

The Emergence of Archetypes in Present-Day Science and its Significance for a Contemporary Philosophy of Nature

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The Need for a Contemporary Philosophy of Nature

Today, the term 'philosophy of nature' sounds curiously anachronistic. It is seemingly a reference to a bygone mode of inquiry - one, however, that spanned more than two millennia and engaged the intellects of philosophers from Heraclitus to the Naturphilosophen of the early 19th Century. At present, it is commonly assumed that the dramatic development of modern science has superceded and made obsolete this type of inquiry. In particular, the task of providing a comprehensive description of the world has been given over to science, and according to some prominent physicists, that task, at least in outline, is nearly complete. It would seem that there is really no need for a contemporary philosophy of nature.

In his argument for a contemporary philosophy of nature, Ivor Leclerc has traced the obsolescence of the philosophy of nature to the ascendancy of the idea that appeared in the first quarter of the 17th Century in the works of Sennert, van Goorle, Galileo and Bacon and which was later systematically developed by Descartes, namely that matter is itself substance rather than the conjunction of form with substance, as it was conceived in Aristotelean science:

The consequence of the conception of matter as itself substance was an ineluctable metaphysical dualism.

The outcome was that the universe was divided into two, one part consisting of matter, constituting nature, and the other part consisting of mind or spirit. The fields of inquiry were divided accordingly: natural science ruled in the realm of nature, and philosophy in the realm of mind. Thenceforth these two, science and philosophy, each went its own way, in separation from the other. In this division there was no place for the philosophy of nature. Its object had been nature, and this was now assigned to natural science. What remained to philosophy was only the epistemological and logical inquiry, which has natural science, but not nature, as its object - today usually called the philosophy of science. Philosophy of nature as a field of inquiry ceased to exist. (1)

Leclerc's analysis brings to light the central irony of the fate of the philosophy of nature: it was the ascendancy of certain philosophical presuppositions about the nature of matter that led to the obsolescence of the philosophy of nature, but it is the philosophy of nature whose task is the critical evaluation of just such presuppositions about nature as the relation of substance to matter which are beyond the empirical methods of science to examine. This lack of recognition for the task of the philosophy of nature has led to the assumption that science is not in need of any philosophic examination of its object of study, nature. Thus, there is a tendency for certain philosophical assumptions about the nature of reality to gain uncritical acceptance in the body of scientific thought. In his argument for the necessity of a contemporary philosophy of nature,

Andrew van Melsen has pointed out that any scientific weltbild contains a philosophic component, whether it is acknowledged or not:

Most scientists have a kind of world picture, wherein scientific knowledge and philosophical consideration go together in a very confused way. Such a world picture seems to be the result only of scientific theories, but is, as a matter of fact, the outcome of a combination of those theories with certain philosophical theses. The importance of the scientific theories of reality is evaluated in the light of philosophical theses. The scientist has, whether he is aware of it or not a certain philosophical outlook toward his science and toward the object of his science... philosophy can be very important for a critical examination of the always present philosophical perspective in which the scientist sees his scientific knowledge... There is a real desire in the human mind to investigate its object in all its aspects, and that is exactly what gives the philosophy of nature its specific task alongside science. (2)

Nevertheless, any inquiry about the presuppositions about nature which are made in science, of which the nature of matter is only one example, can easily become lost in the shadows of the towering conceptual edifices of theoretical physics. There is a sentiment in certain quarters of contemporary physics that the attainment of a comprehensive, unified physical theory - a Final Theory, a Theory of Everything - is nearly at hand and that such a theory would provide a core explanation for all possible physical phenomena, thereby making further philosophical inquiry about nature irrelevant. (3) Currently, the most likely candidates for a Theory of Everything are the superstring theories, which hold out the promise of unification of Einstein's Theory of General Relativity, the theory that describes gravitational phenomena, with the so-called Standard Model, which is the theory that presents the phenomena of the elementary particles and fields in the most unified manner.

It is not difficult to see, however, that any such ultimate theory that may eventually be realized will not be able, by itself, to provide a complete account of reality. Let it be assumed that a Theory of Everything is in hand, as well as the means to mathematically describe and compute the complexity of all of the different levels of organization found in nature. Then beginning with a description of the most elementary of all of the objects in nature, the superstring, the various levels of the hierarchical organization of nature can be constructed, from elementary particles to atoms and molecules, from DNA to the simplest forms of cellular life, onward to living creatures of great complexity. Let it also be assumed that the description of mental phenomena can be achieved completely in terms of physical processes - the flow of neurochemicals, the activation of neural nets in the brain - and thus the longstanding problems of the relationship of the mind and the body are thereby eliminated. This Theory of Everything would then stand as an ultimate physicalistic account of reality. As such, it should be capable of describing the processing of information in the human brain and the concomitant use of symbols and language. In particular, this theory should be able to give an account of itself as a particular expression of the symbolizing activity of the human brain. To do this, however, requires the theory to characterize its elemental starting point, the superstring, also as a complex dance of electrical activity in the brain. Certainly a distinction can be introduced by the theory at this point between the elemental superstring and the neural superstring, but in making this distinction, the door is thrown open to the troublesome issues of understanding the relationship between an object as it is in itself and as it is known by humans. In particular, the question is posed: "What possible relationship exists between the pattern of neural activity in the brain that is the superstring and the elemental superstring that is the basis of all physical reality?"

In pursuing this line of thought, we have arrived at terrain well explored by Kant more than 200 years ago, although today it is now somewhat obscured by the constructs of modern science. Within present-day physics this issue has been discussed by Bernard d'Espagnat in terms of reality that is "veiled", and Carl Friedrich von Weizsacker has related how Heisenberg approached this same problem when he posed it as a very simple but penetrating question: "... why can there be simple theories which are true?" von Weizsacker further remarked that, "Present-day philosophy of science has not only been unable to answer the question why or how fundamental science is possible; it has not even been able to see what is the problem." (4) The problem when expressed in a less radical context than that of the finally reductive, eliminative materialist account given above presents itself from two perspectives: First, the ontological aspect is concerned with the questions, "What are the fundamental features of nature that can be grasped by the conceptualization processes of the human?" and conversely, "How do the limitations and constraints of what can exist in nature influence human conceptualization processes?" The other, the epistemological aspect, is concerned with the questions, "How do humans have the capacity for conceptualization that allows for understanding of nature at a fundamental level?" and conversely, "What constraints and limitations to the understanding of nature are artifacts of the processes of conceptualization that humans possess?" In short, these questions ask about the nature of the interdependence of what can exist and what can be known and about the isomorphic features that may exist between these two categories. Questions such as these are not addressable alone by a Theory of Everything because they involve the determination of fundamental aspects of reality that are already part of the presuppositions of the methods of science. Nevertheless, the answers given to such questions play a large role in the way that the relationship of human beings to the cosmos is characterized and therefore are vitally important features of a comprehensive understanding of nature. As a result, the scientific *weltbild* that could be provided by an optimal Theory of Everything is nonetheless fundamentally incomplete.

It therefore becomes the legitimate and important task of a philosophy of nature to address the foundational questions that science itself cannot answer. Of the issues of ontology, it can inquire about the foundations of such concepts as matter and energy, space and time, causality and chance and the nature of number. Of the issues of epistemology, it can inquire about the human capacities for conceptualization that are implicit in our concepts of nature themselves.

Although the task of the philosophy of nature is separate and distinct from that of science, the results of science need not be irrelevant to a philosophy of nature. Just as science can be informed by the primarily deductive reasoning processes of a philosophy of nature, so may a philosophy of nature be informed by the empirically based, inductive reasoning processes of science. These two modes of inquiry complement each other, and together they have the potential to achieve a more coherent and comprehensive picture of the world than either could produce in isolation from one another. In particular, it is possible that the philosophy of nature might be informed by the science of psychology. Because a central concern of the philosophy of nature is the formation of concepts about nature, it is possible that valuable insights into the processes of concept formation might be gained for the philosophy of nature from psychology. In particular, the research into the nature of archetypes as it was developed in the work of Carl Gustav Jung and his associates may be seen to be especially relevant.

The Development of the Concept of Archetype

The Archetype Concept Prior to Jung

Different expressions of the archetype concept can be found in different contexts within different cultures distributed historically and geographically across the world; thus the archetype concept itself may be considered to be archetypal in the sense given to it by Jung. Paul Schmitt has given the following etymology of the word “archetype”:

The first element ‘arche’ signifies ‘beginning, origin, cause, primal source, and principle,’ but it also signifies ‘position of a leader, supreme rule and government’ (in other words a kind of ‘dominant’); the second element ‘type’ means ‘blow and what is produced by a blow, the imprint of a coin... form, image, copy, prototype, model, order, and norm,’...in the figurative, modern sense, ‘pattern, underlying form, primordial form’ (the form, for example, ‘underlying’ a number of similar human, animal, or vegetable specimens). (5)

Citing Von Blumenthal, Van der Hammen has argued that the meaning given to ‘type’ as ‘the impression made by a blow’ is incorrect, and he derives ‘type’ from the Greek noun ‘typos’, which originally referred to a mould (a hollow form or matrix). (6) There are numerous instances of the use of the term ‘archetype’, or its Greek form, archetypos, or the Latin form, archetypus (7):. The term was used in the metaphysical sense of Idea, namely as the original in the Mind of God of which all things are copies, by Philo Judaeus (first century) and in a more or less similar way by Plotinus. Apparently, Jung took the term ‘archetype’ from two sources, namely the Corpus Hermeticum and Dionysius the Areopagite's *De Divinis nominibus*. Use of the term also appears in Irenaeus's *Adversus haereses*, and its Latin equivalent, ‘ideae principalis’, can be found in St. Augustine's *De diversis quaestionibus*, and later in Agrippa von Nettesheim's *De occulta philosophia, Libra tres*. Instances of its use also appear in *De Dignitate Hominis* of Pico della Mirandola (1463-1494), from which its later use by the Cambridge Platonists, in particular Henry More (1614-1687) can be derived. In the 16th Century, Johannes Kepler used the term ‘archetypus’ to refer to ideas or forms pre-existent in the Mind of God which are geometrical in nature. Because the human soul is, according to Kepler, the Image of God, the human is capable of discerning the archetypal geometrical forms according to which the world is structured. Other usages of the term ‘archetype’ can be found in Rene Descartes’ 1641 printing of his *Meditationes Prima Philosophia* and later by John Locke, in Books II and IV of his *Essay Concerning Human Understanding*.

The most notable and, for some, the most notorious use of the term ‘archetype’ prior to Jung occurred in the development of transcendental morphology that grew out of 19th Century Naturphilosophie. Robert Richards has traced the intellectual diffusion of the archetype concept from Kant’s ‘intellectus archetypus’, which referred to the purposeful design that coordinated the principles of organization of all living beings, to Goethe's notion of the ‘Urbild’, or ‘original plan’ of all vertebrate animals which he equated with Kant's intellectus archetypus. (8) The Urbild or vertebrate archetype consisted of an abstract pattern of the arrangements of bones of the vertebrate skeleton that persisted from one species to another, although the development of the specific elements in each species showed great variability. The concept of a vertebrate archetype was brought to its greatest prominence through the work of the British morphologist, Richard Owen. Nicolaas Rupke has argued that Owen's vertebrate archetype concept was derived from Goethe and particularly from C.G. Carus. (9) According to Rupke, Owen did not at first conceive of his vertebrate archetype in the sense of a Platonic Idea. Rather, it served as a structural model, a generalized simplest schema for vertebrate development. Later, in response

to the anxiety of his patrons, he disassociated the vertebrate archetype from the pantheistic tendencies of the Naturphilosophen, in particular as expressed in the work of Lorenz Oken, and reinterpreted it in a Platonic sense. The approach to homology established by Owen and his predecessors was altered drastically by Darwin. Darwin converted the basis of homology from pattern continuity to evolutionary descent, and in doing this, he changed the notion of archetype accordingly. In *The Origin of the Species* he wrote,

The explanation [for stable patterns] is to a large extent simple on the theory of the selection of successive slight modifications... if we suppose that an early progenitor - the archetype as it may be called - of all mammals, birds, and reptiles, had its limbs constructed on the existing general pattern, for whatever purpose they served, we can at once perceive the plain significance of the homologous construction of the limbs throughout the class. (10)

Jung's Development of the Archetype Concept

Jung does not specifically refer to the use of the archetype concept in morphology as a source for his later use of the concept, but he may have encountered the term in his studies at the Universities of Basel or Zurich, where he studied medicine. The concept of archetype does not begin to appear in Jung's research until after he separated from Sigmund Freud and his school and resigned from the Psychoanalytic Association and his position at the University of Zurich. Isolated and on his own, Jung struggled to develop empirical methods to study the unconscious mind. His research into the psyche inquired about the structure and dynamics and the energetics of the mental processes operating in the unconscious. The specific empirical approach that he developed consisted of examining and comparing recorded accounts of mental phenomena which are dominated by the activity of the unconscious mind - phenomena such as dreams, visions, hallucinations, fantasies, and the like. Jung's technique consisted of examining a series of dreams and fantasies from an individual and searching for an underlying theme or motif. This motif was identified by the recurrence of isomorphic structures whose particular appearance changed from dream to dream but whose functional form remained essentially the same. Jung estimated that in the period of research which led to the formulation of his theory of the psyche, he had examined on the order of 67,000 dreams. He acknowledged that his approach to the study of the psyche was essentially the same as the study of morphology in biology:

My scientific methodology is nothing out of the ordinary, it proceeds exactly like comparative anatomy, only it describes and compares psychic figures. (11) Psychic events are observable facts and can be dealt with in a 'scientific' way... I observe, I classify, I establish relations and sequences between the observed data, and I even show the possibility of prediction. (12)

His method could also be compared to the examination of fossil records by paleontologists to establish the evolutionary development of animal species. Jung supplemented his examination of the records of the unconscious processes of individuals with an extensive study of myths, legends, and folktales drawn from cultures distributed widely both geographically and historically. He found that both the individual records and the collective material contained common thematic structures. This led him to hypothesize the existence of a collective aspect of the human psyche that he called the 'collective unconscious' and to identify the dynamical organizing factors in the unconscious as 'archetypes'. Jung acknowledged that his concept of archetype had its roots in Plato's concept of Idea. He wrote of the archetype concept as, "... an explaining paraphrase of the Platonic *eidos*," (13) and of archetypes as "living dispositions, ideas in the Platonic sense." (14) However, Jung's concept of archetype differs

from Plato's Idea in that the former is multivalent and dynamic whereas the latter is an expression of singular and static perfection.

As early as 1912, Jung was using the term 'primordial images' to describe motifs of myths, legends and fairytales which have a universal character and which appear as images or perceptual patterns (15). In 1917, he wrote of 'dominants of the collective unconscious' which he characterized as 'nodal points' of psychic energy (16). Jung did not begin to use the term 'archetype' until 1919, and at first he used it more or less interchangeably with 'primordial image' and 'dominant' (17):

It is this factor which I call the archetype or primordial image. The primordial image might suitably be described as the instinct's perception of itself, or as the self- portrait of the instinct. (18)

The primordial image, elsewhere also termed archetype, is always collective, i.e., it is at least common to entire peoples or epochs. (19)

With time Jung began to extend the archetype concept beyond the static representations of the primordial images to include dynamical processes and all types of universally recurring patterns of behavior in the psyche:

Archetypes may be considered the fundamental elements of the conscious mind, hidden in the depths of the psyche....They are systems of readiness for action, and at the same time images and emotions. They are inherited with the brain structure - indeed they are its psychic aspect. (20)

[The archetype]... as well as being an image in its own right,... is at the same time a dynamism which makes itself felt in the numinosity and fascinating power of the archetypal image. (21)

Jung's description of the archetype as "an image in its own right," albeit a primordial image, frequently led to the charge that he was reviving Lamarckism - the belief that acquired characteristics - in this case specific visual images and ideas - can be inherited. As a consequence, he repeatedly attempted to clarify the distinction between 'archetype' and the 'archetypal images' which represent it:

We must, however, constantly bear in mind that what we mean by 'archetype' is in itself irrepresentable, but has effects which make visualizations of it possible, namely the archetypal images and ideas. (22)

Again and again I encounter the mistaken notion that an archetype is determined in regard to its content, in other words that it is a kind of unconscious idea (if such an expression be permissible). It is necessary to point out once more that archetypes are not determined as to their content, but only as regards their form, and then only to a very limited degree. A primordial image is determined as to its content only when it has become conscious and is therefore filled out with the material of conscious experience. (23)

The archetypal representations (images and ideas) mediated to us by the unconscious should not be confused with the archetype as such. They are very varied structures which all point back to one essentially 'irrepresentable' basic form. The latter is characterized by certain formal elements and by certain fundamental meanings, although these can be grasped only approximately. The archetype as such is a psychoid factor that belongs, as it were, to the invisible, ultraviolet end of the psychic spectrum. It does not appear, in itself, to be capable of reaching consciousness. (24)

As Jung sought to clarify the concept of archetype and its function in the psyche as an organizer of images and ideas, he came to recognize a non-psychic aspect of the archetype which he called 'psychoid'. Jung explained the psychoid nature of the archetype by means of an analogy of psychic processes with the electromagnetic spectrum. In Jung's analogy, that portion of the spectrum which is visible light corresponds to psychic processes which are capable of reaching consciousness. At the lower 'psychic infrared' end of the spectrum is found the biological, instinctual psyche, which "... gradually passes over into the physiology of the organism and thus merges with its chemical and physical conditions." At the upper 'psychic ultraviolet' end, the realm of the spirit, the archetypes are present as dynamic organizers of ideas and images. Jung reasoned that just as the instincts are grounded in the somatic processes of the neural system, the archetypes similarly possess a nonpsychic psychoid basis:

If so, the position of the archetype would be located beyond the psychic sphere, analogous to the position of physiological instinct, which is immediately rooted in the stuff of the organism and, with its psychoid nature, forms the bridge to matter in general. (25)

Furthermore, Jung concluded that ultimately, both the instincts and the archetypes share a common 'transcendental', irrepresentable source. Jung was drawn to this conclusion by two related factors which led him to investigate further the psychoid nature of the archetype- his study of the archetypal basis of alchemical symbolism as it appeared both in the dreams and fantasies of his patients and in the texts of the medieval alchemists and his repeated encounters with synchronistic phenomena.

Archetypes and Synchronicity

Jung has traced the origin of his thoughts about the concept of synchronicity to conversations with Albert Einstein when the latter held a professorship in Zurich in 1909-10 and 1912-13:

Professor Einstein was my guest on several occasions at dinner... These were very early days when Einstein was developing his first theory of relativity, [and] it was he who first started me off thinking about a possible relativity of time as well as space, and their psychic conditionality. More than thirty years later, this stimulus led to my relation with the physicist Professor W. Pauli and to my thesis of psychic synchronicity. (26)

However, Jung did not begin to formulate the synchronicity concept until the mid-1920's, when he, "... was investigating the phenomena of the collective unconscious and kept on coming across connections which [he] simply could not explain as chance groupings or runs." (27) The phenomena which Jung struggled to understand were the "meaningful coincidences" of certain contents of dreams and fantasies - for example, the dream of a fire, an automobile accident, a visit from a long- absent friend, an encounter with a wild animal, etc. - with a physical event - an actual fire, accident, visit, or appearance of the dream animal. No physical processes can be reasonably held to provide a causal connection between such mental and physical phenomena, but the extraordinary connection through meaning, which invariably has a powerful effect on the individual involved, led Jung to formulate the idea of an acausal connection which he called, 'synchronicity'.

Jung's first use of the term 'synchronicity' occurred in 1930 in a memorial address for Richard Wilhelm in which he gave an explanation of the operating principles of an ancient Chinese oracle, the I Ching. He did not formally present a theory of synchronicity until 1951, when he gave a brief lecture, "Uber Synchronizitat," at the Eranos Conference at Ascona,

Switzer land. In the next year he published, “Synchronizität als ein Prinzip akausaler Zusammenhänge,” which appeared jointly with Pauli's, “Der Einfluss archetypischer Vorstellungen auf die Bildung naturwissenschaftlicher Theorien bei Kepler,” in the volume, *Naturerklärung und Psyche*. (28)

In his monograph, Jung first discussed the concept of synchronicity, “... in the special sense of a coincidence in time of two or more causally unrelated events which have the same or a similar meaning...” (29)

Synchronicity therefore consists of two factors:

- a) An unconscious image comes into consciousness either directly (i.e. literally) or indirectly (symbolized or suggested) in the form of a dream, idea or premonition.
- b) An objective situation coincides with this content. (30)

In “Über Synchronizität,” Jung distinguished three categories of synchronicity:

1. coincidence of a psychic state with a simultaneous, objective external event.
2. coincidence of a psychic state with an external event simultaneous in time but spatially removed.
3. coincidence of a psychic state with an external event distant in time. (31)

Later in his monograph, Jung wrote of this conception of synchronicity as synchronicity in a “narrow sense”, as distinct from a wider view of synchronicity which he preferred to call “acausal orderedness”, which is evidenced in the properties of the natural numbers or the discontinuities of physics. Synchronistic phenomena in the narrow sense are acts of creation in time, whereas the acausal orderedness of the natural numbers or of quantum physics has an eternal, timeless nature:

The meaningful coincidence or equivalence of a psychic and a physical state that have no causal relationship to one another means, in general terms, that it is a modality without a cause, an ‘acausal orderedness’. Into this category come all ‘acts of creation’, a priori factors such as the properties of natural numbers, the discontinuities of modern physics, etc. Consequently, we would have to include constant and experimentally reproducible phenomena within the scope of our expanded concept, though this does not seem to accord with the nature of the phenomena included in synchronicity narrowly understood.

I incline in fact to the view that synchronicity in the narrow sense is only a particular instance of general acausal orderedness - that, namely, of the equivalence of psychic and physical processes where the observer is in the fortunate position of being able to recognize the *tertium comparationis*.

This form of orderedness differs from that of the properties of natural numbers or the discontinuities of physics in that the latter have existed from eternity and occur regularly, whereas the forms of psychic orderedness are acts of creation in time. (32)

The recognition of synchronicity as a particular instance of general acausal orderedness whereby a mental event and a physical event correspond at a particular moment in time was a crucial distinction for the further development of both the synchronicity and archetype concepts. Jung associated acausal orderedness in particular with the phenomena of quantum physics which defy any classical determination of a precise location in space and time with precise values of momentum and energy. The discovery of quantum phenomena early in the 20th Century led to a revolution in physical theory whose full significance is even now not fully understood.

Nevertheless, quantum phenomena are unarguably real, and Jung sought to defend his concept of synchronicity, itself a radical departure from a causal worldview, by associating it with the acausal orderedness of these phenomena:

The modern discovery of discontinuity (e.g., the orderedness of energy quanta, of radium decay, etc.) has put an end to the sovereign rule of causality... Synchronicity is no more baffling or mysterious than the discontinuities of physics. It is only the ingrained belief in the sovereign power of causality that creates intellectual difficulties and makes it appear unthinkable that causeless events exist or could ever occur. (33)

Potentially of greater consequence, however, is Jung's use of the synchronicity concept to provide some insight into the nature of acausal orderedness. In his investigation of synchronistic phenomena, Jung had observed that archetypes consistently act as the mediating principle which accounts for the meaningfulness of the coincidence of the associated mental and physical events. By implication, then, Jung conjectured that behind instances of general acausal orderedness, archetypes act as a mediating principle as well. Thus, the psychoid nature of archetypes was held to extend beyond a neurophysiological basis, into the general dynamical patterns of all matter and energy. This more comprehensive role played by the archetype concept makes it the central character in the archetypal hypothesis formulated by Jung in collaboration with Wolfgang Pauli.

The Initial Encounter of Jung and Pauli

Pauli first encountered Jung in 1931 when he sought him for psychotherapy. Pauli was suffering from the suicide of his mother, the loss of his first marriage, and his estrangement from the Catholic Church. His mood had become extremely irritable, and he had begun to drink heavily. Upon his father's advice, he had an initial consultation with Jung, who found him, "chock- full of archaic material." (34) In order to have the material emerge without Jung's influence, he assigned Pauli to work with Dr. Erna Rosenbaum, an English physician who had just begun to study with Jung. For five months Pauli examined the contents of his dreams and visions with her help. During this period Pauli learned that the content of his dreams were very meaningful, and his attention was drawn to the unconscious, both personally and as a scientist. For the next three months, he observed his dreams alone, recording them in minute detail. During this time he spontaneously invented for himself Jung's technique of active imagination. Following this period, Pauli spent a further two months in conversation with Jung who found that Pauli was, "already almost normal." Jung found that Pauli already understood much of the symbolism of his dreams. From time to time he would seek Jung's advice, and Jung would give him certain hints, "but only so far as this could help him to keep on with the work and carry it through."

For Pauli, the encounter with Jung had led to a personal awareness of the unconscious processes of the mind with their vital role in the integration and balance of the human personality. As a scientist he was also awakened to the significance to science of Jung's research. In particular, Pauli recognized the profound implications that the archetype concept held for science and its epistemological underpinnings.

For Jung, the encounter with Pauli had brought into consideration certain aspects of the nature of reality that would lead to further expansion of the archetype concept. During his ten months of analysis, Pauli had recorded a series of 400 dreams which Jung found to be highly remarkable for its similarities, in both its spontaneously produced images and in the progressive

development of the dream series, to the medieval doctrines of alchemy. Thus Pauli's dreams greatly contributed to Jung's exploration of the psychological significance of alchemical symbolism. Part II of Jung's work, *Psychology and Alchemy*, contains the essay, "Individual Dream Symbolism in Relation to Alchemy", in which he discusses excerpts of 59 of Pauli's alchemical dreams which deal primarily with mandala symbolism.(35) Jung also discussed other aspects of Pauli's analysis in *Psychology and Religion* and in, "On the Theory and Practice of Analytical Psychology" (36). The issue that their excursion into alchemical symbolism had brought forward was the extension of the archetype concept beyond its initial application to unconscious processes in the psyche. Earlier, Jung's recognition of archetypes as patterns of instinctual behavior that are "inherited with the brain structure," had endowed the archetype concept with a biological aspect. As a result of Pauli's alchemical dreams and of Jung's continuing research into synchronistic phenomena, the role of archetypes was pushed beyond the unconscious mental processes, beyond the neural activity of the brain, onward to the nature of matter and energy in general.

Formulation of the Archetypal Hypothesis by Jung and Pauli

The archetypal hypothesis formulated by Jung and Pauli is founded on a perceived parallelism between depth psychology and quantum physics. Jung was struck by the fact that while psychological research into the behavior of the psyche had led to an encounter with certain 'irrepresentables', the archetypes, research in quantum physics similarly had led to irrepresentables, namely the elementary particles which constitute all matter but for which no complete space- time descriptions are possible. Jung concluded that:

When the existence of two or more irrepresentables is assumed, there is always the possibility - which we tend to overlook - that it may not be a question of two or more factors but of one only. (37)

Since psyche and matter are contained in one and the same world, and moreover are in continuous contact with one another and ultimately rest on irrepresentable, transcendent factors, it is not only possible but fairly probable, even, that psyche and matter are two different aspects of one and the same thing. (38)

Jung used the term *unus mundus* to describe the transcendent, unitary existence which underlies the duality of the mind (*psyche*) and matter (*physis*). He stated that the idea of the *unus mundus* is founded:

....on the assumption that the multiplicity of the empirical world rests on an underlying unity, and that not two or more fundamentally different worlds exist side-by-side or are mingled with one another. (39)

Jung held that the *unus mundus* contains all of the preconditions which determine the form of empirical phenomena, both mental and physical. These preconditions are archetypal in nature and are therefore completely non-perceptual, thus pregeometrical and prelogical. Only when they reach the threshold of psychic perception do they take on specific representations in the form of images of geometric or numerical structures. Consequently, archetypes are the mediating factors of the *unus mundus*. When operating in the realm of *psyche*, they are the dynamical organizers of images and ideas; when operating in the realm of *physis*, they are the patterning principles of matter and energy. Thus, archetypes lie behind the acausal orderedness of the physical world, as well as act as structuring principles for causal processes. When the same archetypes operate simultaneously in both realms, they give rise to synchronistic

phenomena. Pauli approached the archetypal hypothesis by questioning the assumption that natural laws can be derived from the “material of experience” alone:

What is the nature of the bridge between the sense perceptions and the concepts? All logical thinkers have arrived at the conclusion that pure logic is fundamentally incapable of constructing such a link. (40)

To account for this link, Pauli postulated the existence of:

...a cosmic order independent of our choice and distinct from the world of phenomena. (41)

This cosmic order, Pauli concluded, corresponds to Jung's conception of the archetypes: As ordering operators and image-formers in this world of symbolical images, the archetypes thus function as the sought for bridge between the sense perceptions and the ideas, and are, accordingly, a necessary presupposition even for evolving a scientific theory of nature. (42)

Pauli held that only by supplementing the knowledge of external objects with the knowledge of the internal operation of the archetypes could a more unified conception of the entire cosmos be obtained. Furthermore, he concluded:

It would be most satisfactory of all if *physis* and *psyche* could be seen as complementary aspects of the same reality. (43)

This “same reality” corresponds to what Jung called the *unus mundus*. The above set of propositions constitute the archetypal hypothesis of Jung and Pauli. The essential elements of the hypothesis may be summarized as follows: The realms of mind and of matter - *psyche* and *physis* - are complementary aspects of the same transcendental reality, the *unus mundus*. Archetypes act as the fundamental dynamical patterns whose various representations characterize all processes, whether mental or physical. In the realm of the *psyche*, archetypes organize images and ideas. In the realm of *physis*, they organize the structure and transformations of matter and energy, and they account for acausal orderedness as well. Archetypes acting simultaneously in both the realms of *psyche* and *physis* account for instances of synchronistic phenomena. Considered altogether, the synchronicity hypothesis represents a new formulation, brought forth in the light of modern consciousness, of the medieval conception of the animation of matter. (44)

Von Franz's Research Concerning Number Archetypes

Jung and Pauli formulated their archetypal hypothesis in the later years of their lives. Neither was able to investigate in depth the nature of the primal archetypes that act as the dynamic organizing principles in the *unus mundus*. Pauli expressed an interest in the archetypal nature of discrete number series and of the continuum:

If, therefore, a more general concept of archetype is used today, then it should be understood in such a way that included within it is the “mathematical primal intuition” which expresses itself, among other ways, in arithmetic, in the idea of the infinite series of integers, and in geometry, in the idea of the continuum... I think it would be of interest to work out more precisely the specific qualities of the “archetypal ideas” which form the basis of mathematics in comparison with more general archetypal concepts. (45)

Jung, however, was drawn to the archetypal nature of the natural numbers through his investigations of synchronicity:

In this connection I always come upon the enigma of the natural number. I have a distinct feeling that number is a key to the mystery, since it is just as much discovered as it is invented. It is a quantity as well as meaning. (46)

He held that,

[number] may well be the most primitive element of order in the human mind... thus we define number psychologically as an archetype of order which has become conscious. (47)

Because of his advancing age, Jung was unable to explore further into number archetypes, so he handed over the notes he had assembled to his close associate, Marie-Louise von Franz. The result of von Franz's research is *Number and Time*, which clarifies and develops the archetypal hypothesis of Jung and Pauli. In *Number and Time* von Franz investigated number archetypes as dynamical ordering factors active in both the psyche and in matter, providing a qualitative characterization of the number archetypes by examining aspects of number and numeration drawn from a wide variety of cultures both ancient and modern, primitive and technologically advanced. In addition, she has investigated the dynamical aspects of the number archetypes and their relation to physical and psychic energy, and she has discussed historical and mathematical models of the *unus mundus* and the role of number archetypes in synchronistic phenomena. From her investigation of number archetypes, von Franz has concluded that the primarily collective, quantitative aspects of number that pre-occupy Western number theory are complemented by individual, qualitative aspects. As with all archetypes, the number archetypes have an inherent dynamical quality; that is, they represent abstract patterns of rhythmical behavior. According to von Franz:

The archetypes primarily represent dynamic units of psychic energy. In preconscious processes they assimilate representational material originating in the phenomenal world to specific images and models, so that they become introspectively perceptible as "psychic" happenings. (48)

In *Number and Time*, von Franz has discussed in particular detail the qualitative aspects of the four archetypes called the *quaternio*. While the *quaternio* are naturally associated with the first four integers, their archetypal nature gives them a much more comprehensive role. von Franz has given a summarizing statement of their archetypal behavior:

Numbers then become typical psychological patterns of motion about which we can make the following statements: One comprises wholeness, two divides, repeats and engenders symmetries, three centers the symmetries and initiates linear succession, four acts as a stabilizer by turning back to the one as well as bringing forth observables by creating boundaries, and so on. (49)

von Franz postulates that representations of this *quaternio* of archetypes provide the dynamical patterns that underlie all processes of perception and symbol formation in the psyche and account for the structure and transformations of matter and energy in the physical world:

Natural numbers appear to represent the typical universally recurring, common motion patterns of both psychic and physical energy. Because these motion patterns (numbers) are identical for both forms of energy, the human mind can, on the whole, grasp the phenomena of the outer world. This means that the motion patterns engender "thought and structure models" in man's psyche, which can be applied to physical phenomena and achieve relative congruence. The existence of such numerical nature constants in the outer world, on the one hand, and in the preconscious psyche, on the other (e.g., in the quaternary structures of the "psychic center," the

triadic structure of dynamic processes, the dualistic structure of threshold phenomena, and so forth) is probably what makes all conscious knowledge of nature possible. (50)

The dynamical behavior of the number archetypes, in particular the *quaternio*, is thus held to characterize all physical processes and mental acts of perception and symbolic representation. The number archetypes are thought to be universal aspects of symbol formation, or symbolic universals, and as such, they function in part as linguistic universals such as those postulated by Chomsky. Consequently, as von Franz has pointed out, the number archetypes should provide the means to formulate what Pauli has called a language which is “neutral” with respect to psycho-physical distinction.” (51) Such a language would offer an archetypally-invariant basis upon which representations of all physical and mental processes could be established.

Von Franz's research into number archetypes has significantly clarified and extended the archetypal hypothesis of Jung and Pauli, which can be restated as a general archetypal hypothesis:

All mental and physical phenomena are complementary aspects of the same unitary, transcendental reality. At the basis of all physical and mental phenomena there exist certain fundamental dynamical forms or patterns of behavior called number archetypes. Any specific process, physical or mental, is a particular representation of certain of these archetypes. In particular, the number archetypes provide the basis for all possible symbolic expression. Therefore, it is possible that a neutral language formulated from abstract symbolic representations of the number archetypes may provide highly unified, although not unique, descriptions of all mental and physical phenomena.

The Relevance of Archetypes to a Contemporary Philosophy of Nature

In summary, the concept of archetype that was initially developed by Jung is an abstraction obtained only by inference from archetypal representations that appear in the form of images or ideas that share a common isomorphic structure. Only these archetypal representations are ever consciously experienced. Because the archetype, as such, functions in the unconscious mind, it is not directly known or knowable. Because archetypes, as such, are held to be prior to conscious thought and to support it, they can never be exhaustively characterized by conscious thought. Thus, inherent in the archetype concept is the assertion of the limitedness of rational thought to provide a complete description of reality. The inferred existence of the archetype, as such, implies an inherently non-rational aspect of reality which assures that no attempt to describe reality in its totality can be held to be completely unique or complete. Through the work of Jung, Pauli, and von Franz, the concept of archetype has been extended from Jung's initial results of his use of a comparative technique for identifying common motifs of images in the psyche to a cluster of propositions that comprise a hypothesis about the existence of dynamical ordering factors operating throughout nature, both in the functioning of the mind and in the behavior of matter. When cast in such a role, the concept of archetype touches upon some of the central concerns of a contemporary philosophy of nature: It suggests a new approach to conceptualizing the dynamics of matter and energy throughout all levels of hierarchical organization found in nature. It also provides an approach for understanding how knowledge of nature is at all possible or, in other words, why it is possible to have simple theories that are true. Even more, it suggests that symbolic representations of certain archetypes

may lead to the formulation of languages that would be capable of providing compact and unified descriptions of all physical and mental phenomena. For these reasons alone, the archetypal hypothesis would seem to warrant close scrutiny as a potentially valuable new approach to the philosophy of nature. This conclusion is further strengthened by the emergence in the social, biological and physical sciences of certain phenomena and issues that suggest the relevance and utility of the archetype concept directly in those areas.

The Emergence of the Archetype Concept in Contemporary Science

Through a process of intellectual diffusion, the concept of archetype that Jung introduced into his studies of the psychology of the unconscious has established its utility in the analysis of literature, drama, art, music and cinema and in the study of religion and comparative mythology. (52) Moreover, it has begun to be discussed directly in the sciences, particularly in biology and sociology. More significant, however, is the circumstance that in many areas of science there are emerging phenomena and concepts used to explain them which have associations and correspondences to the Jungian concept of archetype, although the conceptual link is often unrecognized.

Correlates of the Archetype Concept in the Social and Behavioral Sciences

Jung himself pointed to some of the concepts in the social sciences that correspond in varying degrees to the archetype concept (53): In mythological studies there is the concept of *motif*; in the psychology of primitives there is Lucien Levy-Bruhl's concept of *representations collectives*; in comparative religion Henri Hubert and Marcel Mauss have defined *categories of imagination*; and Adolf Bastian speaks of *primordial thoughts*. More recently, Anthony Stevens has identified additional correlates of the archetype concept: In gestalt psychology there is Wolfgang Kohler's *isomorphs*; in developmental psychology there is John Bowlby's *behavioral systems*; in anthropology there is Robin Fox's *biogrammar*; and in psycholinguistics there is Noam Chomsky's *language acquisition device* and *deep structure*. (54)

The Exploration of the Archetype Concept in the Biological Sciences

Jung began the discussion of the archetype concept within the biological sciences by associating the instincts with his concept of the archetype. In fact, he held, "...that there is good reason for supposing that the archetypes are the unconscious images of the instincts themselves, in other words, that they are patterns of instinctual behavior."(55) In the field of ethology, Konrad Lorenz and Niko Tinbergen have developed the concept of *innate releasing mechanisms* in the instinctive behavior of animals which have some of the same characteristics as Jung's concept of archetypes. Drawing upon Jung's observations, Adolf Portmann explored the idea of archetypal patterns of behavior in animals, and based thereupon, he proposed a three-level classification of archetypal structures in early childhood behavior. (56) In 1977, Ernest Rossi introduced Jungian concepts into the field of neurobiology when he attempted to relate discoveries about the functioning of the left and right hemispheres of the brain to the four psychological functions developed in Jung's theory of personality types.(57) He also correlated the neural processes corresponding to ego, persona, shadow, and the personal unconscious to the functioning of the left hemisphere and, in similar fashion, symbols, archetypal processes, and the collective unconscious to the right hemisphere. Accompanying Rossi's paper was a "Comment" by James P. Henry in which he noted the role of the subcortical brain systems that had been

overlooked by Rossi in his discussion of the possible location of neurophysiological correlates to the archetypes and of the collective unconscious. (58)

In his book, *Archetypes: A Natural History of the Self*, Anthony Stevens has explored on a wide scale the biological evidence which supports the validity of the archetype concept. (59) He specifically approaches the archetype concept as a scientific hypothesis capable of verification. To illustrate various archetypal patterns of behavior, Stevens does not focus upon the content of dreams, myths, and fantasies, but upon the work of ethologists and sociobiologists with topics ranging from aggression to initiation rituals. He also reviews the work of Rossi and Henry, as well as that of MacLean, Flor-Henry, Jouvett, and others in an attempt to provide a synthesis of neurobiological findings with Jungian concepts. In an essay by Stevens on the archetypal basis of religion, he formulates a succinct statement of the archetypal hypothesis which clearly places Jung's concept in a neurobiological context:

The archetypal hypothesis proposes that we possess innate neuro-psychic centers which have the capacity to initiate, control, and mediate the common behavioral characteristics and typical experiences of all human beings irrespective of race, culture, or creed. (60)

Response to Steven's attempt to place the archetype concept into a wider scientific context has come from such disciplines as psychobiology, ritual studies, theology and structural anthropology. For example, Eugene G. D'Aquili has considered the archetypal hypothesis in his research into the psychobiological bases of myth and ritual. (61) J.P. Henry has examined recent neurophysiological research that may indicate an archetypal patterning of emotion. (62) Edith Turner has discussed the concept of relational archetypes to account for preparedness and provide universal patterns of social action. (63) In 1994, the book, *Descartes' Error*, was published in which the neurologist Antonio Damasio presented a broad synthesis of the results of research exploring the organization and activity of the human brain and neural system and their relationship to the human mind. (64) Although Damasio wrote without any reference to Jung's work and his argument, contra Descartes, was for the conception of a fully embodied mind, a concept of mind grounded completely in the behavior of neurons in the human body, several features of his account appear as the neurobiological counterparts of some of Jung's observations or concepts. For both Jung and Damasio, the psyche consists essentially of images. According to Damasio, recalled images, whether they are visual, auditory, or tactile in nature, are representations that are reconstructed through the action of 'acquired dispositional representations' which exist as potential patterns of neuron activity in small ensembles of neurons that he calls 'convergence zones'. For Damasio as for Jung, the psyche is not a *tabula rasa* at birth; in addition to acquired dispositional representations, Damasio posits the existence of 'innate dispositional representations' that are required for control of metabolism, drives, and instincts. While the innate dispositional representations are not held to generate images, the consequences of their activity can produce imagery. Furthermore, beyond the role of innate dispositional representations in bodily regulation, they appear to be involved in the development and adult activity of what Damasio calls 'suprainstinctual survival strategies' that are concerned with social cognition and behavior. Finally, Damasio posits as the main thesis of his work the notion that feeling and emotion must be accorded a central role in human rationality, a conjecture that agrees with Jung's characterization of feeling as a rational mental function. While it certainly would be premature at best to identify specific elements of Damasio's neurological model with psychological concepts developed by Jung - in particular, to equate 'innate dispositional representations' with Jung's 'archetypes' - there does seem to be a basic compatibility between these two areas that suggests that a conceptual convergence between them

might be possible. Recently the concept of archetype has been re-introduced into discussions of biological taxonomy and morphology. Van der Hammen uses the archetype concept in the sense of an innate genotypic pattern underlying evolution. (65) He intends it to serve as a model of the evolutionary genotypic potentialities of a taxon, and as a standard of higher classification based on a complete comparative morphology. Bruce Young has argued that an a priori assumption of the existence of archetypes in the sense of stable, underlying patterns within morphological systems is essential for the incorporation of the concepts of 'structure' and of 'homology' within a morphological science. He holds " ...that the conceptual focus of morphology should be on the archetype, and that the ultimate goal is to determine how archetypes are established and maintained evolutionarily, and the influence they exert upon the system as a whole." (66) Stephen Gould has re-examined Owen's structuralist account of morphology based on the notion of a vertebrate archetype which was displaced by Darwin's functionalist theory of evolution by natural selection. He has pointed out the falseness of the identification of Owen's theory as creationist and of the characterization of the struggle between these two approaches to morphology as a conflict between creationism and evolutionism. He argues that there is a place for consideration of structural factors in an account of evolution:

If adaption provides a key and driving force for functionalist theories, the idea of constraint forms the backbone of structuralist thought about evolution. Change cannot follow all possible paths dictated by external forces; an organism is not putty before a molding environment. Constraints are imposed both by starting points (the form of the archetype for Owen, perhaps the structure of DNA for modern adherents) and by rules of transformation specified by the nature of organic materials. (67)

Later in his essay, after reviewing the history of Owen's vertebrate archetype and the reasons why it was superceded by Darwin's theory, he concludes:

We need an evolutionary theory that unites a molding outside (natural selection producing adaptation to local environments) with a guiding inside (the structural laws that Owen sought, with an antiquated apparatus to be sure, but with a prescient vision).

Besides, the general idea behind the archetype is not wrong. At some level, unity of structure must underpin the diversity of life: such order cannot proceed from formlessness. Owen failed by seeking order at too high a level - in the explicit bits and pieces of an archetypal morphology. We would seek it today in the universal structure of genetic material, in the blueprint of DNA. That blueprint constrains evolutionary possibilities as surely as Owen's archetype channeled vertebrate form. (68)

In 1981, a highly speculative and controversial account of morphogenesis was offered by Rupert Sheldrake which has been at times associated with Jung's concepts of the collective unconscious and of the archetype. (69) Sheldrake's hypothesis of formative causation postulates the existence of morphogenetic fields as presently unrecognized causal agents responsible for producing all of the forms, or patterns of structural organization, of matter and of living organisms. These fields are held to be actual physical fields, although they are non-energetic and non-local - they are distributed without diminishment throughout space and time. Sheldrake proposed that the forms of molecules, crystals, cells, complex organs such as eyes, etc., the overall structures of all living creatures, and even the structure of entire societies are all established by a process of morphic resonance by which a seed structure is guided to its final form by resonating with a particular pre-existing morphogenetic field. Each aspect of form is associated with a unique morphogenetic field; thus Sheldrake's hypothesis involves

unfathomably many of these fields which may grow or diminish in strength in relation to the degree of morphic resonance within the particular field. New structures may appear through the action of a morphogenetic field, giving it an inherently creative aspect as well. The morphogenetic fields, then, act as a collective memory by which previously established patterns guide the emergence of new forms and by which novel occurrences of form proliferate. This collective memory would include established behavioral patterns which help to form specific types of behavior. Sheldrake speaks briefly about archetypes, which he seems to understand as ideal, perennially fixed forms in the same sense as the Platonic Ideas, rather than as patterns of behavior which are fluid and manifold in their representations. He therefore rejects the notion of archetype as a formative cause and characterizes the resonances in the morphogenetic fields as something similar to habits. In a subsequent publication, he has developed his theory of morphic resonance further by proposing that nature is governed by habits rather than by changeless laws and pursuing the implications for the individual and the evolution of human culture.(70)

Following upon Sheldrake's conception of a morphogenetic field, Michael Conforti has adopted an approach that characterizes archetypes as field resonance patterns. (71) He has then used this approach to discuss the interpersonal dynamics of the therapist/patient relationship. Conforti has also organized annual conferences at Assisi, Italy on, "The Confluence of Matter and Spirit in Psyche and Nature". In the context of the Assisi Conference lectures, David Peat, a physicist whose interests have ranged from Jung's concept of synchronicity to Bohm's notion of an implicate order, has discussed archetypes as generative principles of the material world and has questioned how they might be best characterized - whether as eternally fixed, 'crystalline' structures or as evolving 'dynamic' fields. Brian Goodwin, a biologist, has discussed holistic dynamical forms as factors in morphogenesis. Ervin Laszlo, a systems theorist, has advanced the possibility of the existence of holographic information fields associated with fluctuations of the quantum mechanical vacuum state as a source of biases put into quantum mechanical probability distributions, thereby establishing tendencies for certain forms in nature.

Archetypal Behavior in the Dynamics of Non- Linear Systems

During the past thirty years the nonlinear behaviors of a wide variety of complex physical systems have been studied in great detail, largely as a result of the availability of increasingly powerful and fast computers. The techniques of analysis of nonlinear systems have been applied to areas as diverse as fluid dynamics and combustion chemistry, or meteorology and biochemistry. Emerging in the attempts to model the behavior of complex dynamical systems are idealized dynamical models which are being called archetypal models. Mitchell Moncreiff, for example, has developed an archetypal dynamical model to study organized convective systems in meteorology. (72) His archetypal dynamical model is a fundamentally different approach from the statistical or averaging approximations that characterize much of present meteorological modeling techniques; it emulates the basic character of the mass and momentum fluxes by mesoscale convective systems. Similarly, Gray and Scott have developed archetypal model systems which can be used to analyze the nonlinear behaviors associated with autocatalysis in open chemical systems with two components. Such models, they claim, "...are of the greatest value not only in revealing how little is needed to generate great variety in behavior but also in understanding exactly how it arises." (73)

However, the area of nonlinear dynamics that has received a spectacular amount of attention in the last decade, to the extent that it has been claimed to constitute a new science, is the area of chaotic dynamics. While the behaviors of chaotic systems are deterministic, they are

neither regular nor predictable, and as a consequence, they are called 'chaotic'. When the dynamical behaviors of chaotic systems are analyzed geometrically by representing them in phase space, structures called chaotic or 'strange' attractors emerge as portraits of the systems' behaviors. As spatial representations of nonlinear behaviors, strange attractors are characterized by self-similarity and non-integer or 'fractal' dimensionality; for example, the Koch 'snowflake' has a dimension number of 1.26, while Cantor 'dust' has the dimension number 0.63. Dwelling in multi-dimensional phase spaces, they are best characterized by the images that result from their projection onto two-dimensional surfaces called Poincare sections. Studies of nonlinear systems have shown that the same strange attractor may be discovered in the dynamics of very different physical systems. The Rossler attractor, for example, characterizes the chaotic dynamics of systems as diverse as a dripping faucet and a fibrillating heart. Strange attractors thus share some of the important characteristics attributed to Jung's conception of archetypes: Both are patterns of dynamical behaviors which reveal levels of order that are often hidden by the manifestly chaotic behavior of complex systems. Both represent constraints or limitations that are placed on the possibilities of the behavior of the respective systems. Both are irrepresentable in their entirety but may be characterized by a succession of projected images, each of which reveals an aspect, but not the totality, of the system's behavior.

The concepts and techniques that were developed for the analysis of physical systems exhibiting chaotic behavior have been taken far from their original domain and applied to non linear behaviors in areas as diverse as economics, organizational psychology, ecology, political science and depth psychology. In this last area several authors have argued that archetypes may be considered to be strange attractors operating in the complex dynamics of the psyche. For example, J. R. van Eenwyck has equated complexes with the dynamics that are represented by fractal attractors, and he has asserted that archetypes and fractal attractors may be synonymous. (74) He has also suggested that the tension between consciousness and the unconscious may be compared with the nonlinear phenomenon of period doubling and that the boundary between consciousness and the unconscious is fractal. Furthermore, transference and counter-transference show multi-oscillatory dynamics, and defense mechanisms function like fractal attractors. Rossi has suggested that anxiety, phobias, and depression might be seen as psychobiological homeostatic attractors that have gone astray and that social processes, rites and rituals could be considered as broadly based strange attractors in culture. (75) The discussion of the relationship between archetypes and strange attractors will require both caution and care, however, and the simple identification of these two concepts should be avoided. What archetypes and strange attractors share are certain similarities in the way that they describe the phenomena of each of their respective domains. In particular, chaotic dynamics can provide a rich vocabulary which may be used to describe the dynamical phenomena associated with archetypes. However, to claim that archetypes are strange attractors and vice versa would lead to a reductive collapse of the mental and physical realms, when in fact a more profound understanding of the basis by which these two realms are somehow distinguishable is urgently needed.

The Search for Archetypes in Computer Science

Within computer science work is presently underway to develop an archetypal approach to computer programming in an attempt to unify sequential, parallel, and distributed approaches to computing. Dr. K. Mani Chandy is the head of the Archetype Working Group at the California Institute of Technology in the U.S. (76) This interdisciplinary team of students and

researchers, drawn from disciplines such as computer science, applied mathematics, and electrical engineering, base their archetypal approach upon the premise that there are certain patterns that recur very often in a variety of contexts in scientific computing, patterns such as “divide and conquer” strategies, mesh methods, spectral analysis, and others. If an archetypal approach can be developed for presenting and reasoning about such patterns, then it is hoped that the time and effort required to develop computer programs written in a variety of computer languages and run on many different systems and machines can be greatly reduced.

The Suggestion of Archetypes in Quantum Phenomena

Quantum mechanics stands as a revolutionary physical theory not simply because it is able to provide an understanding of certain phenomena that are bizarre and unexplainable in terms of classical mechanics and electrodynamics. Quantum mechanics initiated a radical departure from the prevailing Newtonian mechanistic *weltbild* when it gave to the concept of probability a fundamental role in the description of physical reality. The endowment of probability with this fundamental role prevailed despite intense criticism by Einstein, Schrodinger and many others, as the history of the development of quantum theory clearly reveals. Even today it lies at the heart of many of the interpretative issues actively being discussed. As unexpected as the emergence of the fundamental role of probability was against the backdrop of Newtonian classical theory, it is remarkable that from the perspective of the archetypal hypothesis, this development would be fully anticipated. Because archetypes, as such, are never directly experienced but are inferred from the recurrence of the isomorphic features of their many representations, they appear as a type of order that is inherently probabilistic. The immediate appearance of archetypal order is as a statement of the relative frequency of occurrence of certain characteristics - in other words, as a statement of probability. In his essay on synchronicity, Jung drew attention to the relationship of archetypes to probability when he wrote,

The archetype represents psychic probability, portraying ordinary instinctual events in the form of types. It is a special psychic instance of probability in general, which, “is made up of the laws of chance and lays down rules for nature just as the laws of mechanics do.” (77)

It appears that Pauli first suggested to Jung the connection of archetypes to probability, because in a letter written by Jung to Pauli in the year preceding the publication of his synchronicity essay, he stated:

Your idea that the archetype corresponds to the mathematical notion of probability was very elucidating to me. In fact, the archetype is nothing else than the probability of psychic events. It is so, to- speak, the pictorially presupposed result of a psychic statistic...

Probability corresponds physically to the so-called natural law and psychologically to the archetype. Law and archetype are both modi and abstract ideal cases which exist within empirical reality in each case only in a modified manner. This point of view corresponds to my definition of the archetype as “pattern of behavior”. (78)

Consequently, archetypes operating in the physical world would be expected to lead to the portrayal of the regularities of physical phenomena as statements of probabilistic laws. Thus the emergence of probability as in fact necessary for the description of fundamental physical processes may be understood as an indication of the existence of archetypes operating in the physical world.

A further indication of archetypal order in quantum phenomena may be inferred from the prominent role played by symmetry properties and principles in the formulation of quantum mechanics and in the description of elementary particles. The correspondence of the concept of abstract group with its particular realizations to the concept of archetype, as such, with its archetypal representations has received attention from several authors: Jung himself initiated this comparison when he asserted that the archetype, "might perhaps be compared to the axial system of a crystal, which, as is were, preforms the crystalline structure in the mother liquid, although it has no material existence of its own." (79) Werner Nowacki has pursued the relationship between archetypes and groups further, asserting that symmetry groups may be thought of as primal images:

Symmetries are formal factors which regulate material data according to set laws. A symmetry element or a symmetry operation is in itself something irrepresentational. Only when... it has an effect upon something material does it become both representational and comprehensible. As primal images the symmetry groups underlie, as it were, crystalized matter; they are the essential patterns according to which matter is arranged in a crystal... The analogy between symmetry elements and the archetypes is clearly unusually close. This is the pivot of the structure of reality. (80)

Recently Peat has continued this line of thought, suggesting that:

These fundamental symmetries could be thought of as the archetypes of all matter and the ground of material existence. The elementary particles themselves would be simply the material realizations of these underlying symmetries. (81) It is not clear that symmetries can be simply equated with archetypes, but the fundamental role of symmetry in quantum mechanics and particle physics seems to point in a direction that justifies an intensive consideration of the archetype concept in these areas. Pioneering work for just this purpose was performed by Werner Heisenberg, who with the dictum, "In the beginning there was symmetry," closely associated symmetry as a fundamental ordering principle of nature to the Platonic doctrine of Ideas. (82)

If quantum mechanics has led to a revolution in physics, it is a revolution that has not yet been completed. At the heart of quantum mechanics lies a mystery whose solution may entail deeper and more fundamental changes to our scientific *weltbild* than those which have already taken place. This mystery is quantum non-locality, and it is the most dramatic indication of the possibility of archetypal order in quantum phenomena. As is well known, the issue of non-local behavior in quantum phenomena became prominent with the discussions of the EPR paradox in 1935. By 1964, these discussions took a dramatic turn when J.S. Bell published a theorem which established that any deterministic local hidden variable theory could be experimentally distinguished from quantum mechanics. Throughout the 1970's, EPR-type experiments were conducted to test the inequality relation which, as Bell had shown, must be violated by quantum mechanics. By the early 1980's, the experiments of Aspect had persuasively demonstrated that such a violation does indeed occur, and these results have been confirmed by a number of other experiments during the past decade. As a result, local hidden variable accounts of quantum phenomena have been all but eliminated as theoretical contenders with quantum mechanics. This result has served to highlight what is perhaps the strangest aspect of the behavior of a quantum system - the possibility of inherently non-local connections between elements of the system.

The issue of non-locality in quantum phenomena has received much attention, particularly since the publication of Aspect's experiments. Searching analyses of quantum non-locality have been undertaken to establish its physical and philosophical implications. Despite at times the intention of their authors, these analyses generally lead to the conclusion that non-locality is an enigma that cannot be incorporated into prevailing conceptions of reality. As numerous authors have pointed out, the non-local connections in quantum mechanics are exactly the type of phenomena discussed by Pauli and Jung as acausal orderedness. (83) Because of the centrality of the concept of acausal orderedness to the archetypal hypothesis of Jung and Pauli, it is possible that their hypothesis may lead to the reformulation of a scientific *weltbild* in which non-local behavior in quantum phenomena has a natural and comprehensible role.

von Weizsacker's Theory of Ur - Alternatives

Among theoretical physicists, Pauli's philosophical thought, in particular the ideas about archetypes that resulted from his collaboration with Jung, is generally unknown, although in the past ten years the work of Kalervo Laurikainen, Charles Enz, and others has opened a discussion of his relevant essays and correspondence. Pauli himself was hesitant to introduce the archetype concept into theoretical physics, perhaps with good reason, because the vast majority of the physicists of the day may well have rejected the concept of archetype out-of-hand. However, one theoretical physicist and philosopher of science and a contemporary of Pauli, Carl Friedrich von Weizsacker, was aware of the relevance of the archetype concept to science. In 1965, at a lecture given at the Stuttgart Institute for Psychotherapy and Depth Psychology, he acknowledged that,

Science itself is based on archetypes. The archetypes predominant in modern science are those Plato called mathematical.... But what is given us as the a priori of mathematics, what belongs to the preconditions of the possibility of distinguishing objects that differ from one another and remain identical with themselves in time, by no means constitutes the whole of the Platonic idea: i.e., what Plato calls the idea itself. This idea contains a great deal beyond the mathematical, and it is into these regions that Jung, I think, cast a glance, to see, if only for a fleeting moment, a contour amidst the swiftly moving clouds. More is not to be expected at this point. (84)

von Weizsacker made this last remark a few years after the deaths of Pauli and Jung and before von Franz's publication of *Number and Time*. While his subsequent work does not specifically refer to archetypes, his development of the theory of ur-alternatives is probably the closest approach to archetypes yet made in theoretical physics.

von Weizsacker defined the "ur" as a fundamental binary alternative, a quantum of factual information. The ur is held to be the simplest possible object, but it is not a material particle. As a quantum of information, it is applicable to both the realms of mind and of matter. von Weizsacker's motivation to develop the ur theory is, "...part of an attempt to reduce the laws of physics as far as possible to a statement of the preconditions of experience." (85) These preconditions of experience might be considered as, "...building blocks for the axiomatic of a comprehensive theory." (86) Subsequently, von Weizsacker has presented a reconstruction of quantum theory based on ur-alternatives, and he and other theoretical physicists have explored the implications of this theory for other areas of theoretical physics. John A. Wheeler has succinctly characterized the progression of such a theory from binary alternatives to the laws governing the behavior of matter as, "It from Bit" (87). From an archetypal perspective, particularly in light of von Franz's work on number archetypes, the theory of ur-alternatives can be characterized as an exploration of the kind of binary processes and distinctions associated with the archetypal nature of Two.

Prospects for an Archetypal Philosophy of Nature

In summary, an examination of the task to which a contemporary philosophy of nature might be put suggests that it has a fundamental role in the examination of the concepts and conceptions which comprise the presuppositions which science makes about the nature of matter and energy, of space and time, and of even more fundamental concepts such as those by which any object comes to be distinguished as an object. A philosophy of nature must also engage the problem of human knowledge: It must discuss the means and limitations inherent in the processes of conceptualization itself, for these are necessarily factors in the formation of any concepts by which nature is described. For both of these purposes, the work of Jung, Pauli and von Franz on the role of archetypes in both the realms of mind and of matter can provide substantial new insights which can become the basis of a new philosophy of nature. Furthermore, a survey of developments within various areas of present-day science also suggests the importance of an archetypal approach to issues and problems in those areas. Biology, for example, might profit from an archetypal approach to the patterning of genetic information in replicative processes. The issues arising from the complexity of the nonlinear dynamics in many systems - chemical, biological, psychological, sociological - might also be clarified by an archetypal approach. As well, the recognition of the description of fundamental physical processes as being necessarily probabilistic and the appearance of non-local quantum phenomena both suggest the applicability of the archetype concept to physics. Thus an archetypal philosophy of nature could potentially accomplish the much needed re-examination of the conceptual basis of science which science is incapable of providing for itself, and the result of this might ultimately be the attainment of a comprehensive, unified *weltbild*. A philosophy of nature based upon archetypes could be seen in several respects as a continuation of the approach to nature taken by the Naturphilosophen of the 19th Century. In general terms, a contemporary archetypal philosophy of nature would carry on the concerns of the Naturphilosophen to obtain a view of nature as an organic whole, a macrocosm, in which the human is seen within it as in some sense a microcosm. It would regard the problems of human knowledge and of the knowledge of nature as inseparable. It would give more emphasis to process-oriented, qualitative, dynamic descriptions of nature in order to balance the quantifying, materializing descriptions which show a preoccupation with categorizing the elementary units of matter. As a consequence of the inherently dynamic character of archetypes, an archetypal philosophy of nature would also acknowledge the active, intelligent, purposeful behavior of the world as a whole. It is this aspect of the world that was characterized by Plato as the World Soul, or *anima mundi*, and as such, the World Soul was re-expressed through Neo-Platonic influences in the thought of the Naturphilosophen. Theodore Roszak has suggested that the *ima mundi* itself should be considered to be an archetype that has found various forms of expression throughout history, from primitive representations of the Great Mother, to the more abstract *anima mundi*, to the recent re-emergence of Gaia as a “...superorganismic system of all life on earth” in the *Gaia Hypothesis* of James Lovelock and Lynn Margulis. (88) The concept of *anima mundi* had been rendered obsolete in the view of the world as mechanism that resulted from Descartes’ distinction of *res extensa* and *res cogitans* and the successes of Newtonian mechanics, but the failure of that *weltbild* to account for quantum phenomena in particular has opened the possibility for a re-expression of the concept of the World Soul. In his recent discussion of implications of his theory of ur-alternatives, von Weizsacker has drawn attention to the possibility for the re-emergence of the World Soul: he has argued that if quantum theory may be

understood to be a theory of information, then it applies to information about mental events as well as physical events. According to the ur theory, *res cogitans* and *res extensa* must then enter into appearance together, and thus Cartesian dualism is theoretically strictly refuted. The consequence of this is a holism that encompasses all that exists in both the realms of mind and of matter that brings forth the question of the possibility of a World Soul. (89) von Weizsacker has further argued that just as an organ such as an eye or a hand serves the perceptions and actions of a living organism without itself being conscious of the totality of perceptions and actions of which the organism is aware, it might be that living creatures such as our selves are, as well as being individuals, organs of a world organism, a World Soul, whose consciousness is from time to time partially reflected in our own consciousness. (90) A philosophy of nature could also be seen as having elements of it specifically derived from the Naturphilosophen. Kant and Goethe were important sources of inspiration for the Naturphilosophen, as they were later to be for Jung. For example, Kant's *Ding-an-sich* and his categories of perception both heavily influenced Jung's characterization of archetypes. Goethe's concepts of *Urbild* and *Urpflanze* showed an archetypal approach to biological morphology that may have indirectly influenced Jung's morphological approach to the structure of dreams and fantasies. Jung acknowledged the deep influence that Goethe had upon him; at one point in his autobiography he explained that as a student, "My Godfather and authority was the great Goethe himself..." (91). As well, Lorenz Oken's characterization of numbers as "acts or functions" might be considered as an anticipation of number archetypes. (92) However, an archetypal philosophy of nature would not need to set itself in opposition to the methods of science, as did Naturphilosophie. The rejection of the analytic, quantitative methods of Newtonian physics by the Naturphilosophen can be seen as a reaction against the mechanistic, materialistic *weltbild* associated with that science. At the time, the methods of science and the associated *weltbild* appeared to be inseparable; thus the rejection of the latter necessitated the rejection of the former as well. Now, nearly two centuries later, the methods of science themselves, through the development of Einstein's theories of relativity, quantum theory, and nonlinear dynamical theories, have destroyed the image of the world as a machine. However, there is as yet no replacement - no comprehensive, unified *weltbild* in concordance with present-day scientific knowledge. If such a *weltbild* is ever to be obtained, it will probably appear only as a consequence of far-reaching changes to the conceptual foundations of science, changes which science proper cannot initiate for itself. This is the legitimate sphere of activity for a contemporary philosophy of nature that complements the methods and aims of science and which science itself requires for its own advancement. However, if a contemporary philosophy of nature based on the archetype concept is conceivable, at present it could be only in the early stages of its infancy. Jung's erudition can easily give the impression that his psychological research is definitive and final, whereas, as Jung himself maintained, it is only provisional and just a beginning. Considerable work will be required to establish a stronger methodological basis for the archetype concept in psychology, and its extension to other areas of science will necessitate a thorough-going philosophical and empirical examination. To a certain degree this process has already started: Edmund Cohen and Walter Shelburne have both explored the scientific basis of Jung's theory of archetypes, and Marilyn Nagy has attempted to examine Jung's thought in its philosophical context. (93) However, there are a number of criticisms and misperceptions about the nature of archetypes that will have to be addressed and corrected, and in this process, the present meaning of the concept of archetype may become greatly transformed. (94) The consequence of this transformation, if it is successful, will be a transformation at a very deep level of our understanding of nature and our place in it.

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Literature

1. Leclerc, I.: *The Philosophy of Nature*. Catholic Univ. of America Pr., Washington, D.C., 1986, p.4.
2. van Melsen, A.G.: *The Philosophy of Nature*. Duquesne Univ. Pr., Pittsburgh, 1961, p. 16.
3. Weinberg, S.: *Dreams of a Final Theory*. Pantheon, N.Y., 1992. See also: Davies, P.C.W. and Brown, J., eds.: *Superstrings - A Theory of Everything?* Cambridge Univ. Pr., 1992; Barrow, J.D.: *Theories of Everything*. Ballentine, N.Y., 1991.
4. d'Espagnat, B.: "Veiled Reality", *Symposium on the Foundations of Modern Physics - 1987*. World Scientific, Singapore, 1987, p. 147. See also: Castell, L., Drieschner, M., and v. Weizsacker, C.F.: *Quantum Theory and the Structures of Time and Space*, Vol. 2. Carl Hanser, Munich, 1977, p.11; in addition, see: von Weizsacker, C.F.: *Zeit und Wissen*. Carl Hanser, Munich, 1992, p. 799.
5. Jacobi, J.: *Complex/Archetype/Symbol*. Pantheon, N.Y., 1959, p.49. See also: Schmitt, P.: *Archetypisches bei Augustin und Goethe*. Eranos Jahrbuch XII, Rhein Verlag, Zurich, 1945, p. 98.
6. van der Hammen, L.: "Type- concept, higher classification and evolution", *Acta Biotheoretica*, 30, 1981, p. 5.
7. Jacobi, J.: *The Psychology of C.G. Jung*. Yale Univ. Pr., New Haven, 1973, p. 42. See also Refs. 5, 6, and 9.
8. Richards, R.J.: *The Meaning of Evolution*. Univ. of Chicago Pr., Chicago, 1992.
9. Rupke, N.A.: "Richard Owen's Vertebrate Archetype", *Isis*, 84, 1993, p. 231.
10. Darwin, C.: *The Origin of the Species*. Encyclopaedia Britannica, Chicago, 1952, p. 218.
11. Jung, C.G.: *Letters*, Vol. 1. Princeton Univ. Pr., Princeton, 1973, p. 360.
12. Jung, C.G.: *Letters*, Vol. 2. Princeton Univ. Pr., Princeton, 1975, p. 567.
13. Jung, C.G.: *The Collected Works of C.G. Jung*, vol. 9, i, Princeton Univ. Pr., Princeton, 1958, para. 5.
14. Jung, C.G.: *Collected Works*, vol. 9, i, para. 154.
15. Jung, C.G.: *Collected Works*, vol. 5. para. 45, 209, 316, 373.
16. Jacobi, J.: *Complex/Archetype/Symbol*. p. 33.
17. Jung, C.G.: *Collected Works*, vol. 8, para 270.
18. *ibid.*, para. 277.
19. Jung, C.G.: *Collected Works*, vol. 6, para. 747.
20. Jung, C.G.: *Collected Works*, vol. 10, para. 53.
21. Jung, C.G.: *Collected Works*, vol. 8, para. 414.
22. *ibid.* para. 417.
23. Jung, C.G.: *Collected Works*, vol. 9, i, para. 155.
24. Jung, C.G.: *Collected Works*, vol. 8, para. 417.
25. *ibid.*, para. 420.
26. Jung, C.G.: *Letters*, Vol. 2. p. 108.
27. Jung, C.G.: *Collected Works*. vol. 8, para. 843.
28. Jung, C.G. and Pauli, W.: *The Interpretation of Nature and the Psyche*. Pantheon, N.Y., 1955.
29. Jung, C.G.: *Collected Works*, vol. 8, para. 849.

30. *ibid.*, para. 858.
31. *ibid.*, para. 984.
32. *ibid.*, para. 965.
33. *ibid.* para. 966 and para. 967.
34. Jung, C.G.: *Collected Works*, vol. 18, para. 402.
35. Jung, C.G.: *Collected Works*, vol. 12.
36. Jung, C.G.: *Collected Works*, vol 11 and vol. 18, para. 402- 405. 37. Jung, C.G.: *Collected Works*, vol. 8, para. 417.
38. *ibid.*, para. 418.
39. Jung, C.G.: *Collected Works*, vol. 14, para. 767- 70.
40. Jung, C.G., and Pauli, W.: *The Interpretation of Nature and the Psyche*, p. 152. 41. *ibid.*
42. *ibid.*, p. 153.
43. *ibid.*, p. 210.
44. Meier, C.A.: Wolfgang Pauli und C.G. Jung. *Ein Briefwechsel*. Springer Verlag, Berlin/Heidelberg, 1992. p. 100. See also: Jung, C.G.: *Collected Works*, vol. 8, para. 995.
45. Pauli, W.: "Naturwissenschaftliche und Erkenntnistheoretische Aspekte der Ideen vom Un bewussten," *Collected Scientific Papers of Wolfgang Pauli*. Interscience, N.Y., 1964. p. 1212.
46. von Franz, M.- L.: *Number and Time*. Northwestern Univ. Pr., Evanston, 1974, p. 9.
47. *ibid.*, p. 45.
48. *ibid.*, p. 155.
49. *ibid.*, p. 74.
50. *ibid.*, p. 166.
51. Pauli, W.: "Naturwissenschaftliche und Erkenntnistheoretische Aspekte der Ideen vom Un bewussten." p. 1212. See also: von Franz, M.- L.: *Number and Time*. p. 87.
52. Barnaby, K. and D'Acerno, P., eds.: *C.G. Jung and the Humanities*, Princeton Univ. Pr., Princeton, N.J., 1990.
53. Jung, C.G.: *Collected Works*. Vol. 9, i, para. 89.
54. Stevens, A.: *Zygon*, Vol. 21, n. 1, 1986, p. 9- 29.
55. Jung, C.G.: *Collected Works*. Vol. 9, i, para. 91.
56. Lorenz, K.Z.: *The Foundations of Ethology*, Springer-Verlag, N.Y., 1981, p. 154. See as well.: Portmann, A.: *Eranos Jahrbuch* 18 1950, p. 413-432.
57. Rossi, E. : *Journal of Analytical Psychology*, Vol. 22, n.1, 1977, p. 32- 51.
58. Henry, J.P.: *Journal of Analytical Psychology*, Vol. 22, n. 1, 1977, p. 52- 57.
59. Stevens, A.: *Archetypes: A Natural History of the Self*. Routledge and Kegan Paul, London, 1982.
60. Stevens, A.: *Zygon*, vol. 21, n.1, 1986, p.12. See also p. 296 in reference 59.
61. d'Aquili, E.G.: *Zygon*, vol. 21, n.2., 1986, p. 141-60.
62. Henry, J.P.: *Zygon*, vol. 21, n. 1, 1986, p. 47-73.
63. Turner, E.L.B.: *Zygon*, vol. 21, n. 2, 1986, p. 219-232.
64. Damasio, A.R.: *Descartes' Error*. G.P. Putnam's Sons, N.Y., 1994.
65. Van der Hammen, L.: *Acta Biotheoretica*, vol. 30, 1981.
66. Young, B. A.: *Biology and Philosophy*, vol. 8, n. 2, 1993, p. 244.
67. Gould, S. J.: *Natural History*, V. 10, 1986, p. 18.
68. *ibid.*, p. 27.
69. Sheldrake, R.: *A New Science of Life*. Paladin, London, 1987.
70. Sheldrake, R.: *The Presence of the Past*. Collins, London, 1988.
71. Conforti, M.: *Psychological Perspectives*, Issue 30, 1994, p. 12- 21.
72. Moncreiff, M.: *Q.J.R. Meteorol. Soc.*, vol. 118, 1992, p. 819.
73. Gray, P., and Scott, S.K.: *Phil. Trans. R. Soc. London A* , vol. 332, 1990, p. 69.
74. van Eenwyck, J.R.: *Journal of Analytical Psychology*, vol. 36, 1991, p. 1- 25 and p. 141-163.
75. Rossi, E.L.: *Psychological Perspectives*, vol. 20, n. 1, 1989.
76. See the Archetype Project homepage on the Internet at the following URL:
<http://xent.caltech.edu/~Khare/ArchetypeHome.html/index.html#62086fa4>.

77. Jung, C.G.: *Collected Works*, vol. 8, para. 964.
78. Jung, C.G.: *Letter from Jung to Pauli*, Jan. 13, 1951, in Meier, C. A., ed.: *Wolfgang Pauli und C.G. Jung, Ein Briefwechsel 1932- 1958*. Springer- Verlag, Heidelberg, 1992. p. 72.
79. Jung, C.G., *Collected Works*. vol. 9, i, para. 155.
80. von Franz, M.- L.: *Number and Time*, p. 52.
81. Peat, F.D.: *Synchronicity: the Bridge Between Matter and Mind*. Bantam, N.Y., 1987. p. 94
82. For Heisenberg's interpretation of Plato and the significance of symmetry as the primeval pattern of creation, as Ideas in the Platonic sense, see: Liesenfeld, C.: *Philosophische Weltbilder des 20. Jahrhunderts*. Eine interdisziplinäre Studie zu Max Planck und Werner Heisenberg. Königshausen & Neumann, Würzburg, 1992, p. 153ff.
83. Keutzer, C.S.: *Journal of Analytical Psychology*, vol. 29, 1984, p. 373- 381. See also: Ra schke, E.: *Zygon*, vol. 17, n. 3, 1982, p. 236; Mansfield, V. and Spiegelman, J.M.: *Journal of Analytical Psychology*, vol. 34, 1989, pp. 3- 31; Zinkin, L.: *Journal of Analytical Psychology*, vol. 32, 1987, p. 1-21.
84. von Weizsacker, C.F.: *The Unity of Nature*. Farrar, Straus, Giroux, N.Y., 1980. p. 249.
85. von Weizsacker, C.F.: *Quantum Theory and the Structures of Time and Space*, Vol. 2. Carl Hanser, München, 1977. p. 100.
86. von Weizsacker, C.F.: *Quantum Theory and the Structures of Time and Space*, Vol. 3. Carl Hanser, München, 1979. p. 12.
87. Wheeler, J.A.: *At Home in the Universe*. American Inst. of Physics Pr., Woodbury, N.Y., 1994, p. 295.
88. Roszak, T.: *ReVision*, vol. 16, n. 3, 1994, p. 108-114.
89. von Weizsacker, C.F.: *Zeit und Wissen*. Carl Hanser, München, 1992. p. 353.
90. *ibid.* p. 406.
91. Jung, C.G.: *Memories, Dreams, Reflections*. Pantheon, N.Y., 1973. p. 87.
92. Oken, L.: *Elements of Physiophilosophy*, Ray Society, London, 1847, p. 13.
93. Cohen, E.D.: *C.G. Jung and the Scientific Attitude*. Philosophical Library, N.Y., 1975. See also: Shelburne, W.A.: *Mythos and Logos in the Thought of Carl Jung*. State Univ. of N. Y. Pr., Albany, 1988; Nagy, M.: *Philosophical Issues in the Psychology of C.G. Jung*. State Univ. of N.Y. Pr., Albany, 1991.
94. See, for example, Percival, R.S.: *Journal of Social and Evolutionary Systems*. vol. 16, n. 4, 1993. p. 459- 487.

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2. "The Archetypal Hypothesis of Wolfgang Pauli and C.G. Jung: Origins, Development, and Implications", an invited lecture presented at the Symposium on the Foundations of Modern Physics - 1992, at Helsinki, Finland, and published in the Proceedings of the Symposium by World Scientific Publishing Co., Singapore, 1993, pp. 361- 390.
3. "A New Archetypal Science"; *Psychological Perspectives*, Issue 31, 1995, pp. 62- 64.