



# Four valued logic as a basis for an integrative model of matter, mind and consciousness

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## ABSTRACT

Physics and psychology describe both the objective and the subjective side of reality with complementary concepts, whereby the pure transcendental subject owed to the dualism of objectification remains in the background as an excluded third. In both disciplines, the objective side is represented by the complementarity of mind and matter, while the subjective side is characterized by the pairs of terms factually-possible and conscious-unconscious respectively. In both physics and psychology, the dynamical empirical process is based on repeated self-reflection as the pure subject. In physics, empirical time is expressed in repeated quantum observation, while in psychology it corresponds to conscious experience itself. The underlying ontology possesses two themes, which can be only represented completely by a four valued logic, with two positive values and two repetitions, resulting in an orthogonal complementarity. In this way reflection as the basic process underlying consciousness connects to being as an ontological theme. A four valued logic as a value-placement system contains six dual logics. Three of them correspond to modes of consciousness whereas the other three correspond to underlying levels of reality. Applied to science and psychology the underlying structure is rich enough to accommodate and give deeper insights into various approaches connecting matter, mind and spirit in one logical system.

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- 1) C.G. Jung's and W. Pauli's exchange on the integration of physics and psychology is an example of such a quaternionic system, expanding to a hexagonal dynamics, as the physics Noble laureate Wolfgang Pauli envisioned. The dynamical nature of a complementarity as a reflection corresponds herein to the quantum-process. Mathematically it can be represented by an entanglement of two complex planes, forming the Hamiltonian Quaternions.
- 2) David Bohm's realistic interpretation of quantum-physics introduces an infinite series of super-implicate orders, corresponding to the implicit and explicit nature of consciousness itself. Four valued logic gives an ideal ontological frame for Bohm's idea of a holomovement.
- 3) Considering the nature of living systems to be the creation of meaning from information, understands life to be a self-organizing, scale-free, fractal and self-referential system, bridging the ontological gap between being and reflection. Coherence seems to be the macroscopic state of living-systems to create the classical approximation of objective being and individual conscious existence in an otherwise chaotic world of quantum-fluctuations. By this process matter is reflected in an information field of meaning, which serves as a communication medium for self-referential conscious entities.

**Keywords:** multi-valued logic, self-reflection, quantum-mechanics, information field, consciousness, complementarity, Bohm, Jung, Pauli

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**The depth of reflection of consciousness in orthogonal complementarity**

In the philosophical tradition of Kant, Fichte, Hegel, the German philosopher and logician Gotthard Günther has developed a multivalent logic of reflection (Günther, 1976). While the classical two valued logic formulated by Aristotle is only able to describe a thinking that identically maps being, the multivalued reflection logic recognizes the independence of the reflection process and at the same time allows a repeated reflection. Here reflection itself becomes the object of further reflection, so that thought becomes aware of itself and can recognize its possible independence from Being. While thinking caught in the bivalent can only be a repetition of being, the reflection on the reflection of being, that is, the second or double reflection creates an environment in which the first reflection of being and thinking takes place. This environment is necessarily the third excluded in Aristotelian two-valued logic, so that a three-valued logic and ontology emerges. In this, the three logical values are now no longer denoted by the values true and false,

since these precisely do not admit a third in the classical sense when fully determined, but by the number of reflections by which they are generated. The first value is thus irreflexive, the second reflexive and the third doubly reflexive. This non-classical logic is also a system of truth, which here, however, appears not in two but in three primordial phenomenal forms, namely irreflexivity, reflection and double reflection. The great world religions have recognized this connection already thousands of years ago as trinity and have formulated it in most different symbolism (Günther, 1991).

The consciousness itself still represents a two-valued reflection also in a three-valued system, only that we have to do here with three such reflections with in each case an own topic. The first reflection has being as its theme, the second reflects on thinking and thus brings the process of consciousness itself to consciousness, while the third reflection thematizes the subject or self-consciousness as an existing subject. Following Hegel's formulations, the following thematic structure of three two-valued logical systems emerges:

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<i>Hegel</i>	<i>Theme</i>	<i>Two-Valued Reflection</i>
Reflection in Other	Being	I <> R
Reflection in itself	Reflection	R <> D
Reflection in itself and Other	subject	I <> D

*Table 1: Hegel's three types of reflection*

From this is formed the classical opposition of subject and object, with the difference that the subject of trivalent logic has a twofold depth of reflection. Between the subject and the object now stands the process of reflection as an independent third process. Subject and object thus stand in the relation of a complementarity in that their opposition is mediated and cancelled by an independent process. In this complementarity, both being and subject are present only as subjects of reflection, that is, immanent to consciousness.

Thus, the trivalent logic has no place for an objective being. The self-existence of a subject not dependent on reflection cannot be thought in the framework of trivalent logic any more than in bivalent logic. It possesses only inner-reflexive place values.

At the beginning of the 20th century such isolated objects appeared simultaneously in two scientific disciplines, about which in principle no statement can be made, if they are not put into a reflexive context. In the analytic psychology of C.G. Jung, this is the



collective unconscious, whose contents, which are not in themselves capable of consciousness, can only come to consciousness through the psychoanalytic process, in which there is an integration of conscious and unconscious contents (Jung, 1990).

Likewise, the fundamental material reality in quantum physics is only describable when the one reality that is not in itself describable as a whole is divided into an observed and an observing system (Heisenberg's cut) (Atmanspacher, 1997). The mathematical representability of the underlying material reality is here bought by the price that all statements on concrete physical events have only probability character. Only in the quantum-physical observation an entanglement of these two systems takes place and a concrete measurement result arises.

From both disciplines results the hint that the two complementary subjects of the subject and the object should be represented complementary in each case, in order to be able to describe the complete connection. The objective subject consists in the relation of the observer and the observed, while the subjective subject results from the relation of the conscious to the unconscious. This approach has already been presented in detail in the article on orthogonal complementarity and will be justified and extended here in a formal logical way (Schmieke, 2018).

In our view, both two-valued and three-valued logic do not have the depth of reflection to be able to represent such a double complementarity. A complementarity is in itself already a trivalent system, so that a further reflection on such a complementarity

requires at least a four-valued representation. Likewise, Gotthard Günther has proved that only in a four-valued system place values are contained which correspond to objective realms of reality as they appear in depth psychology and quantum physics.

The purpose of this paper is now to show that a four-valued logic leads to an ontology and reflection structure rich enough to represent the reflection processes of quantum physics and analytic psychology, and at the same time to show their structural equivalence. The resulting four-valued structure can be functionally represented as two complementarities perpendicular to each other, with the two opposites contained therein unified by two complementary processes. Thus, a four valued logic and ontology gives rise to a system with six place values.

Starting from a double or orthogonal complementarity, the first reflection represents the opposition of the first complementarity, while the second reflection represents the corresponding integrative process. By reflecting a third time on this total process, no new classical contrast to this complementarity arises in the sense of a total reflection, but a complementary pole to the first complementarity as a second orthogonal complementarity pole as a second orthogonal complementarity. This four-valued structure can now be represented in the form of six place values, three of which span one reflection level each, two of which span two levels each, and one of which has the total reflection width of three levels. A place value is a two-valued exchange ratio of two elements of a logical system.



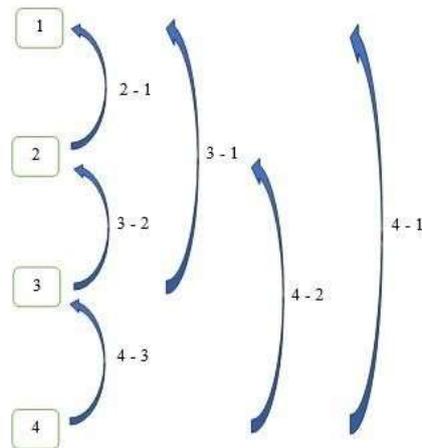


Figure 1: Six two-valued reflections as place values in a four-valued logic

Gotthard Günther has shown several times that in an n-valued logic only those place values correspond to conscious contents whose reflection width is n-1 or n-2. Place values of lower reflection width correspond to objective reality layers (Günther, 1991). In the case of a four-valued logic the following scheme results, where the single-valued place values represent objective being subjects. The two-valued place values have the reflection width of a complementarity, since in each case a classical opposition is embedded in a process environment as a third. A four-valued logic comprises two two-valued place values, which corresponds to the two complementarities perpendicular to each

other. Of these, the first corresponds to the reflection of irreflexive being and thus to the objective complementarity of mind and matter, while the second corresponds to conscious reflection itself thus to the subjective psychic side of reality, which includes the complementarity of conscious and unconscious (Jung, 1955). The final place value of the reflection width n-1 corresponds to the reflection of self-consciousness in being and maps the maximum extent of the associated theoretical consciousness. This is the consciousness of itself as being. The following overview summarizes the six place values of the four-valued orthogonal complementarity:

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Subjectofreflection	Relation to orthogonal complementarity	Width	Two-valuedreflections
Material being	Objectiveopposition	1	1 <> 2
Mind		1	2 <> 3
Unconscious		1	3 <> 4
Consciouslyreflectedbeing	First complementarity	2	1 <> 3
Content of Consciousness	Second complementarity	2	2 <> 4
Consciousness aboutbeing	Existenceas double complementarity	3	1 <> 4

Table 2: 6 placevaluesofreflection

The last three place values of this table form the three levels of consciousness which are repeated in all more than two-valued systems, namely those of reflection into other (being), reflection into itself (reflection) and double

reflection into itself (subject). The three front place values with the reflection width one appear, however, as isolated levels of being, which do not possess a self-existence immanent to consciousness and about which



one cannot make statements for itself. The meanings of these levels in quantum physics and analytical psychology are shown in the following table:

<i>Topic of reflection</i>	<i>Meaning in quantum physics and analytical psychology</i>	<i>Width</i>	<i>Two-valued reflections.</i>
Material being	Material being without Heisenberg's cut. Therefore not describable by wave function.	1	1 <-> 2
Mind	Meaningless information	1	2 <-> 3
Unconscious	Archetypes as unconscious unity of mind and matter	1	3 <-> 4
Consciously reflected being	Reduction of the wave function as a result of the Heisenberg cut made by the observational situation	2	1 <-> 3
Consciousness	Process of becoming conscious and reduction of the wave function.	2	2 <-> 4
Conscious objectified subject	Objectified consciousness	3	1 <-> 4

Table 3: 6 place values related to quantum-theory

Further connections with quantum physical and processes and neurobiological structures are presented in the article "Orthogonal Complementarity" (Schmiede, 2018). If this six-valued place value system with its four

poles not accessible to consciousness is represented graphically in the form of a quaternio, four poles and a double center are obtained:

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	2 <-> 3 Mind Objective complementarity +	
3 <-> 4 Unconscious Subj. complementarity -	1 <-> 3 Conscious process of observation 2 <-> 4	1 <-> 4 Conscious Subj. complementarity +
	1 <-> 2 Matter Objective complementarity -	

Table 4: 6 place values in the orthogonal complementarity

From a trivalent point of view, the result here is the classical triangle Object - Process - Subject in the quaternionic representation of an orthogonal complementarity with the

process of conscious reflection in the center and the diagonals in each of which two place values are mapped onto each other:

2 <-> 3 Reflection process 3 <-> 4	object +	2 <-> 3 Reflection process 1 <-> 4
Subject -	1 <-> 3 Reflection process 2 <-> 4	Subject +



1 <-> 2 Reflectionprocess 3 <-> 4	Object -	1 <-> 2 Reflectionprocess 1 <-> 4
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Table 5: Object – Process – Subject

The five types of reflection processes can be interpreted as the four consciousness functions of analytical psychology and the central self-consciousness (Jung, 1971):

2 <-> 3 3 <-> 4	mind/unconscious	intuition.
2 <-> 3 1 <-> 4	mind/conscious	Thinking
1 <-> 2 3 <-> 4	Matter/Unconsciousness	Feeling
1 <-> 2 1 <-> 4	Matter/Conscious	Sensing
1 <-> 3 2 <-> 4	ConsciousBeing Consciousness	Self-consciousness

Table 6: Fourfunctionsofconsciousness

In summary, a four-valued logic emerges as the three-valued conjunction of two complementarities with four ontological subjects of being. In total, a four-valued logic comprises six place values, which appear as three objective layers of reality and three layers of consciousness. These can be represented as a hexagram in the form of two

interpenetrating triangles. This representation corresponds most closely to the present scientific situation and was given by Wolfgang Pauli as an extension of the quaterniofavoured by C.G. Jung (Pauli, 2001). At this point I interpret this hexagonal diagram in its quantum physical and psychological correspondences:

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	Subject-Existence 1 <-> 4 Measurement result	
Mind 2 <-> 3 Pure information		Unconscious 3 <-> 4 Indestructibleenergy
consciousbeing 1 <-> 3 Heisenberg'scut		Consciousness 2 <-> 4 Consciousness reduction



	Being 1 <-> 2 Matter	
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*Table 7: Pauli's hexagonal connecting physical and psychological energies*

This hexagonal representation is found in many traditional systems such as alchemy, as well as the Jewish and Vedic spiritual traditions. A possible structural extension results from this representation, if the six place values given here are taken as basic values of a six-valued logic. This then results in a total of fifteen place values, of which three again correspond to the three consciousnesses, and twelve objective reality layers. Many traditional systems possess this structure of a fundamental trinity in connection with twelve consciousness-transcendent archetypes, as for example the astrology of different cultures.

**David Bohm's realistic interpretation of quantum-physics**

In the tradition of thought of Einstein and De Broglie David Bohm developed a realistic formalism and interpretation of quantum physics which is mainly reproducing the

results of the Copenhagen interpretation by Bohn and Heisenberg. In this way Bohm showed that maintaining all results of quantum physics a realistic ontology of the particle and wave picture of physics can be maintained (Bohm, 1952). In the Bohmian approach the material particle and the informational quantum potential are real at any given moment, so that classical and quantum versions of reality coexist in one ontological picture. The explicate order of the physical particles is complemented by an implicate order. (Bohm, 1990) Its nature in active information with meaning as its activity. As this process of creating an underlying implicate order of ah higher degree of wholeness can be repeated infinitely a whole hierarchic structure of meaning is created which Bohm identified with more subtle aspects of reality and finer and finer woven nets of consciousness (Schmieke, 2021a).

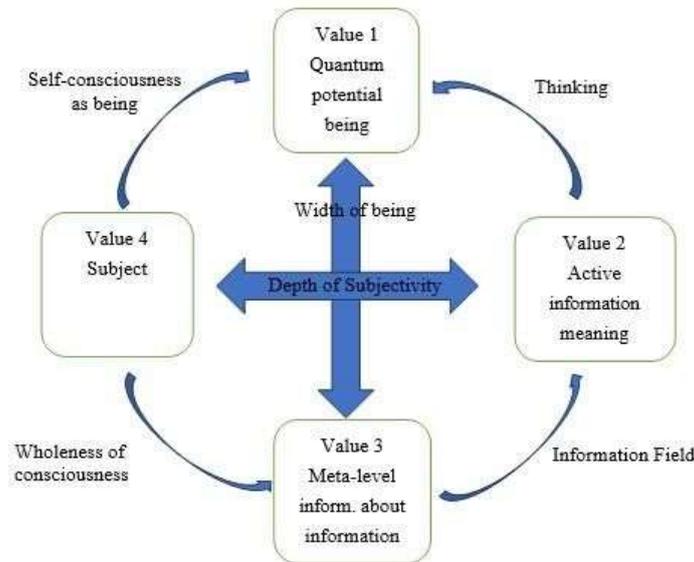
<i>Theme of Reflection</i>	<i>Depth</i>	<i>Two-valued reflection</i>
Physical quantum potential	Meaning; Realities	1
Information, meaning and mental content, Implicate Order	Empirical personality. Information Field	1
Wholeness of Information, meaning and mental content – Super Implicate Order; Holomovement	Unconscious; Archetypes, Spiritual, Self	1
Being - width of the reflection in being Reflection in the other	Objective reality of matter/spirit – The Real	2
Meaning as content of consciousness- depth of the reflection as the conscious process Reflection in itself	Spiritual Information	2
Consciousness about being Existence	Natural Information	3



*Table 8: Six two-valued logics as place values of a four-valued logical system*

The deepest reflection 4 - 1 reflects on the object as being, which also changes its character as the depth of the reflection 3 - 2 increase (Günther, 1976). The increasing depth in the iterative 2 - 3 two valued system realize a higher level of wholeness

(information, meaning, mental content) in the observed object. The 4 -1 reflection is the consciousness of oneself as a being. It possesses unlimited depth in the conscious reflection and unlimited width in the nature of the object.



*Figure 2: Four-Valued logical reflection structure*

Fig. 2 shows the underlying four valued logical structure of the Bohmian approach. Value three is derived by a second reflection, which can be iterated infinitely, and in this way creating an unlimitedly deep field of information and meaning, defining the term Information Field (Pylkkanen, 2016). The final reflection on the totality of reflections from value 4 results in transcendental

selfconsciousness of unlimited reflective depths and final reflection on the level of being (value 1).

The following diagram shows the iteration process of the third value and the final reflection constituting the fourth value of transcendental self-consciousness (Schmieke, 2022).



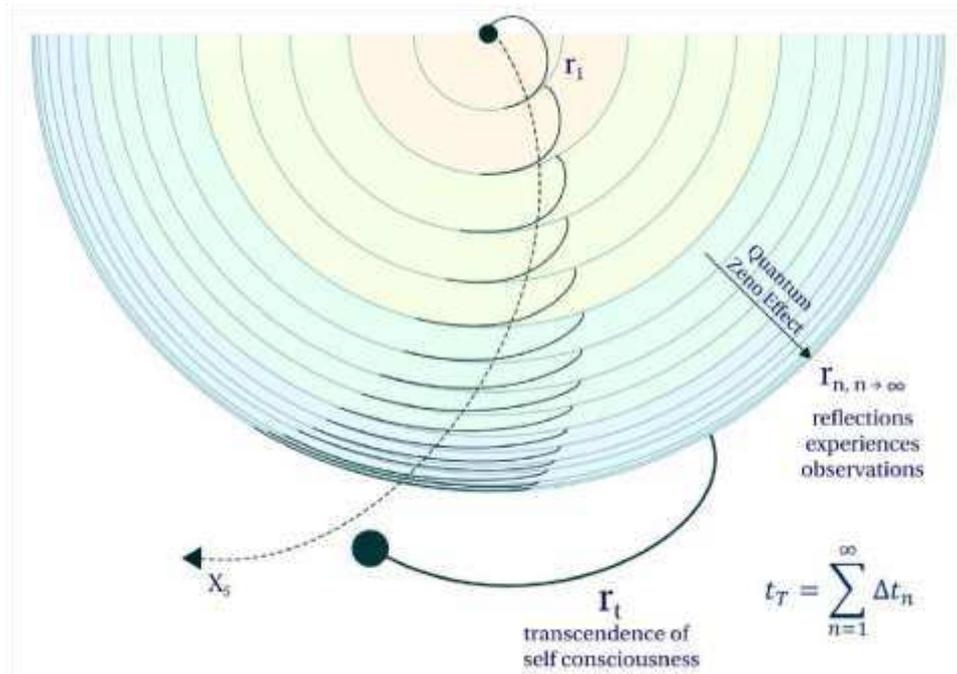


Fig. 3: Infinite iteration of the implicate orders and the total reflection as the underlying implicate consciousness

### Information Fields and Coherence in Living Systems

A life-process is characterized by its self-organizing, self-referential nature. Being closely related to its environment, a living entity is one unit, which functions as a whole. All the information exchanged with its surrounding is reflected on in terms it's wholeness, survival and goals. This reflection turns the exchanged information into meaning. The accumulated meaning of the living system constitutes its information field (Schmieke, 2021a,b).

The evolutionary biologist William B. Miller (Miller 2018) defines the information field in a similar way:

“It has been previously advanced that all living entities assess information beyond their immediate environment and exist as part of a system of Pervasive Information Fields (PIFs) (Miller, 2016). These fields of information are best modelled after the concept introduced by Lloyd (Lloyd, 2002) as self-organizing, universal, and scale-free informational sets that can be appropriately applied to biological organisms. Within this frame, each living organism has its own unique Information Field within spacetime as an attachment to outward information space. This is composed

by its physical environment and by the overlap of all the individualized Information Fields of each of the varied constituents with which it can communicate, both near and far.” The self-referentiality of the information field in biology is a second reflection on meaningful information, which is already a reflection on the information exchanged by the living system and its environment. Such a self-referential system actualizes itself continuously by a constant repetition of the self-reflection process (Heinrichs, 2021, ch. 1). Heinrichs defines consciousness as self-reflection, which is a reflection on itself, in this way becoming conscious about being reflective. Heinrichs suggests that so called self-mirroring neurons might be considered to be the physical substrate of self-consciousness (Heinrichs, 2021, ch. 3), as mirror-neurons have been suggested as a physical basis of empathy or reflection on the emotional state of others (Rizzolatti, G.; Craighero, L., 2006). Analogously to the infinite iteration of the super-implicate orders this iterative process of self-reflection and self-actualizations is completed by a third final reflection as the transcendental self-consciousness on the entire infinite process. In order to achieve full self-consciousness such a process needs to



have infinite depths transgressing the physical, biological and psychological realms into the realm of meaning. In this way living entities create meaning from information by a self-reflection process, which constitutes its Information Field (Schmieke, 2021a,b). The physical home of the Information Field is the dynamic hierarchy of super-implicate order in David Bohm's theory and the sum total of all quantum entanglements of the living system in quantum theory. In quantum-field-theory the information field is reflected in the lowest energy states of the quantum vacuum, which consists of quanta of order, representing long range macroscopic correlations in living

systems. These quantum-vacuum states manifest in space-time through the spontaneous emergence of coherent domains within the water within and without the cells of the organism (Del Guidice, Vitiello, 2006). As water consists of electrical quantum-dipole-molecules it can be coherently ordered by those quantum-vacuum states, which constitute the informational counterpart to the material structure of life. The condensed quantum-vacuum-states contain meaning rather than information as they actualize the information in relation to the self-referential process of the living entity. The four values of the living process therefor are:

1 Information
2 Meaning
3 Self-referential cognition as a continuous iterative process
4 Self-consciousness as the total reflection on the potentially infinite process of self-actualization

Table 9: 4 values of the life process above the quantum-vacuum

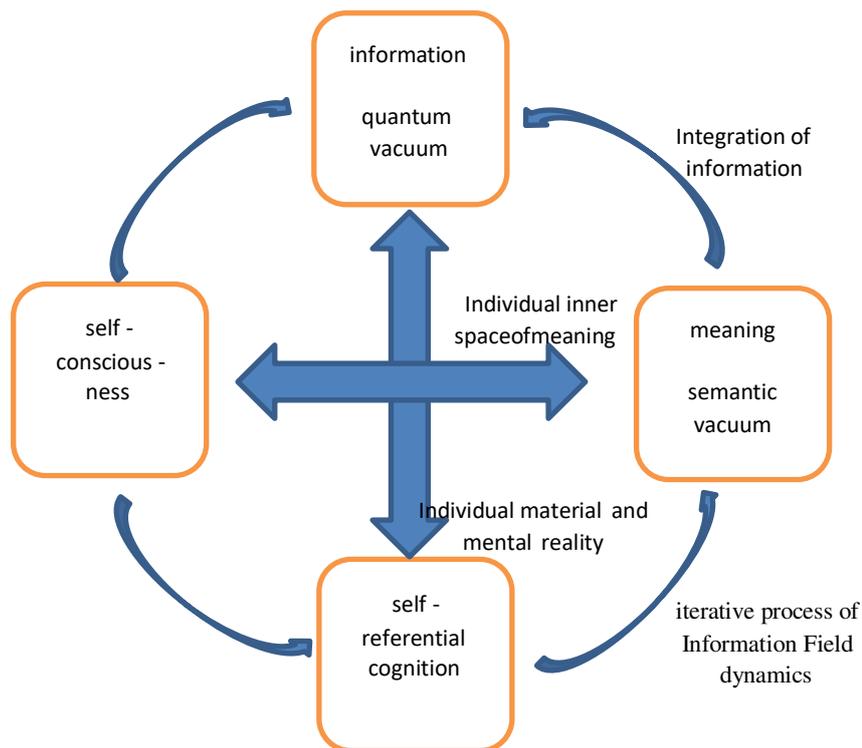


Fig. 4: threefold reflection from the quantum-vacuum, to the subject

In the explicate material level of the organism the manifestation of meaning appears as the macroscopic quantum-states of coherent domains within water, which in turn result in

coherent behaviour of related physiological processes (Bischof, Del Guidice, 2013). Examples of spontaneous manifestation of coherence in living organisms are:



Coherent ultra-weak cell-radiation (biophotons), coherent domains of brainwaves in the EEG (coherent firing of neurons), coherent frequencies in the hearts beat-to-beat intervals (HRV measurement) etc., emergence of meridian system in connective tissue, emergence of microtubules in cell-water.

In this manifestation of the Information states of the quantum-vacuum within the molecular structure and dynamics of water in living systems another four-valued reflection process can be found. The dynamics of the water-molecule-dipoles is reflected by the dipole-wave-quanta dwq, which are reflected

on the level of the quantum-vacuum by the so-called Bose-Einstein-condensate of the dwq as lowest-energy-vacuum-states. The integrated information represented by such a condensate of N dwq's is the forth state in this series of three reflections. It is the informational subject of the integrated molecular and quantum activities of a living entity and in this way represents its unit or informational self. It is the momentum of another logical quadrupole as seen in fig. 4 from which the inner subjective space of meaning, empirical self-consciousness and the transcendental subject emerges.

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1 Water-molecules
2 Dipole-wave-quanta of water
3 Dipole-wave-quantacondensate (Bose-Einstein-condensate)
4 Integrated information state of the quantum-vacuum

Table 10: 4 values of the life process up to the quantum-vacuum

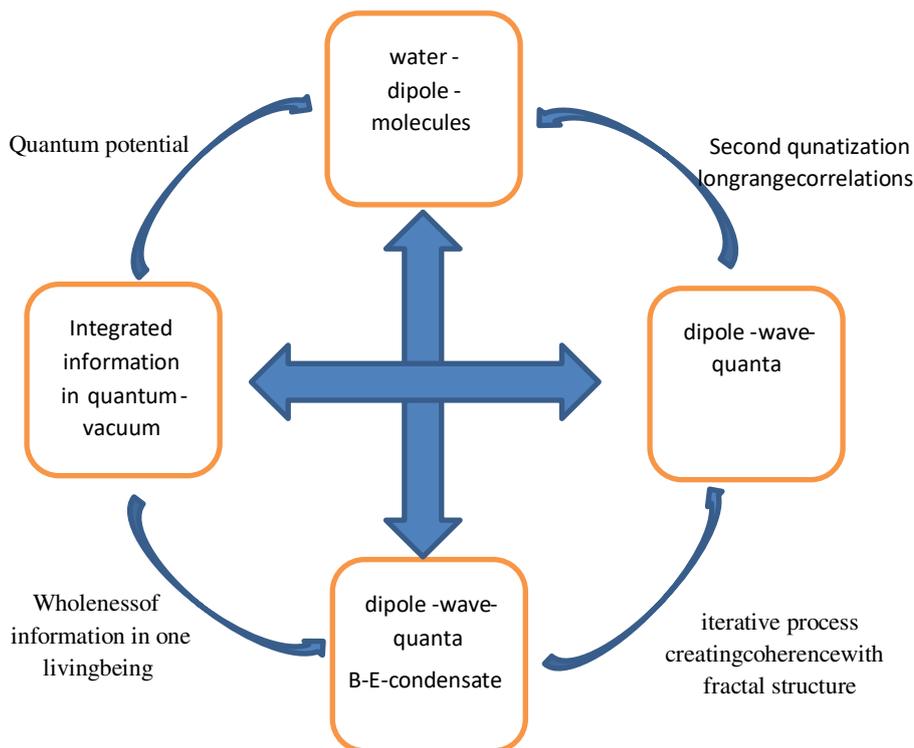


Fig. 5: threefold reflections from water to information

**Conclusion**

The rigorous application of two valued thinking, logic and formalism results in a

purely objectivating science for the price of losing the subject entirely. It also results in a division of science into multidisciplines, with mostly incompatible languages and



descriptions of reality, the human being and the life process. Quantum-theory has already pointed towards an expanded logic and also the integration of psyche and consciousness into hard sciences call for a richer ontology and logic. In all the modern scientific disciplines reflection has complemented being as an ontological theme. As consequence a four valued logic with two ontological themes seems to be rich enough as a theoretical frame for new emerging sciences as quantum-theory, system-theory and consciousness research. It allows the integration of ontologically and logically differentiated realities into the one real complex existence. It seems very promising to analyse its potential for solving fundamental questions in science as the hard problem of consciousness and the integration of quantum-theory and general relativity.

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