

The Complex Information Process

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Received: 28 January 2000 / Accepted: 5 February 2000 / Published: 24 July 2000

Abstract: This paper examines the semiotic development of energy to information within a dyadic reality that operates within the contradictions of both classical and quantum physics. These two realities are examined within the three Peircean modal categories of Firstness, Secondness and Thirdness. The paper concludes that our world cannot operate within either of the two physical realities but instead filiates the two to permit a semiosis or information-generation of complex systems.

Keywords: energy, information, classical and quantum physics, evolution, complexity.

1. Introduction: the reality of dualism

Energy is the essence of both abiotic and biotic reality. Energy can only exist in our cosmos when it is transformed from so-called 'free energy' or 'effete matter' to 'matter' or 'information' by processes of organized restrictions or constraints which can be understood as codifications of this free energy within patterns of relations. As such, energy is transformed into information by semiosis; these processes take place within a dyadic architectural frame.

What is a dyadic or dualistic world? It is a world that operates within an architecture that differentiates the actions that develop reality into two levels of physical and epistemic processes. Both of these 'worlds' are real, they are not naive aspects of subjective idealism. Furthermore, their natures are completely contradictory and therefore, these two realities cannot merge or the resultant implosion would catastrophically obliterate our universe. However, both realities are vital and necessary for the maintenance and evolution of energy to information. Energy requires 'two worlds' and semiosis is the means, the only means, to filiate and relate these two worlds.

2. The two realities

What is a non-dyadic or monadic world? We might imagine such within a state of homogeneity, the pure symmetry of wholeness. "What could appear as being in the present instant, were it utterly cut off from past and future...there plainly could be no action... the world would be reduced to a quality of un-analyzed feeling"[1-2.85]. A world without differences and therefore without particulars would be a motionless silence, a site of 'nothingness', for as Aristotle pointed out, "not to have one meaning is to have no meaning" [2- *Met.*1006b7). It "will experience no constraint and will be able to exist in all its probable states"[3]. To mean everything is to mean nothing.

What about a possible state where symmetry is not so complete and therefore, rudimentary forms of energy might exist? In this situation we could focus on the rules by which these rudimentary particles operate. We could postulate that this monadic world of uncomplicated particles is one that operates according to universal or omnipresent laws. This is the classical world of Newtonian physics, where, according to Depew and Weber [4] its laws are deterministic, closed, reversible and atomistic. Ulanowicz [5] adds that they are also universal.

Using yet another analogy, we might postulate a very different world where the particles do not operate according to symmetrical but to asymmetrical laws. Here, processes are not reversible, universal, deterministic, atomistic and closed but irreversible, local, contingent, organic and open. This is the quantum world, which threw the classical world into a turmoil. Quantum rules, rather than being global in a non-senescent manner, are local, i.e., they are dependent for their emergence on local exchanges, the so-called 'observer-created reality' Reality is therefore contingent rather than isolate and deterministic, for you cannot predict the probability of the actualization without also including that as yet undetermined action of measurement. "Before your observation only probability existed. But it was not the probability that an actual object existed in a particular place (as was the case in the classical shell game) – it was just the probability of a future *observation* of such an object, which does not include the assumption that the object existed there prior to its observation" [6].

These two realities, the classical and the quantum, are antithetical to each other. How does one deal with contradictory worlds? Some have rejected the one in favour of the other. One world is real and the other a figment of our imagination – and which world is the real and which the fictive has been a matter of intense debate. A reductionist will state that the more complex or relativistic quantum world(s) of the biological and the conceptual can be reduced to the fundamental operations of the classical world of physics. A postmodernist will insist that the entire world is a conceptual and subjective construction. A more conciliatory approach is to consider that quantum refers only to the microscopic experiences, while the classical refers to the macroscopic, though this epistemic cut involves vagueness of exactly where one ends and the other begins. Some have tried to deal with these 'two worlds' by introducing the idea of 'multiple worlds' [7], a cosmos that includes all actualizations of potentialities by virtue of isolating each into different spatial and temporal 'world-spaces'.

What if, instead, we have a world that operates by both sets of rules? What if, rather than the one or the other of these worlds, we postulate that our world necessarily requires both processes, the classical and the quantum? How can we have one world, existing within processes that are contradictory to each other? The answer is - semiosis.

3. Semiotic codification - to permit differences

Energy is, in its pure state, potentiality, which means that it does not exist as a discrete state. Potential energy is aspatial and atemporal, it is expansionist, it is everywhere, by virtue of the first law of thermodynamics. Spatiotemporal existence, on the other hand is, by definition, actualization, which is the constraint of the expansionist pressure of potentiality within closures. Closures enable differentiation or discrete realities. Without differentiation, energy remains potential and acts as homogenous expansion, as effete matter. Differentiation, a process by which energy is constrained by means of codification, such that this encoded matter can exist as spatiotemporally unique from other forms of encoded matter, is the essential primal action.

Differentiation is achieved by codification. The continuous movement of this 'effete matter' or potential energy is restricted by confining its expansionist desires, which we can understand as the 'work-force' or 'will-to-be' of energy, into codal patterns. These codes are constraints, with the result that one demarcated energy is differentiated from other forms of energy. Therefore, a basic postulate is that energy cannot exist, in its pure state, as motion, as heat, as 'the force to work' but can exist as such only within the restrictions and constraints of codal patterns. Furthermore, energy that is codified should be understood in this constrained state not simply as 'matter' which by itself is a meaningless term but more accurately as 'information' because this energy is then capable of informing on and about, by relating its codes and organizational properties to other forms of coded energy, other forms of energy-as-matter. The process of codification of energy is known as semiosis. Semiosis has nothing to do with language or with human or biological consciousness but begins at the very primal level of energy existentiality, by virtue of the basic requirement of energy to exist, which can be achieved only by its organization within differential codal constraints.

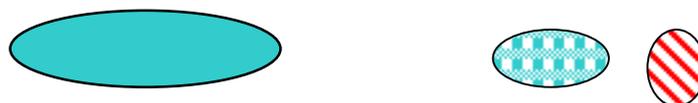


Figure 1. Monadic homogeneity versus closures by differentiation.

4. Basic semiotic dyads

The first semiotic action, which I suggest began in the earliest stages of the evolution of our universe, is the generation of codal differentiation, where x-encoded energy is differentiated from y-encoded energy. This permits the energy of the universe to physically differentiate itself into discrete units, for example, atoms, such as hydrogen, oxygen, helium and installs a framework which permits interaction, even if only between similar atoms, such as the linking of hydrogen and hydrogen.

The second semiotic action sets up asymmetrical relations among these codal differentiations. This permits the development of multiple types of links, such as ionic, covalent and isotope relations. This leads to more diverse and complex bonds, it enables larger associations of energy and promotes the development of chemical macromolecules and an increase in the diversity of both relations and molecules.

These two semiotic actions of codal differentiation and asymmetrical relations enable the operation of a system within closures. Closure of codification is a vital semiotic process. Closure is an isolation of a codal organization by a ‘shell’ that establishes a unique internal zone of operations by means of a membrane-phase that separates internal from external codal processes. Closure not only permits a particular organization of codification to exist; it also permits a vital type of codification, which is known as *Relation* to develop between these closures.



Figure 2. Closure and Membranes.



Figure 3. Codal Relations between Closures.

Relations are codified ‘strings’ or ‘links’ between closures-of-energy. Relations are actually associations of energy , encoded convergences of attention that permit different masses of energy to interact with each other, and thereby permit them to exchange energy, as information, amongst themselves. Energy is not merely further conserved and stabilized within the universe by means of these vast networks of codal relations but both the particles-as-coded and the relations-as-coded are expanded and re-oriented by the semiotic opportunities such relations provide within contacts with other closures and other relations.

Based on these three primal processes of codification, more complex semiotic dyads can emerge. We can define five more complex dyads that make use of primal differentiation, asymmetry and relations, to extend the codal properties of semiosis. They are:

| | | | |
|---------------------|----------------------|--------|------------------|
| zone of operations: | internal | versus | external |
| spatial coverage: | local | versus | global |
| temporal coverage: | actual | versus | potential |
| codal type | dissipative/entropic | versus | inert/continuous |
| authority of code: | particular | versus | universal |

4.1. Internal-External

This permits different types of codification. The zone of internal codification is going to differentiate its codal properties from the zone of external codification This differentiation of codal typologies into the internal and external is an important factor in the development of complex semiotic processes. The question is - how and how much do these two codal operations affect each other?

4.2. Local-Global

This sets up a codification that differentiates itself dependent on whether its zone of operations is local and contingent upon close spatial and/or temporal links with other codifications, or, the codification is global and can act ‘at a distance’. Essentially, the result of this codal differentiation is a loss of homogeneity and an increase in heterogeneity. Codification, rather than being universal, develops the ability to ‘be different’ based on its establishment of a niche or zone of operations that permits both separation, distinction and relations.

4.3. Actual-Potential Dyad

Actual codification is the *hic et nunc* state of existence in current time. This codified reality occupies a definite location in space and time. It is ‘this’ differentiated from ‘that’. The potential, on the other hand, as defined by many, such as Aristotle, is atemporal and aspatial. It exists, if it even can be said to exist as such, in a vague, general, embryonic state.

Classical physics laws are universal and atemporal, and therefore there is no differentiation in value between the potential and actual. Our lack of knowledge of future codified forms is understood only as a manifestation of our own ignorance. In this world, all freedom to evolve vanishes from our cosmos. Everything already exists, predetermined in itself even if only in embryonic form. (Darwinism’s insertion of random or accidental mutation is an attempt to operate within the classical infrastructure and yet, insert the potential for change.) Genuine evolution, on the other hand, requires a potentiality that exists in a state of undetermined vagueness.

In quantum physics, the particular or actual particle does not exist in a potential form prior to the collapse of the wave-function. ‘The wavefunction is the whole story; there is no ‘actual atom’ in addition to the wavefunction’ [6] and therefore, the wavefunction is global; it collapses to particle locality when closure and codification is achieved.

4.4. Particular-Universal Dyad

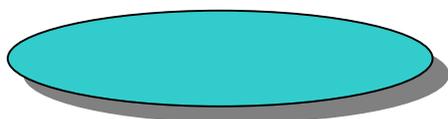
This dyadic codification sets up two different spatial zones of codification. One sets up irreversible particular codification and the other sets up universal and reversible codes.

4.5. Inertia-Entropy Dyad

Closely aligned with the particular-universal codal differentiations is a codification of two types of motion. One type is inert, within the classical physics properties of continuous, reversible, atemporal and aspatial codal actions. The other type is entropic, made up of spurious, irreversible, and historical codal actions.

The question therefore, is which of these two realities - the classical or the quantum - is ‘right’? Which do we live in? Does this epistemic cut, this boundary between the microscopic and the macroscopic have any validity? We have long been encouraged to accept only one of these realities as valid; the other, we are told, is either an error of our subjective consciousness, our human psychology or an error of our material inadequacy. Others say that we can and do, live within these two contradictory worlds. If so, how do we relate them? Some say that it is only by the action of consciousness and that

the filiation of these two realities, the classical and the quantum, requires a consciousness, which is to say, a human mind. Otherwise, as ‘animals’ or ‘brute beings’ we operate within a monadic state - without a soul. I suggest that the means of filiation is semiosis, the generation of signs, and that semiosis is not confined to consciousness or the human mind but is a basic force of the abiotic and biotic world, which is to say, of Universal Mind.



Entropic/Internal/Local/Actual/Particular
Inert/External/Global/Potential/Universal

Figure 4. Two Realities.

5. What is a sign

A sign is to be understood as the means by which energy is transformed into matter or information. It does this by codifying this energy within different organizational constraints and then, establishing encoded relations between closures.

”A *Sign* is anything which is related to a Second thing, its *Object*, in respect to a Quality, in such a way as to bring a Third Thing, its *Interpretant*, into relation to the same Object, and that in such a way as to bring a Fourth into relation to that Object in the same form, *ad infinitum*. If the series is broken off, the Sign, in so far, falls short of the perfect significant character. It is not necessary that the Interpretant should actually exist. A being *in futuro* will suffice”. This is Peirce’s mature 1907 definition of the sign [1-2.92] The focus on establishing relations with the future is a vital aspect of semiosis. ”A sign is something by knowing which we know something more” [1-8.332] The nature of the sign, therefore, is as a process of developing networks of relations one to another. This means that signs are not ‘entities’ but are ‘processes’ which produce both entities, or states of closure, as well as relations, or associations of closures. To put it another way, what we have, within semiosis, is a process of generating nouns (entities) and relating them by means of verbs or predicates (relations).

The distinction between noun (entity) and predicate/verb (relation) can be recognized in the ancient conflict between Platonic and Aristotelian analyses of the sign. For Aristotle, a noun is ”a sound significant by convention, which has no reference to time, and of which no part is significant apart from the rest” [2-*De Int.* 16a20]. This definition of the noun is also the traditional semiological definition of the sign, as a ‘sound significant by convention’. Saussure’s analysis of the sign states that ”the linguistic sign unites, not a thing and a name, but a concept and a sound-image” such that ”the two elements are intimately united, and each recalls the other” [8]. Morris explains that signs ”denote the objects” and ”something is a sign only because it is interpreted as a sign of something by some interpreter”. He understands sentences as mere ”compounds of other signs” [9]. Eco defines the sign as ”everything which can be taken as significantly substituting for something else” [10] These definitions of the sign as a noun have been dominant in the literature for many years. They understand the sign as a ‘this’ substituting for a ‘that’. This nominalist understanding of reality sees it as inanimate, made up of ‘things’ and their images, which must be related to each other by an external Agent, the Interpreter.

This is a misunderstanding of semiosis. The sign is a process of active mediation, and as such, the sign is, in itself, a logical sentence made up of both a noun and a predicate. According to Aristotle, a verb "carries the notion of time", this verb indicates only present time and a verb 'is always a sign of something said of something else' [2-*De Int.* 16b5-10]. Furthermore 'no part of it has any independent meaning'. The lack of 'independent meaning' in the verbal process is a vital aspect of the semiotic sentence/sign. What the verb does in the semiotic sentence/sign is to establish relations, to "arrest the hearer's mind, and fixes his attention" [2-*De Int.* 16b20]. We might go so far as to consider the sentence, or, as I am calling it, the sign, as a premiss, where "every premiss states that something either is or must be or may be the attribute of something else" [2-*De Int.* 25a1]. We should remember this definition when we come to outline the modal category of Thirdness. "A sign means a demonstrative proposition necessary or generally approved: for anything such that when it is another thing is, or when it has come into being the other has come into being before or after" [2-*De Int.* 70a5] The predicate is the relation-seeking process that links the noun with other sentences/signs - which sentences/signs are also made up of nouns and predicates. That is, the sign contains, in itself, the means of interpretation, which is to say, it contains in itself the means of seeking out and establishing relations. There is no need, as there is in the nominalist or platonic definition, for an external interpreter.

I also understand the verb, the active predicate of relation-seeking within the sign, as the action of 'phantasia', the vital creative process of the imagination, for not merely is imagination "that in virtue of which an image arises for us" [2-*De Anima* 428a1], it is also the true generative force of codifications. The means by which these mind-images evolve, develop and exist, is within the logical processes of the mind - and I mean any logic - abiotic and biotic, non-human and human. Mind is not confined to the human species but is the basic ordering principle of nature.

A degenerate semiosis, made up only of nouns, can only operate as a kind of data displacement or metaphor substitution. Such a Shannon-style processing of replicas is a dead-end semantics. The nominalists "understand experience in their nominalist sense as the mere first impressions of sense" [1-6.492] A genuine semiosis is an active process operating within a logical sentence consisting of a noun and a verb where the nouns or agents actively seek out and select, within emergent logical and pragmatic verbal relations, their links with other semiotic sentences. Do we have such a process in either of the two realities so far discussed?

6. The semiotic categories

Let me first take a brief side trip to introduce Peirce's three categories. These categories describe the modes or states-of-being of energy-as-matter or information. Our common view of energy is as a 'capacity or tendency for vigorous action', which suggests that energy is a fuel to 'make things act'. Even the more scientific definition of it 'as the capacity to do work' follows this theme. I feel that energy does not exist simply as a Newtonian force to act on other things, but in a far more complex manner, within three basic modes of existence. Peirce referred to them as Firstness, Secondness and Thirdness.

Firstness is feeling, quality, chance, immediacy, a 'state of unawareness of anything else'. "By a feeling, I mean an instance of that kind of consciousness which involves no analysis, comparison or any process whatsoever, nor consists in whole or in part of any act by which one stretch of consciousness is distinguished from another" [1-1.306]. "The idea of First is predominant in the ideas of fresh-

ness, life, freedom...freedom can only manifest itself in unlimited and uncontrolled variety and multiplicity" [1-1.302] Energy codified within a state of Firstness has no capacity to refer to a comparative codification; it is the pure expansiveness of Aristotelian potentiality.

Secondness is mechanical action, it is "a mutual action between two things regardless of any sort of third or medium, and in particular regardless of any law of action" [1-1.322]. Secondness "meets us in such facts as another, relation, compulsion, effect, dependence, independence, negation, occurrence, reality, result" [1-1.358]. Secondness includes "the element of struggle" [1-1.322]. The "idea of second is predominant in the ideas of causation and of statical force....constraint is a Secondness" [1-1.325]. Energy codified in this state of Secondness is in immediate contact with other closures but without the capacity for reflection on this interaction. Peirce continues that "pure dyadism is an act of arbitrary will or of blind force; for if there is any reason, or law, governing it, that mediates between the two subjects and brings about their connection. The dyad is an individual fact, as it existentially is; and it has no generality in it. The being of a monadic quality is a mere potentiality, without existence. Existence is purely dyadic" [1-1.328] With an obvious reference to classical physics, he states that "there has been during the nineteenth century a decided leaning of scientific opinion to discredit any other sort of action in the external world than that of dynamical force; to understand a dynamical force to be a purely brute force with no element of inherent reasonableness in it, but merely to be the only force that scientific research could discover" [1-6.329]. Secondness is the hard reality of our common-sense world.

Thirdness is the key mode. "By the third, I mean the medium or connecting bond between the absolute first and last ...Continuity represents Thirdness almost to perfection. Moderation is a kind of Thirdness" [1-1.337]. Thirdness is a generative and future-oriented or evolutionary process for "not only will meaning always, more or less, in the long run, mould reactions to itself, but it is only in doing so that its own being consists [and it] ... "is that which is what it is by virtue of imparting a quality to reactions in the future" [1-1.343]. Thirdness is the process of generalization and habit-taking and as such is a "matter of law, and law is a matter of thought and meaning" [1-1.345]. As I said before, the sign as a sentence is a relational premiss of logic, where "every premiss states that something either is or must be or may be the attribute of something else" [2- *De Int.*25a1].

I suggest that each of these Peircean categories of codification operates, differently, within the two realities of classical and quantum physics. There is a semiotic codal process of Firstness, Secondness and Thirdness, that operates in classical and also in quantum physics, and these processes take on the codal characteristics of each of the two realities.

6.1. *The two modes of Firstness*

In classical physics, Firstness can be recognized as the Dynamic or External Object in its nature as pure objective reality. In the classical world, this basic matter, operative within universal rules, is necessarily detached from the spatiotemporal subjectivism of the perceiver. It is, as such, not interpreted; it simply 'is' matter. As a modal category of being, Firstness cannot, itself, be degenerate or regressive, but classical physics Firstness is actually a degenerate Secondness, where a noun, an entity, stands not as one spatiotemporally unique thing attached (whether in struggle or in harmony) to another thing (as in genuine Secondness), but as an aspatial and atemporal embodiment of a universal. As such a mimetic and informationally empty ideal, it operates in a nominalist and closed rather than open or distributed state of Firstness.

In quantum physics, Firstness is exactly as described by Peirce, in its expansionist richness of sense presence. Unlike the Secondness-in-Firstness classical state, this semiotic process is not universal but operates within a spatiotemporal or locally attached sign and therefore, is already restrained and undistributed, even if only within primitive attachments. Genuine Firstness is a process of generative energy dissipation; it acts as a constant source of an expansionist desire-to-relate; its uninhibited desire for freedom works to disengage and deconstruct the bound energy of the sign-sentence, releasing it from its constraints and codal organizations, to explore further semiotic links. "The drive to redundancy comes from Firstness and the compressing drive from Thirdness" [11].

6.2. *The two modes of Secondness*

In the classical system, Secondness as a codification or 'interpretation' of the Dynamic Object operates as a one-to-one correspondence with that object. This is an externalist or non-interpretive semiosis. "That truth is the correspondence of a representation with its object is, as Kant says, merely the nominal definition of it" [1-5.553]. Its material existence is universal, its interpretation is equally universal. "The genuine second suffers and yet resists, like dead matter, whose existence consists in its inertia....unalterable fixity becomes one of its attributes" [1-1.358] In classical physics, the semiotic process of codification within Secondness is genuine, in that it ignores interpretation. In such a mechanical cybernetics, the human or other agent of interpretive mediation, is irrelevant. "To think of the second in its perfection we must banish every third" [1- 1.358].

The quantum mode of Secondness, on the other hand, is a completely internal or agent-powered process of codification focused on internal interpretations of its energy-content. Energy, restrained and constrained within the membrane-zone of an interpretive force, whether that zone be a molecule, cell or human, sets up localized energy-attractions. The quantum process of Secondness, operating within that highly charged internal friction can be understood as a dissipative 'attractor' of energy. As such an expansionist force, it is readily understood to be actually Secondness operating within the mode of Firstness; it is a degenerate or regressive Secondness. "All degenerate seconds may be conveniently termed internal, in contrast to external seconds, which are constituted by external fact, and are true actions of one thing upon another" [1-1.365]. We must not understand the term 'genuine' or 'degenerate' in an evaluative manner. A degenerate sign is one that merges with another modal category, so degenerate Secondness includes a process of Firstness. A degenerate Secondness can be understood to "arise from the mind setting one part of a notion into relation to another" [1-1.365]. In this sense, degenerate Secondness extends the power of the sign to release energy from the noun part of the semiotic sentence. It specifically searches for energy within closures and actively continues the dissipative power of pure Firstness.

We should note therefore that quantum physics contains within itself two means by which it can dissipate and distribute energy, it contains two processes of Firstness - genuine Firstness and also, Secondness-in-Firstness. This means that the quantum semiotic process dissipates more energy for further codification than the classical semiotic process. We must further note that both classical and quantum physics have a codification process that operates within this same degenerate Secondness. The difference is in how each deals with the dissipation of energy that this mode produces.

What does the second law of thermodynamics have to do with our codal categories so far, with Firstness and Secondness? Entropy understood only as noise, energy-loss, or dissipative chaos is a per-

spective focused around a belief in a world operative within stability, universality, deterministic causality, atomistic sanctity, and closure. This is the definition used by classical physics, and therefore, entropy in this mode is regarded as a problem of deterioration, a collapse and loss of information, a decay of matter. Classical physics has, on its own, no means of recapturing this loss of energy. In quantum physics, entropy is understood as an active expansionist force and is therefore considered a source of energy for use within further explorations of semiotic codification [12, 3].

6.3. *The two modes of Thirdness*

Thirdness is, in both classical and quantum physics, degenerate. In classical physics, Thirdness or the normative laws, are understood as original and universal 'Forms' Thirdness in classical physics is degenerate in the second degree, which is a state "where there is not even true Secondness in the fact itself" [1-1.366]. This means that the 'facts' of Thirdness, the normal laws, are not a reality as laws but are derived abstractions or iconic states of Firstness. "This kind of synthesis appears in a secondary form in association by resemblance" [1-1.383]. This associationism operates by similarity and resemblance rather than within the genuine Secondness process of real connection. Therefore, classical physics is based on statistics, on universal averages, on the development of abstract models, as collated by an external and objective observer. These are the laws of classical physics and this is the territory of inductive science. "In portraiture, photographs mediate between the original and the likeness" [1-1.367] Translate this to classical physics, and the statistical average is the photograph that mediates between the external object and the interpretation. "In science, a diagram or analogue of the observed fact leads on to a further analogy" [1-1.367]. In classical physics, Thirdness operates as an iconic or diagrammatic sign, "which exhibits a similarity or analogy to the subject of discourse" [1-1.369] This statistical average is developed as a model by an external observer and is completely alienated from material reality. It is not a process of habit formation within reality but a process of external image or diagramme formation.

In quantum physics, Thirdness operates as degenerate in the first degree. It does not operate as in classical physics as a derived external abstraction of universal statistics, but, internally within the system it operates as a Secondness, and an "unalterable fixity becomes one of its attributes" [1-1.358]. This fixity is that irreversible localization in space and time that is a factor of quantum physics. This type of degeneracy is "where there is in the fact itself no Thirdness or mediation, but where there is true duality" [1-1.366]. Peirce's example is a pin fastening two things together; the pin remains in either, even if the other is annihilated; the particle exists as the wavefunction disappears by virtue of the introduction of the pin - and the observer-pin remains as an integral part of the sign. "A mixture brings its ingredients together by containing each. We may term these accidental thirds" [1-1.366]. Therefore, "synthetical consciousness degenerate in the first degree, corresponding to accidental Thirdness, is where there is an external compulsion upon us to think things together" [1-1.383] Quantum physics synthesizes by accident but its conjoining actions are compulsive, that is, the action "forces the attention to the particular object intended without describing it" [1-1.369].

Genuine Thirdness is always relative; it can never, unlike Firstness and Secondness, be absolute or unrelated or pure 'in itself' - as Secondness is absolute in classical physics, as Firstness is absolute in quantum physics. Thirdness is always relational and inconclusive for it is 'the medium of the connecting bond [1-1.337], and when it is genuine, it mediates the arbitrariness of the quantum sign-sentence

and the inflexibility of the classical sign-sentence, such that we can obtain a future-oriented generative or evolutionary sign-sentence. For "the highest kind of synthesis is what the mind is compelled to make neither by the inward attractions of the feelings or representations themselves, nor by a transcendental force of necessity, but in the interest of intelligibility that is, in the interest of the synthesizing 'I think' itself; and this it does by introducing an idea not contained in the data, which gives connections which they would not otherwise have had" [1-1.383] Genuine Thirdness is the filiation of the two realms of semiotic processing of energy, the quantum and the classical modes. This sets up an architecture somewhat like a moebius strip, where the boundaries of these two realities or worlds are filiated, as in a double-helix, without denigrating the integrity of each string. I am further stating that these two worlds, the classical and the quantum, are not epistemological realms, they are not constructs of the human mind, but are actual physical realms within which energy is transformed, in the style of each world, into information. The Thirdness that relates these two worlds is an evolving and future-oriented process and is thus a creative action ' an action of synthesis that shows "relations between elements which before seemed to have no necessary connection" [1-1.35]. Thus "intelligibility, or reason objectified, is what makes Thirdness genuine" [1-1.366]. It achieves this integration by virtue of reason or logic. I do not mean human reason or logic but natural reason and logic. Genuine Thirdness involves Mind - not necessarily the human but the natural Mind. The sign in genuine Thirdness is therefore not an iconic copy, not an indexical contact, but imaginative and symbolic, which "is the general name or description which signifies its object by means of an association of ideas or habitual connection between the name and the character signified" [1-1.369].

We can therefore see that these two realities, the classical and the quantum, when taken separately, lack the means to provide a full and genuine semiosis, for both of them lack a verb or predicate, a means of developing spatiotemporal affiliations. Classical physics operates as a closed and idealist nominalism; actions are supplied by an external determinist agent. Quantum physics operates as an open and dissipative nominalism; actions are supplied by an internal spurious agent. How can a genuine semiosis, which is to say, a codification of energy that is evolutionary in a self-organized, developmental and highly adaptive sense, emerge, when both systems lack an associative or affiliating force?

7. The two realities, the three modes and the three laws of energy

My thesis is that the two realities are necessarily linked. The traditional duality is situational, it provides two sites for information-processing: mind and body. I suggest that the correct duality is codal rather than situational and refers to a duality of codifications: dynamic or potential versus thermodynamic or actual; wave-function versus particle; open versus closed; reversible versus irreversible; deterministic versus contingent; universal versus particular; atomistic versus organic. Furthermore, these contradictory codal processes work, in their oppositions, together, and the process that connects these two, is semiosis. Therefore we must examine the process of semiosis within the laws of energy or thermodynamics.

7.1. First law of inertia

What does the first law of inertia or the conservation of energy have to do with Thirdness? Thirdness, the deliberate establishing of networks and the constant exploration of new relations, breaks

down isolate codal formations, releases their energy to the population, sets up affiliations among disparate codes, and thereby maintains the continuity of energy-access to a larger proportion of the population.

The first law of thermodynamics, operating as a degenerate Thirdness in the classical world, produces only abstract diagrammes of averages, which then act as a hegemonic superstructure to constrain all energy within its standardization. This instrument of authoritative collation serves, importantly, to maintain codal stability but can play no role in the dissipation of superfluous or ineffectual codes or the development of new codes. Inertia operating in the quantum world, as a different type of degenerate Thirdness, produces only short-term irreversible units linked by a local and contingent compulsion. This serves the vital need for short-term local adaptations but cannot develop long-term communal emergent habit-generation.

7.2. Third law of stasis

What does the third law of stasis or the ‘zeroeth law’, dealing with the availability of free energy have to do with Firstness? The law of stasis refers to an intrinsic motion, the Aristotelian ‘unmoved mover’. This is not the same kind of motion of energy as we see in the reactive one-on-one confrontations within Secondness or the on-going associative affiliations of community-based codification that are the property of Thirdness, but is a motion of energy that is in a neutral detached and unfocused codal state of Firstness. This ‘eternal motion’ of energy is intrinsic, uncondensed and expansionist in a decidedly non-interactional and non-relational manner. It is found, in classical physics, only within a degenerate Secondness and is therefore ineffective. It is found in its pure state in quantum physics but - can its free energy be used within the quantum method of processing energy, which lacks the means to affiliate this energy within a genuine Thirdness?

7.3. Second Law of Entropy

Entropy is produced within the codal processes of the direct frictional contacts of Secondness. It is the process of ‘brute contact’ or one-to-one resistance between differentiations that generates or frees energy from codal closures. In classical physics, a genuine Secondness exists, with its vital capacities to differentially encode energy and set up dyadic relations - things in contact with other things. However, without the mediating filiations of Thirdness, classical physics can only produce a world operating in the mechanical one-to-one bonds of cybernetics and Shannon information theory and it thus establishes a determinism that considers every feature linked by proximate cause to another. This means that despite the tremendous importance of genuine Secondness, classical physics is without the ability to use the energy dissipating from these frictional contacts to generate new codes. (Accidental mutation, as a means of supplying new codes is an inadequate response to the need for a secure and on-going process of new codal generation.) As such, its current encodements inevitably collapse to a lower level of synergy with an irretrievable loss of this freed energy. To maintain a stable order within the classical system requires the external input of more energy and codification, an intrusive insertion of an authoritative rather than a self-generating communal Thirdness, a Thirdness degenerate in the second degree, acting as an alienated model of original purity.

Entropy, operating in the internal or quantum world, is a degenerate Secondness and as a Firstness, sets up an acceleration of electromagnetic radiation of attraction of one-to-another. This interaction lacks a referential or generalizing metastate, a stabilizing communal or pragmatic reference or even, as in classical physics, an authoritative dictator, and therefore this sensate and highly charged energy is highly volatile and unpredictable. This is the world of hysteria, of sweeping avalanches, of catastrophes, where the force of energy moves from one nodal site to another without establishing any habitual links or codal relations with those sites.

8. The filiation of the two worlds

If you set up an architecture that entwines these two realities, the classical and the quantum, then you get a semiosis capable of producing any and all types of signs and above all, a sign that is, to give it the Peircean name, a 'Rhematic Indexical Legisign'. This is "any general type or law, however established, which requires each instance of it to be really affected by its Object in such a manner as merely to draw attention to that Object" [1-2.259] It represents, as Spinks points out 'the full trichotomous relation' [13], because it sets up not merely an actual link between objects but also develops a general law of their connections. As a means of filiation of all modal categories and all laws of thermodynamics, it can be considered the fundamental semiotic process of evolutionary innovation.

The existence of a general law or set of normative habits, actualized or embodied within a particular 'thing', means that associative relations can exist within actual space and time. They are not abstract conceptual ideals but are encoded within actual physical matter. This enables the general laws to affect not merely the single noun-objects touched by these laws, but above all, themselves in their nature as verbal connections. The laws, embodied in the actual objects, become permeable to energy released from other objects, and their codes can evolve, in interaction with the other codes embodied in those other objects. This is developmental evolution, an evolution that emerges within the pragmatics of interaction and actualization, and has nothing to do with chance, random mutation or external judgment, but everything to do with an on-going process of a future-oriented exploration between the self and its environments [14, 15].

Andrade explains traditional Darwinism as 'instructivist approaches that think of organisms as passive entities that obey instructions from the environment. Traditional selectionist approaches are in fact instructivist since they did not realize the semiotic character of selection' [11]. The classical world is 'instructivist' But a triadic process will filiate the two worlds, the external and the internal, by a mediative and self-organized process of active interpretation, which Andrade refers to as a 'demon' and states that "Maxwell's demon's are not passive receptors of information but rather gatherers, users, processors and generators" [11]. It was, as Peirce noted, this triadic relationship, one that works within all the categories, in both their genuine and degenerate forms, which it can only do by a filiation of the two worlds of physics, that generated life as we know it. As Peirce said, "life in the physiological sense would be due to life in the metaphysical sense" for "there is some essentially and irreducibly other element in the universe than pure dynamism" or pure Secondness [1-6.322].

A genuine triadic semiotic process is a sentence made up of a logical relation of nouns and verbs. The *rhematic sign*, operating in Firstness, supplies entropic energy by deconstructing the closures of the nouns in the sentence; the *indexical sign* operating in Secondness, establishes direct bonds between released microparticles to prevent complete dissipation, and the *legisign* supplies the generalized ver-

bal relation that develops new associations and new particles. All three act as a genuine sign, a sentence of reflexive generation. Therefore "the triadic fact takes place in thought. I do not say in anybody's thinking, but in pure abstract thought; while the dyadic fact is existential" [1-6.324]. This is not anthropomorphic. "We humans are not the only ones to measure and to encode, every living entity does so; hence by recognizing in living entities an intrinsic subjective world or Umwelt we avoid personifying the word nature" [11]. I go further, every associative process, abiotic and biotic, engages in the active semiotic sentence of universal Mind.

'Life evolved by enhancing its interpretive potential or capacity to establish ever new couplings that expand the world of signification" [11]. This is my point about the genuine sign. It is an active power and as such must operate with the capacities of both closure (redundancy or closure into nouns) and associationism (compression of closures by verbal links). "The drive to redundancy comes from Firstness and the compressing drive from Thirdness. They both meet in actually existing living forms whose connections and deterministic features are expressions of Secondness. This local decrease in entropy is paid for by entropy dissipation. Part of it remains bound in the system and manifests itself as redundancy or naturality" [11]. When Secondness restricts energy by its bonds, free or accessible energy comes from the expansive force of Firstness. Then, the demon or exploratory Thirdness generates new codes to associate these differences, using that freed energy, so "new structures emerge as the energy flows and generates new codes, when former regularities are identified as signs by others" [11]. This permits "a highly unpredictable exploration domain of new possible interactions and signification through measuring trials with different standards" [11].

9. Why are there two worlds?

Why are there two worlds? Why cannot we operate solely within the one or the other? And why must these worlds be contradictory?

The actions of the robots of Rodney Brooks of the MIT Mobile Robot Laboratory can be compared with the operations of molecules in classical physics. "Such creatures do not depend on a central reservoir of data or on a central planner or reasoner. Instead, we see a 'collection of competing behaviors' orchestrated by environmental inputs. There is no clear dividing line between perception and cognition, no point at which perceptual inputs are translated into a central code to be shared by various on-board reasoning devices" [16] It is essential to note that these 'simple creatures command, i.e., internalize "no stored long-term plans or models of its environment" [16]. Thirdness in this format is immobile; all it supplies, by external agents, are algorithmic diagrammes. Again, the key factor is "the lack of any central memory shared by all processors, the lack of any central executive controls, the restricted communications between subdevices, and the stress on solving real-time problems involving sensing and acting" [16] This robot, operating in a pure state of Secondness, of 'brute force of action and reaction' rejects the concept of interpretation and the development of an internal integrated world model or 'umwelt' or mediation that is essential to the genuine semiotic triad. As described by Hofstadter this is a process where "thinking occurs through the manipulation of symbolic representations, which are composed of atomic symbol primitives" and this leads to "a structuring of reality that tends to be fixed and absolute" [[17].

The other world, equally, does not operate with a central planning systemics. The connectionist model or neural network or parallel distributed processing model "whose distributed representations

are highly context-dependent” [operates] ”where there are no representational primitives in internal processing.” [17]. This is a quantum world, for ”the individual units (neurons) are generally sensitive only to local information –each ‘listens’ to what its neighbors are telling it” ([16]. As outlined in my earlier example of Thirdness operating as Secondness in the quantum world, the connectionist model produces particular realities - particles - which can interact only randomly, without the logical associations provided by a verbal mediation.

Classical physics has no genuine Firstness, which means that it has no capacity for the progressive dissipation of energy. It has a genuine Secondness, which gives it an ability to codify energy into differentiated noun-closures with direct physical links with other nouns. Its Thirdness or process of verbal mediation is not associative but nominal and dissociated. Classical associationism operates only as an inductive collation of statistics, an abstract algorithm of the ‘mean’ Quantum physics has genuine Firstness and therefore can act as an infinite source of free energy, readily deconstructing nouns or particles into accessible energy. It has, on the other hand, no capacity for spatiotemporal physical links between these nouns. Its mode of Secondness, operating in Firstness, deconstructs particles and produces a heightened state of attraction between brittle closures, which sets up both the weakened particles and the tenuous links in a state of borderline fuzziness. Quantum physics cannot associate the energy that it frees from closures; its verbal process of habit-formation, Thirdness, is degenerate and operates only within nominalism, a state of Secondness, rapidly enclosing the profuse amounts of free energy into short-term isolate particles. Therefore, neither physical world functions in any complete sense on its own. If we add up the semiotic activities of these two worlds, we will find all but one of both the genuine and degenerate forms of Firstness, Secondness and Thirdness. Indeed, it is probably the separation of these two worlds that permits this ‘saturated’ collation of modal categories, for to have them all within one zone of operations might nullify their unique properties. What is missing? There is no genuine Thirdness. This can only arise from the filiation of the two worlds, the classical and the quantum.

The solution to the ‘problem’ of the two worlds may be an acceptance and promotion of both their differential separation along with their associative filiation. Others have suggested that the process of developing evolutionary complexity may be enabled via the development of hierarchies [18, 19, 3]. However, such hierarchical linkages of increasing complexity can, I suggest, only be achieved within the interpretive future-oriented processes of a genuine Thirdness. In this sense, the ‘mind’ or active process of Thirdness of a higher level uses the ‘matter’ or brain energies of a lower level, to generate diverse and increasingly complex codifications of that energy. Think of these two worlds as, together, acting as a sentence-of-logic, made up of nouns related within verbs. ”By a noun we mean a sound significant by convention, which has no reference to time, and of which no part is significant apart from the rest...nothing is by nature a noun or name – it is only so when it becomes a symbol” [2-De Int 16a28]. A verb, on the other hand ”is that which, in addition to its proper meaning, carries with it the notion of time’..[it]’indicates the present existence of the state”, [which makes it local] [2-De Int. 16b5-10]. Furthermore, with regard to a verb, ‘no part of it has any independent meaning, and it is a sign of something said of something else’; that is, ”a verb is always a sign of something said of something else, i.e. of something either predicable of or present in some other thing” [2-De Int.16b5-10]. This is a clear description of the ‘pointing-to’ associational or generalizing concept of the predicate which is Thirdness. The classical realm degenerates this verb to Firstness and the quantum realm de-

generates it to Secondness, supplying, for both these realms, additional codal processes in Firstness and Secondness. A genuine Thirdness sets up, in addition, a full sentence of semiotic affiliation, linking all modal categories and all sign-processes within an expansive and exploratory self-organized codification.

I suggest that the dual realities operate together, because it is only thus that our world can exist, in both an actual as well as potential factuality of energy processing [20]. They must remain as two worlds or we would lose the distinct properties of each if they merged; we would lose genuine Firstness and Secondness as well as their equally useful degenerate versions. Together, they are Active Mind, which is to say, they are generative, exploratory, creating closures as actual entities, dissolving these closures and generating new closures, not haphazardly, but within the workings of an exploratory and evolutionary logic and pragmatism.

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