in its projecting/construction mode rather than in its merging mode.

Naturally, there can be various kinds of combinations of the two sorts of bijective mapping. However, the more the ratio of the two kinds is dominated by the projection mode rather than the merging mode, the more will the individual be removed from a true understanding of either phenomenology or that which makes phenomenology of such structural character possible.

Consequently, all methodology constitutes a mapping process that attempts to establish various degrees of homeomorphism between phenomenal and noumenal neighborhoods. Difficulties arise, however, when: a given methodology identifies a phenomenal neighborhood as a noumenal neighborhood and, therefore, assigns an incorrect set of boundary parameters to that phenomenal neighborhood of points.

Although the ideal case in hermeneutics or epistemology would exist when a homeomorphic relationship held between two structures, one is not likely to achieve the ideal in very many, if any, cases. One reason for this is that, with the exception of all but the simplest issues, the ontological context tends to have an inherently richer structural character than does the hermeneutical context.

Often times, the most one can hope for is to establish congruence functions. In a sense, congruence involves a special, limited case of homeomorphism in which only certain key or essential neighborhoods are linked together through mapping relationships.

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Appendix 3: Glossary of Terms

The terms appearing in the following glossary do not exhaust the variety of ideas appearing in the previous pages. However, the terms in the glossary do encompass many of the concepts that give expression to structural currents that are at the heart of hermeneutical field theory as conceived of in the present overview.

Moreover, one should keep in mind that the descriptions associated with the different terms in the glossary are not intended as definitions in any self-contained and definitive sense. The descriptions are characterizations that serve as a starting point for further exploration, analysis and elaboration. The glossary is intended as a convenient means of keeping track of, and reference guide for, some of the structural themes that play a key role in different facets of hermeneutical field theory.

Finally, although some of the terms in the glossary are similar to various mathematical and scientific concepts, there also are significant conceptual differences that are being introduced into the terms in the glossary. These differences modulate, if not considerably alter, the original mathematical and/or scientific ideas on which some of the terms of the glossary are modeled. These differences reflect the structural character of the role that such terms play in hermeneutical field theory.

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Analog: A reflectively representing some other point-structure, neighborhood or latticework by preserving essential phase-relationships and structural themes inherent in the latter and despite differences in the character of the medium through which the respective point-structures, etc., are given expression. Usually, an analog structure is considered to be a discrete representation of a continuous phenomenon. However, given that all structures are marked by one or more principles of continuity that couple together the different components or facets of the structure and, thereby, permit the structure to maintain its integrity across time and various transformations, the extent to which anything is truly or purely discrete is open to question. In any event, in the context of the present dissertation, the issue of discreteness tends to fade into the background and emphasis is placed on the features that permit certain kinds of mediums to be able to preserve the phase relationships of neighborhoods and latticeworks that are integral to the character of different structural mediums.

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Angle of orientation: Refers to the structural character of the hermeneutical perspective through which a given experiential engagement is undertaken. Relative to the structural character of what is being engaged, the interpretive perspective, through which the engagement takes place, intersects that which is being engaged from a certain hermeneutical direction and on a certain level of scale. Thus, in a sense, the point of engagement or structural intersection forms a kind of conceptual or hermeneutical angle of orientation for the individual who is undergoing the engaging process.

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Attractor: A system with the capacity to draw events, objects or processes falling within the sphere of influence of that system along certain structural currents that are characteristic of that system. Such currents might tend toward: (1) a single, static point or state of resolution; (2) a set of two points between which the system oscillates; (3) a multiplicity of points that form an envelope of values giving rise to behavior that is self-similar, rather than self-same, in nature and, as a result, the system never settles down to any simple, linear system of equilibrium.

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Chaotic: The quality of being governed by one or more attractor systems that are: (1) nonlinear with respect to the dialectical processes that link, by means of phase- relationships, the point-structures, neighborhoods and/or latticeworks within the sphere of influence of such an attractor system, but are (2) determinate with respect to the character of the envelope or boundary structure of self-similar modes of manifestation that is generated through such a nonlinear dialectic. Chaotic structures also tend to be extremely sensitive to the initial conditions surrounding the initiation of the nonlinear dialectical process through which such structures are given expression. Moreover, chaotic structures tend to exhibit fractal properties.

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Characterization: A process through which one establishes a ration of constraints and degrees of freedom that are considered to be reflective of some aspect of experience, phenomenology, and/or ontology. Generally speaking, the process of characterization involves an element of judgment that generates a set of structural themes (i.e., the ratio of constraints and degrees of freedom) intended to be descriptive of the purpose, value, nature, function and/or classification of the aspect of experience and/or ontology to which identifying reference is being directed on a given occasion.

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Congruence functions: Mapping relationships that are directed toward establishing the extent to which, and manner in which, there is a reflective, analogical correspondence between the focal/horizonal features of different structures. Usually, one of the structures being linked through such mapping relationships is one or more hermeneutical point-structures, neighborhoods or latticeworks. The other structure being linked in this manner is one, or more, point-structures, neighborhoods or latticeworks of the phenomenology of the experiential field -- or some aspect(s) of the ontology -- which makes possible a phenomenology of the experiential field of such character.

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Constraint: A limit, parameter, boundary or demarcation that places restrictions on how, when, where, why, and/or to what extent a given structural theme will manifest, and/or be induced to manifest, itself.

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Continuity: Refers to the manner in which two or more point-structures, neighborhoods, or latticeworks are linked together by virtue of the set of events, processes or themes that permit the point-structures, etc. to overlap through the way they give expression to their respective ratios/spectrums of constraints and degrees of freedom. The linking together feature might range from: a mere juxtaposition of the point-structures, neighborhoods and/or latticeworks within the context of an ordered set of relations, to a complex dialectical interaction of such point-structures, and so on.

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Coupling constant: This gives expression to the way in which a given structure is embedded or rooted in an aspect of an order-field that is responsible for maintaining the integrity, or coupling together the various thematic components, of a structure across a variety of transformations. Furthermore, this coupling constant maintains structural integrity despite the presence of a certain amount of variability and fluctuation in the manner in which the structure's ratio of constraints to degrees of freedom is manifested at different times and under different circumstances and on different levels of scale.

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Curvature: The vectored and/or tensored structural character of a given surface, manifold, dimension, field, neighborhood, or latticework. The character of such curvature might be an expression of the dialectic of point-structures, neighborhoods and latticeworks that are indigenous to a surface, manifold, dimension, etc.. On the other hand, curvature might be the result of some form of external source of distortion or warping that is acting on the structural themes indigenous to a given surface, manifold, and so on. Finally, curvature also might constitute a function of a combination of vectored and or tensored forces that are both intrinsic as well as extrinsic to a given surface, manifold, dimension and so on, or are a function of an interacting set of such surfaces, manifolds, dimensions, etc.

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Degree of freedom: A potential or capability (sometimes essential and sometimes contingent) indigenous to a given object, state, condition, process, or event that lends flexibility to how, when, where, why and/or to what extent a given structural theme will manifest, and/or be induced to manifest, itself.

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Dialectic: The dynamics that are manifested on any number of levels of scale by means of the spontaneous and/or induced manner in which different structures engage one another in either a horizonal, focal or focal/horizonal manner. This engagement occurs through the emergence of phase relationships. Such phase relationships probe, analyze, shape, modulate, influence and/or alter the spectrum of ratios of constraints and degrees of freedom that constitute the respective structures involved in the dynamics of a given instance of such engagement.

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Dimension: A tensor matrix that gives expression to a particular realm of the order-field. This realm has a characteristic spectrum of ratios of constraints and degrees of freedom that is not reducible to any other tensor matrix expression of the order-field. For example, space constitutes such a tensor matrix and, therefore, has a characteristic spectrum of ratios of constraints and degrees of freedom that permit one to distinguish it from other tensor matrices such as time, energy, and consciousness. Although, traditionally, the tendency has been to suppose that normal, everyday space gives expression to, at least, three dimensions, the perspective being suggested here is that length, breadth, and height are but degrees of freedom that are possible in one and the same dimension.

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Envelope: Refers to the horizonal membrane that establishes the boundaries within which a given set of structural themes, currents, values, and so on, fall. Linear envelopes are fairly well defined because of the self-same character of the boundaries established by such envelopes. Chaotic envelopes, on the other hand, are more difficult to discern or grasp because of the self-similar, rather than self-same, character of the boundaries that are established. However, whether one is dealing with linear or chaotic envelopes, there is a yin-yang quality to an envelope since it gives expression to structural themes of both constraints and degrees of freedom.

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Experiential field: The manifold that is generated by the dialectical interaction of a variety of vectored and tensored components (such as: sensation, emotion, motivation, desire, conceptualization, imagination, willing, and/or evaluation) with awareness. Such awareness might be focused or diffuse, reflexive or un-reflexive.

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Focus: An interior set of structural/dialectical themes that emerges within the horizonal envelope of constraints and degrees of freedom that is generated during a given instance of reflexive consciousness and/or identifying reference.

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Force: That which has the capacity to: (1) alter the ratio of degrees of freedom and constraints that constitutes a given expression of structural character; (2) induce a structure to manifest one or more modes of that structure's ratio of degrees of freedom and constraints, or of that a structure's spectrum of such ratios.

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Fractal: a property of those structures that: (1) are capable of manifesting themselves across an indefinite number of levels of scale; (2) are capable of exhibiting self-similar rather than self-same modes of manifestation on many, if not all, levels of scale on which they are operative; (3) are capable of giving expression to various facets of the degrees of freedom of the dimensional character of such a structure as a function of the way in which a given methodology engages that structure.

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Gauge: a methodological means of applying a series or set of transformation operations to a given field, neighborhood, manifold, latticework or tensor-matrix for the purpose of comparative measurement. Such a methodology should leave fundamental properties involving the structural character of the neighborhood, manifold and so on, intact or invariant. The idea of a gauge is to permit transformations in the mode of measurement while preserving symmetry.

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Hermeneutical field equations: a series of eight qualitative equations which provide a means of descriptively summarizing some of the main themes of hermeneutical field theory such as: phenomenological induction; structural character; neighborhood formation; bound and unbound hermeneutical operators; orientation; congruence functions; dialectical tension due to unanswered or problematic issues; the coupling constant and distortion.

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Hermeneutical operator: a tensor matrix consisting of six components: namely, identifying reference; reflexive awareness; characterization; interrogative imperative; inferential mapping and congruence functions. The operator can both spontaneously engage some aspect of the phenomenology of the experiential field, as well as be induced to engage some aspect of that field. However engagement arises, this tensor matrix is capable of altering, shaping, grasping, analyzing, probing, coloring, distorting, experimenting with, and/or interpreting the structural character (or aspects thereof) of that which is engaged. The operator is a dialectical expression of the dimension of intelligence that helps generate, in part, the phenomenology of the experiential field.

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Hermeneutics: A theory of methodology concerning the problems surrounding any process of interpretively engaging and trying to understand a given work (literary, religious, cultural, historical, scientific). Such engagement is undertaken with the intention of finding a way to merge horizons with, or open oneself to, various aspects of a given work and, thereby, come to a better appreciation or understanding of the work being engaged.

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Horizon: This refers to the complex boundary dialectic that surrounds, shapes, permeates (to a degree) and engages, as well as is shaped by, is permeated by (to a degree) and is engaged by: focal activity. The horizon is capable, potentially, of linking focus not only to other aspects of the phenomenology of the experiential field, but horizon also is capable, under the right circumstances, of linking focus with various aspects of the ontology that helps make a focal/horizonal dynamic of such a structural character possible.

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Identifying reference: The process of drawing attention to a particular aspect of ontology as that aspect is manifested in terms of, or expressed as a function of, the phenomenology of the experiential field. The character of such a process might be as simple as an instance of ostensive pointing, or as complex as a full-blown theory, model, or belief system. The intention of such a process is to attempt to point out as many features of the relevant aspects of the phenomenology of the experiential field as are necessary in order that other individuals might be able to zero in on the phenomenon or phenomena in the phenomenology of their own experiential fields to which their attention is being directed. This process of identification does not presuppose that the mode employed for directing the attention of others is rooted in a correct understanding of the phenomenon to which identifying reference is being made.

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Inferential mapping: The tracing out and charting of the character of the phase relationships that give expression to the mode(s) of continuity that is (are) manifested under various structural and dialectical conditions of engagement. Implication, inference and entailment relationships can be construed differentially in terms of the degree and kind of continuity present in a given instance of structural or dialectical dynamics.

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Interrogative imperative: The tendency to explore, question, puzzle over, be curious about, seek explanations for, understandings of, and answers to, a wide variety of issues, problems, experiences, themes, and challenges that emerge within the phenomenology of the experiential field.

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Isotopic-spin: Refers to certain aspects of the internal dynamics of a given quantum entity, irrespective of whether this quantum entity is physical or semiotic in character. This internal dynamic appears capable of bringing about a transformation in the structural properties of such an entity, or of altering the manner in which the quantum entity's spectrum of ratios and degrees of freedom manifests itself under a given set of circumstances. In the case of hermeneutical isotopic-spin, the internal dynamic consists of the dialectic among the six components of the hermeneutical operator during a given instance of experiential engagement.

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Latticework: Brings together the ideas of a framework, network and lattice in an attempt to make reference to an ordered or systematic arrangement of point-structures and/or neighborhoods that is governed by one or more principles that shape the way the continuity of such a system manifests itself. The character of the ordered or systematic arrangement governing such a system need not be restricted to the simple sorts of inclusion/exclusion principles that are characteristic of mathematical lattices. A variety of complex phase relationships are capable of linking together the different components of the latticework.

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Logic: A mapping process that attempts to identify and delineate the character of the hermeneutical phase relationships that establish continuity between, among, or within various structures across different circumstances, conditions, states, processes, events, engagements, interactions and so on. Such mappings might or might not be reflective of, or congruent with, those aspects of the structural character of hermeneutical phase relationships to which these mappings are making identifying reference.

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Manifold: A dimensional neighborhood or latticework (or the multidimensional tensor matrix formed through the interaction of two or more such neighborhoods, etc.) that is characterized by a set of boundary properties formed as a result of the way in which the dimensional neighborhood or latticework gives expression to its intrinsic ratio of degrees of freedom and constraints at a given point in time and under a given set of circumstances. In mathematical contexts, a manifold is often construed as being a generalized surface of some sort. In the context of hermeneutical field theory, however, manifolds are construed in terms of the boundary properties of one or more dimensional mediums. Such boundary properties are manifestations of the manner in which the tension or dialectic between constraints and degrees of freedom play off against one another.

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Mapping: A process of projecting congruence functions onto, or into, a neighborhood or latticework of point-structures. Full congruence is realized when the mode of projection establishes bijective or one-to-one correspondences that show, at a minimum, that the structures being linked through the projection process are analogs for one another.

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Merging horizons: The process of establishing extensive congruence functions between the structural character of a given individual's understanding and the structural character of those aspects of ontology or a given structure to which the individual is making identifying reference through a given instance or set of instances of hermeneutical activity. Such congruence functions enable one to become open to, or appreciative of, or properly oriented toward a variety of themes that are integral to the structural character of the object, event, state, etc. being explored.

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Neighborhood: A collection of point-structures that are linked together in a continuous fashion by means of some principle(s). The nature of the principle(s) that couples together the various point-structures contained in the neighborhood might be physical, material, conceptual, emotional, ethical or metaphysical in character. Furthermore, the nature of the coupling process might or might not be simultaneous in character. In other words, the principle might manifest its linking or coupling capabilities in different ways from one juncture in time to another such juncture. However, whether or not a given point-structure is currently being linked by the coupling principle in an active fashion, any point-structure that comes under the sphere of influence of a given coupling principle and, therefore, is, in a sense, “on call" (i.e., capable of being linked to other point-structures in the neighborhood) is considered to be part of the neighborhood. Finally, the coupling or linking principle need not involve physical contiguity.

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Nonlinear: Any system of dynamics in which the dialectical character of the components of such a system can be reduced to being some sort of rule-governed function only at the risk of introducing a significantly distorting curvature into one's understanding of the principles inherent in that system's structural character. Nonlinear systems usually involve principle-governed phenomena rather than rule-governed phenomena.

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Order-field: An ontological attractor with a complex internal dialectic capable of generating, or expressing itself in terms of, a variety of dimensional tensor matrices that dynamically interact with one another to yield all phenomena on all levels of scale. As is the case with any field, the order-field does not tolerate action-at-a-distance. This means that any given point-structure of the order-field influences other point-structures of that field only by means of the principles of continuity that are manifested through the phase relationships that couple together the various point-structures, neighborhoods and latticeworks of the field. In the context of the present dissertation, the idea of the order-field leaves open the issue of whether the ultimate nature of the order-field is physical or metaphysical in nature.

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Orientation: The hermeneutical perspective that colors understanding at any given time. This perspective can be shaped by a set of tensor matrices consisting of a variety of beliefs, values, ideas, feelings, goals, expectations, sensations, and attitudes. An orientation can be selectively focused to emphasize only a small set of tensor matrices ... sometimes just a single tensor matrix. On the other hand, an orientation might be an extremely complex expression of a large set of tensor matrices.

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Phase relationships: The structural/dialectic themes that link different point-structures, neighborhoods and latticeworks with one another as a function of the way the order-field manifests itself or unfolds over time. Phase relationships place, situate or give context to a given structural or dialectical theme with respect to the over-all order of the point-structures, neighborhoods or latticeworks to which the structural or dialectical theme being considered helps give expression.

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Phenomenology: The manner in which the medium of awareness detects, on at least some minimum level of scale, the presence of various currents, events, states, objects, processes, conditions, themes, structures, dialectical engagements and occurrences that are manifested as a stream of phenomenon within, and through, such a medium.

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Point-structure: This refers to those structures that give expression to a narrow or restricted envelope of values or ratios of constraints and degrees of freedom on a given level of scale. Like its geometric counterpart, the point-structure often plays a role as a fundamental unit of construction in the generation of larger structures, such as neighborhoods or latticeworks, on more complex levels of scale. Moreover, like its geometric counterpart, the point-structure figures into issues involving continuity.

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Principle: Refers to certain kinds of arrangements of ratios (or spectra of ratios) of constraints and degrees of freedom. Such ratios (spectra) might be manifested in the form of point-structures, neighborhoods, or latticeworks. What makes a given ratio of constraints and degrees of freedom, or set of such ratios, a principle has to do with the structural character of the phase relationships that exist in the ratio's (spectrum's) internal dialectic. A principle consists of a set of phase relationships that form an attractor basin. Usually speaking, principles involve chaotic attractors.

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Quantum of action: Whether dealing with hermeneutical issues or physical/material systems, this constitutes the basic unit of dimensional dialectics that is operative in a given set of circumstances. It summarizes the way different dimensions come together to give expression to a specific phase state of a point-structure by establishing a ratio (or spectrum of ratios) of constraints and degrees of freedom that characterizes the boundary conditions of that structure in such a phase state. The establishing of these boundary conditions determines the range, orientation, intensity, value and general character of the point-structure's mode of activity when expressing itself through a given phase state.

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Ratio of constraints to degrees of freedom: This gives expression to the basic idea of structural character. Essentially, structural character is a function of how a set of constraints, together with a set of degrees of freedom, are arranged and interact under specified circumstances to generate a set of boundary conditions. These boundary conditions are manifestations of the dialectical tension between the sorts of constraints and degrees of freedom that are operative in, around and through a given structure. The boundary conditions are an index of the character of the ratio between the two sets of components that give expression to any given structure.

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Reflexive awareness: The process of turning awareness back on itself in a concentrated, intense manner in order to explore, examine, analyze, reflect on, and think about the focal and horizonal aspects or focal/horizonal dialectic of a given realm of awareness that is being manifested through the phenomenology of the experiential field. This process not only involves an awareness of awareness per se, it involves, as well, an awareness of, interest in, and attending to, the shifting focal, horizonal and dialectical currents that shape, color and orient the way in which awareness engages different aspects of the experiential field being manifested through a given realm of phenomenology.

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Rule: Deals with those arrangements of phase relationships in the context of a point-structure, neighborhood, or latticework that form an attractor basin that either tends toward a fixed-point equilibrium or tends toward some sort of cyclical fluctuation among a small set of alternatives. The character of this cyclical fluctuation manifests a self-same sort of property that does not give rise to variations that are similar to, but transcend the horizons of, the basic set of alternatives available to the rule-governed system.

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<u>Self-similar</u>: A property exhibited by aperiodic, nonlinear oscillating systems in which, on the one hand, the system's fundamental cyclical character never quite repeats itself in a self-same manner, and yet, on the other hand, the values manifested through such a system's cyclical character always stay within a determinate set of boundaries, thereby giving expression to cycles with similar characteristics to one another.

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<u>Semiotic quantum</u>: The fundamental unit of hermeneutical action. It gives expression to the hermeneutical counterpart to isotopic-spin in quantum mechanics. The structural expression of any given semiotic quantum will be a complex dialectical function of the various components of the hermeneutical operator. This dialectic will manifest itself either in a spontaneous fashion (due to forces, properties or principles intrinsic to a tensor matrix that constitutes a given instance of the semiotic quantum), or as a result of being engaged by forces exterior to the semiotic quantum that are capable of inducing such dialectical activity, or as a combination of both spontaneous and induced factors. The semiotic quantum can be one of the primary sources for introducing curvature into the phenomenology of the experiential field.

<u>Structure</u>: Any process, event, object, state, condition, or relationship that exhibits a set of constraints and degrees of freedom when manifesting itself or being induced to manifest itself. Implicit in such a set of constraints and degrees of freedom is a dialectic that gives expression to the coupling constant or aspect of the underlying order-field that permits the structure to maintain its integrity as a structure of identifiable and recognizable character across one or more transformations, despite alterations in various aspects of the constraints and degrees of freedom that constitute the structure's characteristic ratio or spectrum of such ratios.

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<u>Symmetry</u>: The capacity of a system to undergo transformations and still preserve the structural character of certain facets, components, themes, properties, and/or neighborhoods of that

system. Those aspects of the system that maintain their structural identity across the transformation are said to exhibit symmetry with respect to such a transformation. When the invariance of some property or facet of a system is maintained across a given transformation that is applied to every point-structure, neighborhood or latticework in that system, the symmetry is said to be global in character. On the other hand, when invariance in one or more of the properties of a system is preserved despite a variety of transformations occurring at different junctures within that system, this is known as an instance of local symmetry.

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<u>Temporal identity</u>: Those aspects of a given neighborhood, latticework, tensor matrix, and so on which are shaped, colored, oriented and modulated by phase relationship currents of the temporal dimension. This shaping, coloring, etc. establish a variety of fundamental themes that help determine the structural identity of such neighborhoods, latticeworks, and so on. As a result, certain temporal modes of manifestation become characteristic of, and identified with, the way a given structure unfolds as a function of an underlying dialectic of dimensions.

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<u>Tensor</u>: Any force, physical or otherwise, which has magnitude and direction and whose modes of expression involve elements of twisting, torque, tension and so on as a result of the dynamics of the dialectic internal to the tensor. In the context of hermeneutical field theory, there is an element of transvariant currents that extends beyond the usual mixture of covariant and contravariant forces inherent in the way a tensor usually manifests itself. Transvariant currents do not conform to the largely linear characteristics of covariant tensors, contravariant tensors or mixed tensors. Instead, transvariant currents refer to: multi-dimensional, non-linear tensions, stresses, and dialectical activities that are capable of affecting the manner in which the semiotic quantum gives expression to its property of isotopic-spin.

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<u>Tensor matrix</u>: A way of representing the dynamics at work in the complex dialectics of some tensors. Each cell of the matrix gives expression to a different component of the dialectic. The character of the phase relationships among the various cells of such a matrix will generate the various currents, pressures, tensions and so on that will determine the resultant nature of the tensor's mode of expression as a whole.

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<u>Transvariant</u>: The property of hermeneutical tensor matrices that refers to those nonlinear sources and/or expressions of dialectical currents, tensions, stresses, and torque within such matrices that fall beyond the boundaries of the covariant and contravariant linear forces at work in a given hermeneutical tensor matrix.

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<u>Understanding</u>: A state of hermeneutical orientation. This state of orientation might or might not be congruent with the structural character of that to which identifying reference is being made during a given engagement of the phenomenology of the experiential field or during an engagement of that which helps make possible a field of such structural character.

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<u>Vector</u>: Any force, physical or otherwise, which has magnitude and direction. The nature of the magnitude and directional components are limited in the sense that although they might be manifested in more than one dimension at a time, the manner of expression of any single vector will be free of all elements of twisting, torque, tension and so on. The lines of expression, so to speak, of a vector are not complicated by the dynamics of any dialectic internal to the vector.

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<u>Waveform</u>: Refers to the structural character of the form which is generated in a given dimensional medium (or intersection of such dimensions) through the presence of a force or series of forces capable of inducing wave phenomena in such a medium (or mediums). Such forms can vary in structural complexity according to the nature of the dialectic between (or among) a given dimensional medium (s) and the force (s) inducing the wave phenomena in such a medium (s). The

mediums can range from: gases to: solids, and from: time to: the phenomenology of the experiential field. The forces can range from: electricity to: emotion, and from: heat to: the hermeneutical operator.

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