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## THE INFORMATIONAL STANCE: PHILOSOPHY AND LOGIC. Part I

### The basic theories<sup>\*†</sup>

**Abstract.** To better understand what information is and to explain information-related issues has become an essential philosophical task. General concepts from science, ethics and sociology are insufficient. As noted by Floridi, a new philosophy, a Philosophy of Information (PI), is needed. In the 80's, Wu Kun proposed a “The Basic Theory of the Philosophy of Information”, which became available in English only in 2010. Wu and Joseph Brenner then found that the latter's non-standard “Logic in Reality” provided critical logical support for Wu's theory. In Part I of our paper, we outline the two basic theories as a metaphilosophy and metalogic for information. We offer our two theories as a further contribution to an informational paradigm. In Part II [WuB14], we develop the relation between information and social value as a basis for the ethical development of the emerging Information Society.

**Keywords:** contradiction, dialectics, dynamics, ethics, information, interactions, logic, ontology, phenomenology, systems, values, transdisciplinarity.

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\* At the 4<sup>th</sup> International Conference on the Foundations of Information Science in Beijing, August, 2010, Professor Wu Kun of the Xi'an Jiaotong University presented, for the first time in English, the results of some thirty years of his research on the theory and philosophy of information.

Describing his recent extension of logic to real process systems (Logic in Reality; LIR), including information, at the same Conference, Dr. Joseph E. Brenner, a member of the International Center for Transdisciplinary Research, Paris. They noted that Wu Kun's positions and Brenner's normative principle of the reality logic had many key concepts in common. This joint paper is the outcome of the consequent collaboration between Wu and Brenner.

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## Introduction

The motivation for research in the field of information — as in all science and philosophy — is an increase in knowledge and the potential benefit for humanity. However, information in nature, its common existence in human cognitive and social fields, possesses a number of levels, and exhibits many forms, properties and functions. To better understand what information is and how to explain information-related issues, arguments can not be confined, as it they have been, by general concepts from science, ethics and sociology. As noted also by Floridi for somewhat different reasons, it is necessary to establish a new philosophy — a Philosophy of Information.

In the past 30 years, the work of Wu Kun has laid a general foundation for such a Philosophy of Information, summarized in one of the few documents available in English (The Basic Theory of the Philosophy of Information; BTPI; see [Wu10]). In his view, a Philosophy of Information (PI) should, first of all, have the nature of a metaphilosophy, with the capability of providing the following six essential theoretical components:

- Philosophical-ontological Status: a philosophical-ontological status for information, from the most general level of a theory of existence, demonstrating the universal character of information at its core.
- Emergence and Existence: a foundation in basic physics for information as a basis for emergence and existence.
- Dynamical Description: a dynamical description of information at levels that extend logically from the interactions for natural information to biological information, to information capacity of the human cognition and social level evolution of information.
- Value: a general definition of the value of information.
- Informational Thinking: a model and its interpretation for the information mode of thinking.
- Basic Framework: the most general possible framework for a unified information science.

In these two papers, in addition to the basic framework and content of the Philosophy of Information established by Wu, we discuss work by Hofkirchner, Marijuan, Capurro, Burgin and others who all have made contributions to the understanding of information and a Unified Theory of Information with more or less general philosophical character. We will show that the BTPI (The Basic Theory of Philosophy of Information)

is a further comprehensive, integrated contribution to a shift toward an informational paradigm.

This joint paper seeks to accomplish the following objectives:

- To provide a realistic logical support to the Philosophy of Information developed by Wu.
- To demonstrate that the logical basis of information does not have a Cartesian, bivalent material and cognitive nature.
- To apply the newly available Logic in Reality to the many levels of evolutionary information processes and interactions, and provide a description of the value of information.

In the two papers, we outline both the Brenner Logic in Reality and the Wu Basic Theory of Information and present the synergy between the two approaches that defines a Metaphilosophy of and a Metalogic for Information. On the basis of Wu's concept of Informational Thinking, we propose an *informational stance*, a philosophical stance that is most appropriate for, and above all not separated nor isolated from, the emerging science and philosophy of information itself. We propose the joint theory as a contribution to the establishment of the foundations of a unified science of information and to provide further theoretical support for the ethical development of the information society.

**Outline of part I.** In Section 1 we focus on the most important issues connected to Philosophy of Information.

Section 2 of this part, Basic theories, provides an overview of the Brenner Logic in Reality, based on the contradictorial or dialectical properties of energy. It includes comparisons with the dialectics of Hegel as well as some more recent dialectic logics. Two other logical systems that are relevant for a theory of information are natural logic and the Universal Logic of He Hua-can and Jean-Yves Béziau.

Section 3 discusses the concepts and principles of Wu's Basic Theory of the Philosophy of Information (BTPI). This section includes the BTPI emphasis on qualitative distinctions of kinds of information. A first comparison with Logic in Reality from an ontological standpoint is made.

Section 4 suggests a reinterpretation, based on the same logic, of the concept of self-organization, used by Wu and others, that avoids some of its circularities.

Part II, "From physics to society" [WuB14] develops the applications of the basic theories of this paper.

## 1. The philosophy of information – state of the art and problems

Driven by the rapid expansion of the new information and computation technologies, the Philosophy of Information is emerging as a significant independent discipline. However, despite agreement on the importance of information, there is a lack of consensus on what constitutes information, how its quantitative and qualitative aspects can be reconciled, and whether a unified theory of information is possible. The motivation for research in the field of information is the same as for all science and philosophy—an increase in knowledge and benefit for humanity. However, because of the pervasive nature of information and its multiple properties and functions in the individual and society, improved understanding of information has become even more of a moral imperative.

The need for an adequate Philosophy of Information has been emphasized by Floridi, a pioneer in the development of the philosophy as well as the logic and ethics of information [Flo10]. His work focuses on the necessary understanding of the lowest semantic levels of information and their quantitative properties, and prepares the ground for further discussion of qualitative aspects of information and its value and meaning [Bre10]. It is striking to note, however, that in a recent special section of the prestigious journal *Synthese* (vol. 175, no. 1, August, 2010) devoted to “The Nature and Scope of Information”, most of the articles failed to address the question of its “nature”, placing the emphasis on formal technical issues. [Fre10] did allege that tools were available to deal with the problem of the hypostatization of information, considered as an abstract noun; Mares [Mar10] presented a theory in which he admitted to using a “static” notion of information, promising a more dynamic one, related to contemporary treatments of information flow, using linear and dynamic epistemic logics.)

Starting in 1980 from philosophical considerations of the essence of information, Wu Kun, working at the Jiaotong University in Xi’an, People’s Republic of China, developed a Philosophy of Information (PI) that included information ontology, an informational theory of knowledge, evolution, value, an ‘informational thinking’, social information theory including a rigorous conceptual system for the natural properties of information and an interpretation of its biological significance, methodological aspects and social value. Wu Kun published more than 250 papers on the Philosophy of Information and related areas in Chinese,

plus a 14-volume monograph. Only a minute fraction of this work has just become available in English in “The Basic Theory of the Philosophy of Information” (BTPI) [Wu10].

In Wu’s view, the Philosophy of Information is the highest form of philosophy, a metaphilosophy that includes various philosophies as its branches [Wu89, 03]. PI considers information as a broad concept referring to a generalized form of existence, a mode of knowledge and a scale of values, and whose evolutionary principles can be explored. From the corresponding metaphilosophical perspective, a new information ontology, information epistemology, theory of information production, information social theory, information theory of value, information methodology, information theory of evolution, *etc.* can be constructed. Wu believes that establishment of a PI makes possible a new conception of nature, understanding, society and values and actively promotes the development of human information society, and a more civilized and democratic social polity, economic and cultural new order.

These are major conclusions for the role of any philosophy, and in this paper, we will only be able to give an overview of Wu’s work in its totality. Also, we must position Wu’s Philosophy of Information and its system framework in relation to work by Hofkirchner, Marijuan, Capurro, Burgin and others who have also made contributions to the understanding of information and its role in the society (cf. Hofkirchner’s work on a Unified Theory of Information) with a general philosophical character. We will show that the BTPI (The Basic Theory of Philosophy of Information) is a further comprehensive, integrated contribution to the shift toward an informational paradigm.

A recent extension of logic to real, complex phenomena, including information, has been made by Brenner, *Logic in Reality; (LIR)*. As a consequence of discussion between us (Wu and Brenner), we have decided on this joint paper that seeks to accomplish the following objectives:

- To provide a realistic logical support to the Philosophy of Information established by Wu Kun.
- To demonstrate that the logical basis of information cannot be of a binary or Cartesian nature.
- To apply *Logic in Reality* to many levels of information processes and interactions, and provide a more complete description of the value of information and the mechanism of its evolution as a process.

In these two papers we focus on how the work of Wu and Brenner together suggest a new approach to addressing philosophical and scientific issues in the formulation and application of information theory<sup>1</sup>.

## 2. A logic for information

Logic in Reality is a formal system. The rationale of presenting it in advance of the Basic Theory of the Philosophy of Information of Wu Kun is that it will be the basis of interpretations of specific aspects of that Philosophy (the BTPI) as they appear in Section 3 and subsequently.

### 2.1. Logic in Reality (LIR)

Logic in Reality (LIR) is a new kind of logic that extends the domain of logic to real processes and is applicable to complex interactions at the level of individuals and society, as well as relating them to a new perspective on the underlying metaphysics. Based on the work of the Franco-Romanian philosopher Stéphane Lupasco [Bre10a] (Bucharest, 1900, Paris, 1988), LIR is grounded in a particle/field view of the universe, and its axioms and rules provide a framework for analyzing and explaining real world entities and processes, including information, at biological, cognitive and social levels of reality or complexity.

The term “Logic in Reality” (LIR) is intended to imply both 1) that the principle of change according to which reality operates is a *logic* embedded in it, *the* logic in reality; and 2) that what logic really *is* or should be involves this same real physical-metaphysical but also logical principle. The major components of this logic are the following:

- the foundation in the physical and metaphysical dualities of nature,
- its axioms and calculus intended to reflect real change,
- the categorial structure of its related ontology,
- a two-level framework of relational analysis.

Details of LIR are provided in [Bre08]. Stated very rapidly, the most important concepts of LIR are that 1) every real complex process is accompanied, logically and functionally, by its opposite or contradiction,

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<sup>1</sup> This paper will not discuss the distinctions between theory and philosophy, and the terms will in some cases be used interchangeably. In any case, it is in the spirit of the Brenner logic that while philosophy is a broader concept than theory, the two are not totally separated or separable.

but only in the sense that when one element is (predominantly) present or actualized, the other is (predominantly) absent or potentialized, alternately and reciprocally, without either ever going to zero (the Axioms of Conditional Contradiction and Asymptoticity); and 2) the emergence of a new entity at a higher level of reality or complexity can take place at the point of equilibrium or maximum interaction or “counter-action” between the two (the Axiom of the *Included* Middle). Together, these contradictory relations will be referred to as the Principle of Dynamic Opposition (PDO) of LIR.

LIR should be seen as a logic applying to processes, in a process-ontological view of reality [Sei09]<sup>2</sup>, to trends and tendencies, rather than to “objects” or the steps in a state-transition picture of change [Bre05]. Stable macrophysical objects and simple situations, which can be handled by binary logic, are the result of processes of processes going in the direction of a “non-contradictory” identity. Standard logic underlies, rather, the construction of simplified models which fail to capture the essential dynamics of biological and cognitive processes, such as reasoning [Mag02]. LIR does not replace classical binary or multi-valued logics but reduces to them for simple systems. These include chaotic systems which are not mathematically incomprehensible but also computational or algorithmic, as their elements are *not* in an appropriate interactive relationship. Such interactive relationships, to which LIR applies, are characteristic of entities with some form of internal representation, biological or cognitive.

### 2.1.1. Categorical ontology

A major component of LIR is its categorical ontology in which the sole material category is Energy, and the most important formal category is Dynamic Opposition. From the LIR metaphysical standpoint, for real systems or phenomena or processes in which real dualities are instantiated, their terms are *not* separated or separable! Real complex phenomena display a contradictory relation to or interaction between themselves and their opposites or contradictions. On the other hand, there are many phenomena in which such interactions are not present, and they, and the simple changes in which they are involved can be described by classical, binary logic or its modern versions.

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<sup>2</sup> This paper provides a complementary formal view of process ontology.

LIR thus approaches in a new way the inevitable problems resulting from the classical philosophical dichotomies, appearance and reality, as well as the concepts of space, time and causality as categories with *separable categorial features*, including, for example, final and effective cause. Non-Separability underlies the other metaphysical and phenomenal dualities of reality, such as determinism and indeterminism (see below), subject and object, continuity and discontinuity, internal and external and simultaneity and succession. This is a ‘vital’ concept: to consider process elements that are contradictorily linked as separable is a form of category error. The claim is that non-separability at the macroscopic level, like that being explored at the quantum level, provides a principle of organization or structure in macroscopic phenomena that has been neglected in science and philosophy.

Luhn [Luh10] has also called for a new ontology of information that appropriately conceptualizes its physical variables and the triadic process of change involving sender, information and receiver. The world is continuously “updated” by (apparently) spontaneous processes which are *both*, from the LIR standpoint, causes and the effects of causes.

### **2.1.2. Implications for philosophy. Determinism and non-separability**

Many theoretical arguments depend on some form of absolute separability of dichotomous terms *via* the importation, explicit or implicit, of abstract principles of propositional binary logic into exemplified, in the standard notions of time, space and causality. LIR discusses philosophical problems in physical, dynamical terms that do not require abstract categorial structures that separate aspects of reality. To repeat, the critical categorial feature of the LIR process ontology is the *non-separability* of opposing phenomena, *e.g.*, two theories or elements of phenomena, *e.g.*, syntax and semantics, types and tokens.

The philosophy of LIR can be very rapidly characterized as a non-naïve dualistic realism that assumes a real, interactive relation between all the classic dualities when they are instantiated in reality. It is part of the current *ontological* turn in philosophy, a “naturalization of metaphysics”, expressed for example by Ladyman and his colleagues [Lad07] in their “Information-Theoretic Structural Realism”.

The LIR view, critical for the discussion of free will, is that the world is both deterministic and indeterministic, in the contradictorial relation suggested above. All processes are deterministic, in the sense that the trajectory of all particles could in principle be followed since



their creation; indeterminacy is epistemological, not ontological. The possible exception is that of the timing of radioactive decay<sup>3</sup>, but this does not affect the further argument. The key idea is that starting at the quantum level it is the potentialities that are the carriers of the causal properties necessary for the emergence of new entities at higher levels. Other randomness is epistemological and the cognitive result is a deterministic reality — classically, necessity — dialectically linked to the appearance of chance.

The obvious and often stated concept that no theory, including LIR, is 100% true has ontological value as part of its core thesis. *No* complex real process is totally instantiated or instantiated in all cases *vs.* some alternative — entity or construct as the case may be. The only exceptions to this rule are either trivial or outside the domain of human existence, that is, of thermodynamic change. There are no exceptions to the law of gravity or the inverse square law of electromagnetic radiation.

### 2.1.3. Internal and external

The fundamental axioms of LIR imply a major change in the definition of intrinsic and extrinsic properties. No property of a system that is involved in some form of dynamic interaction, that is, at the quantum, biological and mental levels can be separated from its opposite or negation. All properties are partly intrinsic and extrinsic, and their internal and external aspects (predicates in the LIR ontology) are alternately actualized and potentialized. As Wu Kun has said, this principle of internal and external interaction matches internal and external information phenomena, providing supporting evidence of the complex interactive restructuring and innovative or emergent processes that *define information itself*.

A source of difficulty in understanding the dynamics of complex cognitive interactions has been the apparent absolute dichotomy between two individual human minds. While it is easy to see a cell, say, in dynamic interaction with its environment or context, with change possible in both directions, it is difficult to understand how our context can be both internal and external without externality being determined by our consciousness. This would demand a fully anti-realist position.

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<sup>3</sup> Effective indeterminism at this level does not preclude determinism at any other, but only that it is, effectively, potentialized.

The LIR approach is to analyze the details of our acquisition of perceptions and effectuation of actions into actual and potential components. Thus while “your” mind is physically external to mine, some of its perceptible potentialities can be internalized, perhaps by mirror neurons in the concept of Ramachandran [Ram98]. To anticipate somewhat, individuals, as part of a group, contribute in this way their individuality to it. But the group instantiates aspects of group psychology and this becomes part of the individual. What is the ‘group part of the individual’ is something instantiated at higher, amore intuitive level, but not the less real for that. At all levels of reality, we will assume that there is a conflict or opposition between epistemological elements and the energetic processes to which they correspond. One may and in fact always will focus on one or the other aspect, but the contradictory relation is present, one aspect is actualized while the other is potentialized.

Further development of the epistemology of LIR is not possible here, but the reader may wish to keep in mind Hegel’s dictum that the function of philosophy is to put us in touch with the real, and that is certainly also the objective of LIR.

#### 2.1.4. Information-as-process

In the approach by Brenner to a theory of information, all the familiar activities of information production, transfer and reception of information are considered to be energetic processes. As such, they, and any theory of them, should follow the dialectical principles of Logic in Reality. In this approach, the real properties of informational entities or processes, binary and non-binary, are not independent of and require reference to the *a priori* non-binary energetic processes that are their source, in some real situation, at all levels of reality. Further, what information is in reality and what constitutes a proper theory of information, of which information is its substrate, cannot be totally separated.

The definition of information that is most congenial to LIR was made by Kolmogorov [Min03] to the effect that information is any operator which changes the distribution of probabilities in a given set of events. This is quite different from his well-known contribution to algorithmic information theory, but fits the process conceptions of LIR. In LIR, logical elements of real processes resemble (non-Kolmogorovian) probabilities, and the logical operators are also processes, such that a predominantly actualized positive implication, for example, is always accompanied by a predominantly potentialized negative implication. It is possible to ana-

lyze both information and meaning (higher level information) as having the potential or being a mechanism to change the informational context.

The LIR approach thus incorporates and provides for a relation between two complementary components of information: 1) information as well-formed, meaningful and truthful data; and 2) information as real energetic processes, whereby information-as-processes can function as higher-level operators on information-as-data at a lower level<sup>4</sup>.

## 2.2. Natural Logic

### 2.2.1. Grize

Language is frequently considered to have its own logic, but one with its own rules, much more vague and difficult to formalize and axiomatize, despite its character as action. Grize's natural logic was an offshoot of the Operative Logic (*logique opératoire*) of Piaget. Its objective was to capture aspects of non-formal human reasoning and is defined most simply [Gri96] as a logic used spontaneously for customary reasoning performed by means of everyday language. The point in this theory that relates it to a logic of/in reality involves a schematization of 'logical-discursive' operations in which what is essential is not a text or a discourse as such, but the underlying activity (pretext), the reality of language-in-use. A distinction is made in the domain of application of natural logic — to first person experience — and that of formal logic — to scientific observations.

Natural logic is thus always situated in a social context and is *not* subject or topic neutral. Formal, classical logic and the formal view of reasoning was specifically criticized by Grize as taking place in a closed domain, elaborated at some point from facts, but without further relation to reality. An absolute concept of truth is implicit in that premises are stated as such and their establishment is not required, and the only rule of deduction is *modus ponens*. Natural logic on the other hand is referred to not only as a "logic of subjects", but *also* as a "logic of objects", and care is taken to differentiate natural logic from formal logic also designated as a physics or logic of "any old object". This idea confers the particularity of context to objects and raises their ontological status, so to speak. In the logic of dynamic opposition, subject and object are

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<sup>4</sup> For a discussion of levels of reality and abstraction and relation to information, cf. Brenner [Bre10b].

dialectically and contradictorily related. The failure of early attempts to relate natural logic to logics of action such as that of von Wright, in this view, was because such logics do not in fact adequately describe action and change.

### 2.2.2. Wu Kun

Giving another interpretation to the concept of natural logic, in his *Natural Logic* published in 1990 [Wu90], Wu explored the natural existence and inner logic of the evolution of information. The book, in three parts, proposed theories of 1) direct existence; 2) indirect existence; and 3) natural evolution. It was clear in the early 80s in the 20th Century that information ontological theory needed to be further expanded and grounded into a philosophy of information, and Wu's book explores the nature of the dual existence and the dual evolution of physical form and information form, proposing a specific mechanism for these processes.

Wu [Wu88] argued in a 1988 paper entitled “‘*In the name of the natural*’ to express nature” that any natural law approach can only be ontological.

In the concept of natural laws, we obviously have a contradictory situation: on the one hand, natural laws are purely objective; on the other hand, the expression of natural law requires subjective understanding as an intermediary, resulting in some kind of epistemological characteristics of natural laws as formulated. Thus, an ‘objective’ law is not purely objective to this extent. Although the human modes of knowledge are dependent on the level of understanding, we can distinguish laws of nature and human understanding itself. Here, the law is on a natural foundation, rather than on human knowledge. Formulation of objective laws of nature must be taken as relatively external to the method of understanding and proceed through philosophical reflection. This approach permits the specified frame of reference or structure of understanding to be discarded, while allowing the requirements of the natural laws to exist ‘on their own’. We must ‘in the name of the natural’ express nature. This method of describing the laws of nature can only be ontological.

This is extraordinarily close to the perspective of the Logic in Reality (LIR) and to the conception of natural laws of Paul Davies [Dav07], who wrote that it is not necessary to appeal to something outside our universe to explain the “fine tuning” of the laws of nature.

As an example of very different kind of approach, we cite the work, over the same period as that of Wu, of Igor Gurevich [Gur10]. Gurevich, as also Tegmark, Lloyd and others, postulates a universe constituted by bits of information which follow what he calls ‘informational laws’. In our view, however, his set of laws which include, among other things, the Gödel principles and Shannon’s entropy, beg the question of the origin of bits, which for us requires that energy be primitive. The picture provided by Gurevich is thus an *a posteriori* static classification of a basic information content of matter that provides no information (sic) on how it can evolve dynamically.

On the other hand, just as in LIR, Wu sees a “logic” in natural existence and its evolution that builds an ontology, an ontological physical basis of information. His statement implies that the method of interpretation of (the laws of) nature can only be ontological *in general*, “in the name of the natural”. It is this system, also, which is necessary to “express” or describe nature correctly, ontologically that constitutes a “Natural Logic” *without reference to language or the truth-functionality of propositions*.

Of course, language and propositional logics are also in nature and have Natural Logical aspects, but their abstract properties are not *constitutive* for Natural Logic. Information, on the other hand, is a dynamic process that cannot and should not be reduced to its semantic, “in-itself” (see below, Section 3.2) characteristics. Information requires something like a Natural Logic for its description, because of its “dual existence nature”, to use Wu’s term.

Logic in Reality does the same, with the addition of the Principle of Dynamic Opposition, the sequential alternation of the actuality and potentiality of opposing or contradictory aspects of a phenomenon, such as physical and informational form. Informational form is also “physical”, a physical process within the laws of nature, but it operates at a higher level of reality, and what predominates (is primarily actualized in LIR terms) are its “for-itself” (Section 3.2) characteristics. The duality in nature (natural substances) is *not* a dual *substance* theory, in which two substances are 100% the same or different. In the LIR conception of reality, things are the same *and* different, partly both at the same time, and this conception applies to Natural Logic as viewed by both Grize and Wu.

### 2.3. Hegel

The logical system first developed by Lupasco is a dialectics, and it, and the Logic in Reality (LIR) of Brenner that derives from it, have been compared with that of Hegel and his followers, including Marx, Engels and Lenin. The differences between Lupasco and Hegel are, however, more important than the similarities as pointed out in [Bre08]. Both Hegel and Lupasco started from a vision of the contradictorial or antagonistic nature of reality; developed elaborate logical systems that dealt with contradiction and went far beyond formal propositional logic; and applied these notions to the individual and society, consciousness, art, history, ethics, and politics. Hegel incorporated contradiction in logic and rejected the idea of a classical ‘formal’ logic that claimed to be a study of the form of thought in abstraction from content<sup>5</sup>.

Hegel proposed three axioms that imply a primarily diachronic sequence of  $A$ , non- $A$ , and  $A$  as thesis, anti-thesis, and synthesis. Hegel’s logic is still Aristotelian, integrated into a “metaphysical dialectic” [Lup87], in which the contradictory duality he introduced was continually abolished by successively purer and broader syntheses of antithetical terms. The subsequent dialectics of Marx and Engels simply transposes, to the social level of reality, the same Hegelian drive toward a synthesis involving the suppression of, in contrast to Hegel, *all* contradiction.

Lupasco’s system, however, involves *two* dialectics, ascending and descending (*diverging*) toward the non-contradictions of identity and diversity and a *third* dialectics *converging* toward contradiction. As above, the source of contradiction is inherent in energy and is the only existent reality. As Lupasco expressed it, Hegel’s system was “only half of a dialectics” [Lup47]. In Hegel, the affirmative value of identification always transcends the negative value of diversification.

As pointed out by Taylor [Tay75], Hegel’s thesis depends on a premise of ontological necessity that in turn depends on the contradiction of the finite. Hegel established or expounded his ontological structure at ‘high’ levels, but his project required demonstration of his ontology at the lowest level of simply determinate beings, and his attempted proof of contradiction failed. We suggest that the realism of LIR successfully answers this major objection to the coherence of a system like that of

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<sup>5</sup> In a paper for publication, “What is formal logic?”, Jean-Yves Béziau shows, from the standpoint of contemporary logic, that the notion of ‘formal’ is neither essential nor useful to characterize it.

Hegel, without requiring a commitment to his basic thesis, the idealist part of his doctrine. More importantly for the humanist thesis that is defended in this paper, our dialectics do not result in the totalitarian, anti-social ideological theses which, as Popper has abundantly shown [Pop45, p. 11] were Hegel's main interest.

Piaget's view of contradiction was also a standard Hegelian form of Marxist dialectical materialism, which correctly accords a central role to conflict and contradiction in the transformation of social realities. However as shown by Priest [Pri89], Marxist dialectics fail to give an adequate account of the true contradictions involved in society: an inconsistent or paraconsistent logic is necessary for such an account, albeit in our view not sufficient. A logic of the LIR form seems required to characterize the emergence of new structures from real contradictions.

#### 2.4. Dialectical logics and dialectical realism

Anticipating the categorization of the existential field by Wu Kun, we simply point out here that philosophy, as well as Brenner's Logic in Reality, must be seen as continuations of the line relating philosophy, logic and dialectics that runs from Kant through Feuerbach, Marx and Lenin. Wu's conception of "objective reality" is based on that of Lenin and he states that it opened the way for the development of a non-hypostatization of dialectical materialism [Wu02]. This concept was then applied to his proposal of "information thinking" at the heart of a new informational paradigm for the economy and the society [Wu04].

It is impossible here to provide a detailed discussion of the development of the relation between logic, dialectics and reality. The interested reader is referred to the excellent book by Ilyenkov [Ily74]. As quoted by Ilyenkov<sup>6</sup>, going beyond Hegel, Lenin wrote that logic is not the science of the external forms of thought, but of the laws of development of all material, natural and spiritual things. There are no essential differences of principle between logic and a theory of knowledge. Since logic was also merged with dialectics, logic as a theory of knowledge and dialectics were "in a relationship of full identity". One of its key categories is in fact contradiction, properly understood. Marx avoided the metaphysical reduction of internal contradictions to external ones, focusing on the reality of internal contradictions and relations of phenomena to

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<sup>6</sup> We are indebted to Yuri Melkov of the University of Kiev for drawing our attention to this document.

themselves. Dialectics, on the other hand derives one from the other, recognizing the objectivity of both. Logic in Reality uses the same “language”, but avoids the requirement of “*full* identity”, itself an absolute statement that reflects the “old” (bivalent) logic whose critique Hegel had begun.

Logic in Reality has a more detailed founding in current physics than the “energy doctrine” of Lenin. The Lupascian form of philosophy is perhaps best described as “dialectical realism”, rather than “dialectical materialism”, in line with current theories of ontological structural realism such as that of James Ladyman and his colleagues [Lad07]. Such a realism immediately implies a corresponding “unrealism”, and this duality is at the heart of the BTPI (cf. Section 3).

One of the most important conclusions from this analysis, as anticipated by Marx and Lenin, is that for real processes, there is no distinction between logical contradiction and dialectical contradiction, which is also logical in the extended sense of LIR. Only in the linguistic or simple mathematical domain, to which standard, truth-functional bivalent or multivalent logics apply, is it correct to maintain the distinction.

A key methodological conclusion is that the Wu–Brenner approach contributes to recovering dialectics as an appropriate strategy for philosophy and science, including social and political science. As shown, the dialectical principles of Logic in Reality, grounded in physics, include properties enable their operation at all levels of reality or complexity. To say, for example, that contradictory tendencies pose both positive and negative potentials at the same time, for example, of opportunities and risks is, in the theory proposed here, a *logical and dialectical* statement that can be linked to similar phenomena at all levels of reality.

We follow Hofkirchner here [Hof09]: “Dialectic analysis in this context means complex dynamic thinking (or informational thinking, following the LIR logic)”. In a dialectical analysis, phenomena are analyzed in terms of agency and structures, discontinuity and continuity, the one and the many, potentiality and actuality, global and local, virtual and real, optimism and pessimism, essence and existence, immanence and transcendence, *etc.* LIR is thus an understanding of how things transform from one state to another state. Our interpretation, at the ontological level, is that all of these states have the inalienable nature, and the implication that both can evolve according to the same principle is also reflected in the philosophy of information.



## 2.5. Universal Logic

One of the most pertinent recent advances in standard logics of the last decade has been the development, primarily by He Hua-can in China [He06] and Jean-Yves Béziau in Switzerland [Béz00], of what these authors refer to as Universal Logic [Béz07]. Dialectics, information, logic and social progress were linked in a poem by He Hua-Can presented at the Second World Congress and School on Universal Logic [He07]:

Progressing Step by Step:

- the foundation of information is logic,
- the various logics should be unified,
- the progress of unifying should be gradual,
- the key to progress is dialectic.

Universal Logic has a parallel function to universal algebra that provides the abstract basis for the unification of a wide variety of alternate algebras, Béziau has defined universal logic as not in and of itself a logic, but rather a universal theory of logic grounded in current mathematical thought.

He [He05] has further shown the limitations of logics with standard static variables, among which Japaridze's computability logic must be included, in addressing problems in computer science. Although, according to He, mathematical logic will always be an important basis for computer science and AI, it must be changed from being "rigid" to a "flexible" logic that can include, in a more functional dialectical manner, contradictions and uncertainties in order to be oriented to the complexity of the real world. Again, however, despite the expanded scope of He's Universal Logic, which includes both rigid and flexible logics, and can allow for "contradictions and uncertainties", it refers to systems of *propositional* logics. This limits in our view the kinds of real processes and properties of real systems that can be addressed, but does, on the other hand, further define the domain of computability.

A number of additional interpretations of Universal Logic have appeared in a book just published (available on-line) of which Béziau is the principal editor, entitled *Is Logic Universal?* Unfortunately, most of the articles maintain a mathematical-linguistic conception of logic which cannot be applied to the phenomenology of processes, including information.

From the point of view of information theory, however, what is needed is exactly a logic that is applicable to both the lowest semantic level

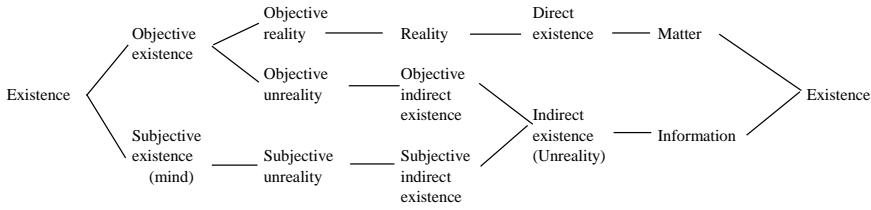


Figure 1. Partition diagram of the existential field [Wu86]

of information-as-data as well as information-as-process (see above Section 2.1.3). The Universal Logic of He describes the mathematical dialectic aspects of logic and is thus appropriate for the former. LIR describes the non-mathematical dialectics appropriate for the latter. Both are accordingly needed, in our view, for a complete logic of a science of information.

With this background in logic and dialectics, let us now turn to the detailed discussion of Wu’s approach to information.

### 3. Wu Kun’s Philosophy of Information

#### 3.1. The Basic Theory: The Existential Field

Wu Kun’s philosophy of information is based on the insight that the traditional doctrine “objective reality – objective existence” cannot describe the world of information world. Such a world requires the corresponding establishment of a new ontology and worldview to completely and accurately grasp its field of existence.

Wu therefore defines a classical logical system with two terms and their opposites: objective ( $P$ ) and real ( $Q$ ) and subjective (non- $P$ ) and unreal (non- $Q$ ), leading to the six formulae of classical bivalent logic. In the Wu logic, the categories of existence are reduced to four by the elimination of the contradictories ( $P \wedge \text{non-}P$ ) and ( $Q \wedge \text{non-}Q$ ).

Let us begin by reproducing Wu’s diagram that shows the formal relation between his terms, summarize their definitions, and point out its major consequences for our theory of information. The consequence will be what Wu calls the resegmentation of the existential field (see Figure 1).

We now present the original argument in the logical form as made by Wu, which indicates that even within the limits of classical logic a new dynamic interpretation of information is possible.

1. **Objective Reality** ( $P \wedge Q$ ). The commonsense notion of matter-energy as Objective Reality is perfectly adequate as the starting point for this discussion, because it is not only the basic form of reality that contemporary science discloses as the composition of the world, but it also corresponds to our everyday life experience of that form of reality.

The concept of Objective Reality is usually taken in the scientific literature to refer to matter and energy; at a general philosophical level, take they are called substances, or in Wu Kun's system Direct Existence.

2. **Objective Unreality** ( $P \wedge \neg Q$ ). Objective unreality refers not to the process of interaction between things, but to the result of this process, the 'condensation' of its content. Wu Kun called the content the "trace" of the natural relations between objective things that is present (like reflection),

The "trace" of the general mapping is a construction in the objective world, is precisely a specific coding structure of all reaction the stored contents of the interactions between different objects. It is in this particular sense that we say that there is a difference of essence between "objective unreality" and the existential way of "objective reality" of signs in the material world. Objective Unreality means content of objective relations of condensation in the objective things, which is different from phenomenon of a subjective present in a phenomenological sense. It is what Wu Kun called the display of images by material objects by purely objective physical processes.

3. **Subjective Reality** ( $\neg P \wedge Q$ ). In this theory, subjective reality is not existence, because a subjective image of something is not that something itself. If one takes something as real, then the same real can not be used as the concept to describe its subjective image, which is similar to it. One can not use the same real concept to describe both an objective thing itself in its mode of existence, and the other things reflected in the content of the same relationship.

4. **Subjective Unreality** ( $\neg P \wedge \neg Q$ ). Wu Kun uses this concept to refer to the subjective existence of all mental phenomena, from the lowest animal level of perception and memory to the highest human levels of perception, memory and thinking. It includes "not real" conscious and

unconscious psychological phenomena, cognitive activities, the creation and application of new images, symbols, *etc.*, and their systems.

Wu Kun further pointed out that because objective unreality and subjective existence are not *both* unreal, therefore, subject and object can be interconnected to achieve a unity: it is impossible to separate the knower and the object of knowing, exactly as in the LIR epistemology.

On this basis, Wu Kun redefines a constitutive mode of the existence field. He proposes two new categories, direct existence and indirect existence. Indirect existence is direct existence of itself displays. Objective unreality is objective indirect existence; subjective existence is subjective indirect existence. Wu Kun used direct existence to refer to objective reality that is the philosophical and material scope of phenomena. Indirect existence refers to objective unreality and subjective existence; the concept of information is usually transformed into a philosophical concept that refers to its indirect existence.

Summarizing, we have the following model of equivalence relations as established by Wu Kun:

$$\begin{aligned}
 &\text{Objective Reality} = \text{Reality} = \text{Direct Existence} = \text{Matter} \\
 &\text{Unreal} = \text{Objective Unreality} + \text{Subjective Unreality (Mind)} \\
 &\quad = \text{Indirect Existence} = \text{Information} \\
 &\quad \text{Objective Unreality} = \text{Objective Indirect Existence} \\
 &\quad \quad = \text{Objective Information} \\
 &\quad \text{Subjective Unreality} = \text{Subjective Indirect Existence} \\
 &\quad \quad = \text{Subjective Information}
 \end{aligned}$$

Based on his analysis, Wu Kun gives a philosophical definition of information as a philosophical category of signs of indirect existence [Wu84]. Information itself displays the same mode of existence and status as matter ([Wu81]).

Wu Kun's approach to information is to analyze the structure of the existence field from the natural ontological standpoint, first dividing existence into the two major areas of objective and subjective. These are then subdivided into the real and unreal types, and the areas and types placed in a  $2 \times 2$  matrix or cross-combination into a unified category for study. The meaning of each combination is discussed and leads to the following further segmentation of the existence field: the matter – objective reality = direct existence; information – objective unreality +

subjective unreality = indirect existence. This classification is similar to traditional philosophical view of existence divided into distinct material and spiritual areas. It is an exhaustive classification of the propositional elements of subject and object, and the classification of reality and unreality is also exhaustive. Consequently, these two classifications generate four propositional pair combinations that form the classification of existence field must to be exclusive and exhaustive, and the resulting division of the existence the field is also a logically self-consistent and exhaustive classification.

Brenner has questioned the application of standard category theory to complex process phenomena such as information. At this point however, we are still at a preliminary stage of our ontological analysis, and the split made by Wu is extremely useful and providing a naturalized base for further discussion. Thus, restating Wu Kun's key conclusion, information has an Indirect Existence that is both objective and subjective, the existence of which are defined, again by the following:

- Subjective Indirect Existence is Subjective Unreality as defined above, both human and animal.
- Objective Indirect Existence derives from Objective Unreality that is nevertheless part of Objective Existence.

Existence is constituted in this picture, then, by *both* matter-energy (see Part II, Section 5) and information from a physical perspective. From the diagram, we can thus extract the essence of information namely, that it is “tied” to existence and reality through its objective and subjective aspects. It *is* those aspects.

Existence is constituted in this picture, then, by the co-existence of matter-energy and information from a physical perspective. Hence all entities are characterized as dualities of matter-energy and information. The complexification that occurs in moving from one informational form to the next is readily interpreted in terms of grades or levels (see Section 3.4). The concept of information as indirect but still material existence enables Wu to show that any object is constituted by its directly and indirectly existing parts. Any existing material structure contains in itself, in Wu's term, its ‘condensed’ history, its current properties and the information of its possible or potential future development. Such a ‘condensation’ of the contents of relevant relationships has been designated by Wu as an “informosome”. This term is currently in use in biology [All98] to refer to mechanisms of protein transfer in the cell, but this process should indeed be understood as informational in the broad

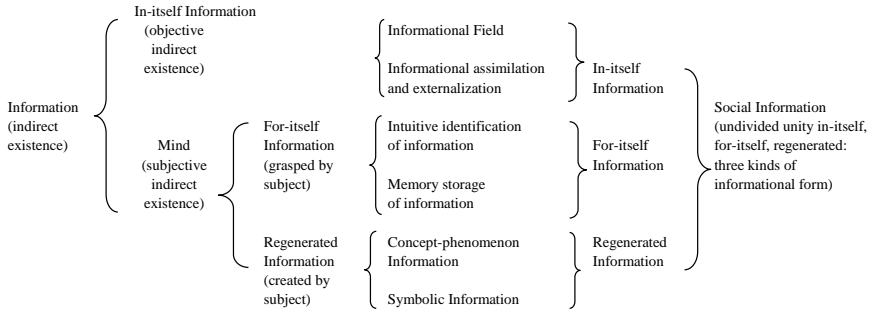


Figure 2. The philosophical classification of information [Wu87]

sense of this paper. This is a further consequence of our view that both material processes and their informational components evolve together. (The neologism of “informosome” is similar to the new term “exposome”, also from the field of biology). The term exposome refers to the totality of environmental exposures of an individual from conception onwards, and has been proposed to be a critical entity for disease etiology. We note that, interestingly, that like the informosome, the exposome is constituted by a totality of *information*. It *is* an informosome). Of course, the scope of the abstract informosome concept is far beyond its original designation. (It is important to distinguish this “historical” view of objects (or, rather, the more or less rapidly evolving processes that we define as temporarily static objects) from the historical view of society that is rightly criticized by Popper. In our system, there is no abstract attribution made of imagined possible prior states.)

What we will show later is that this descriptive resegmentation of the field of existence (the extant domain) of Wu, when applied to informational processes or ‘activities’, benefits from the principles of LIR that further explicate their active non-quantitative and normative properties.

### 3.2. The classification and structure of information

Wu then classifies information into three independent forms and one dependent form (see Figure 2).

**In-itself information.** In-itself information has an objective indirect existence, independent of any subjective features. The information field

and the reception and emission of information are two basic forms of in-itself information. The information field is derived from the internal and external interactions taking place in matter (mass and energy), but in standard physics, the informational field is seen only as a material field. However, due to the inclusion of the energetic nature of the interaction between internal and external processes (cf. the ontology of Logic in Reality), one can ascribe the proper ontological status to the different relations and interactions involved, ultimately implying that the informational field instantiates meaning and value..

According to Wu Kun's description, the existence field is a duality of physical field and information field. Information reception and emission refer to the object in the process of interaction, with the information field playing an intermediary role. Standard physics says that change is a change in a substance's structure, but here the difference between these structural changes and the original structure is the information sent or received as caused by the information field.

We assume that any change of structure requires some asymmetrical relationship, and that the resulting structural changes are condensed or crystallized, with the information encoding their meaning and value. The informational aspects of both the sending and receiving of a message have meaning; sending the message involves an aspect of separation from (alienation) and its reception/integration (assimilation) by the receiver. These concepts of alienation and assimilation will be used as technical definitions of real, ontological processes that are implied by and involved in the generation, transmission and reception of information, but to which only Wu gives the proper ontological value.

Due to the universality of physical interactions, and since the beginning or better non-beginning of matter and time, any existing structure of objects in the universe is a consequence of the all subsequent process interactions. Therefore, the structure of all objects encodes the information for the significance of their physical form. From this it can be concluded that all objects at the same time possess both a material structure and the informosome, as a unity. It can thus be said that as long as there is matter there is structure and there is information. The activities of in-itself information are the foundation of all other information activities, and other information activities at all levels must also be accompanied by a corresponding to in-itself information activities.

Using the diagram in Figure 3, Wu illustrated the process of in-itself information activities involving information assimilation and alienation

*via* the information field as a logical circle, which *has and does not have* a beginning! It (the logical circle) has a beginning because all objects must first be derived from the information field in order to appear. It does not start, because all objects have is an informosome, from which the information field is derived. It is impossible to have the initial information that is without of significance in this sense.

However, this only the *logical* starting point, rather than the real one. From an historical occur point of view we need to define the start or initiation of a set of information activities start; otherwise, we can could not describe how information is generated from them. Information is generated in real material interactions, and there is no “start” to material interactions. Everything in the world are already exists; information in general, through the process of assimilation and alienation, has been transformed into informosome that condenses of the multiple relationships. Thus, in reality, the generated the information field that breaks away from the information of the original historic informosome. In this sense, all multi-level information fields involving the movement of their information are follow-up activities of to the corresponding information derived phenomena, containing the history of the movement of their own information in as an intermediate part of their structure. The information content of the information field involves both the creation of new information, but also the reproduction of the original information, as well as multi-informational processes of distortion, matching, restructuring and reconstruction. Thus, the content of in the information field linstantiates many levels of complexity.

The reader must by now realize that it is only in a dynamic logic of and in reality such as LIR that such an “in-itself” contradictorial logical circle can be accepted as a valid concept.

**For-itself information.** For-itself information is the consequence of the grasp and processing of in-itself information by a subject with the necessary mental-psychological capacities, giving it subjective indirect existence. Wu designates this subject as the “informational subject”.

These two categories immediately recall Sartre’s division of being, following Hegel, into the categories of in-itself (*en-soi*) and for-itself (*pour-soi*). In Sartre, the terms in-itself and for-itself are applied to objective and subjective existence: existence of in-itself is “it is that something”. For-itself existence is a complex thing: it is not a separate entity, it has no existence on its own basis, it can not leave existence, but



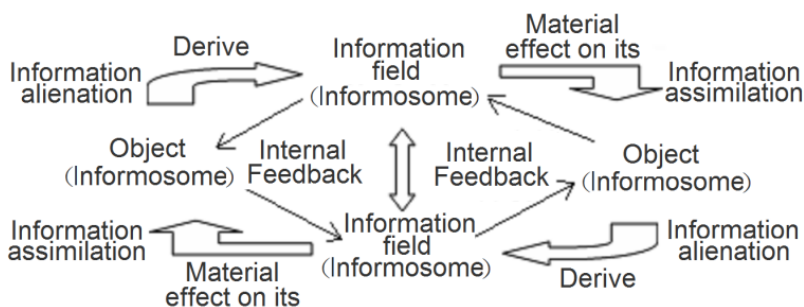


Figure 3. The logical circulation of in-itself information activities [Wu11]

it exists. It is the existence of some kind of nothingness, that is: it is that something that is not it is that thing [Sar43]. Sartre's classification thus showed the dialectical relationship between existence (*être*) and nothingness (*néant*). We do not intend to further pursue this classification in terms of its long history, starting with Hegel, and uses. Here we just want to use this classification to talk about the existence mode of information to describe the essential form and process of information.

As noted above, in the Wu Kun system, in-itself information and for-itself information belong to the information field. The former is a sign of objective information, while the latter is a kind of subjective information, but not of all subjective information, but of a relatively low-level form. The restructuring and rebuilding of objective information through interaction and matching elevates the form of the subjective information to consciousness and mind. This process again corresponds to the ascent in Deacon's picture from thermodynamic to morphodynamic to teleodynamic levels, human perception, memory and creativity.

Similarly, Wu's concept of the in-itself and for-itself relativity of the concept also well describes human perception and memory activities, in which the corresponding visual relationships are related to object information. The visual characteristics corresponding to the human information activities of perception and memory become for-itself information relative to in-itself information.

In the Wu Kun concept of existence, there is no question but that both matter and information exist. Matter is the existence of in-itself, but it is not all inclusive existence of in-itself, because there are still in-itself information processes in the objective world, and in addition to

the forms of in-itself and for-itself and there is regeneration of information. For-itself and regeneration information both have the same form of existence: they are not nothingness, or an impossible emptiness. In the terms of Logic in Reality, they are both real *and* unreal, with reality and unreality linked dynamically, more or less potentialized or actualized, as the case may be. Also in the objective world, there is also not real there, in-itself information is not *completely* real existence, following the same dialectics. As the subjective world is not totally real existence, and because the two large areas of real existence and not real existence are present in the objective world, these two areas are nested (in a relation of dynamic opposition), establishing a world with a dual existence of the matter and information.

**Regenerated information.** Regenerated information is a form of subjective indirect existence, information created by a subject. Its basic content is concept-phenomenon information and symbol information. Concept-phenomenon information is thinking in terms of images to create a new image; symbol information is a kind of for-itself information and a sign of concept-phenomenon information. Human abstract thinking is a kind of logical deduction for symbolic information, a high-level integrated process of analysis and transformation. At some point, as also recognized by Lupasco in his book *The Psychic Universe* [Lup79] information activities must lead to the establishment of a cognitive control system. The essence of thinking is precisely that it is within the thinking subject through the operation of information processing, the information processing steps performed to achieve the subjective creative activities. This subjective creative activities of information are thus based upon an advanced form of information activities involving for-itself information processing and transformation. We common reference to “mind” (spirit) is in fact to for-itself and regenerated, processed information, equivalent to subjective indirect existence.

**Social information.** Social information is not a form of independent information; it embodies the three above types of in-itself, for-itself and regenerated information and their relationships showing a comprehensive, three-fold form of organization of information. There are three social worlds of information: first, human understanding and transformation of the part of in-itself information (in the form of in-itself informosome exists) of the objective world; second, human knowledge of for-itself and

regeneration activities within the information field itself; third, the external storage of regenerated information (which constitutes the created culture of the world).

“Information society” is a term for the part of the information world that it necessary for people to understand and master. The social information required to understand and transform the human subject combines in-itself, for-itself and regenerated information. (In Figure 2, the dotted lines indicated that only part of in-itself, for-itself and regenerated information have the organic unity to enter the range of social information.)

Just as matter has gone through different stages of evolution of its form, the corresponding information has also gone through different stages of evolution of its form. Natural information, from the standpoint of its aspects of in-itself and for-itself information has undergone a long evolutionary process of regeneration resulting in a coherent body of social information, having a unity of essence (that has been largely ignored by philosophers). This is what we call the dialectics of the movement of the *form* of information.

### 3.3. The informational field. Additional aspects

Wu Kun’s concept of an informational field further defines the essence of information. The informational field is a multidimensional conceptual construction, including the various functions, roles, structures and relationships involved in the production, transmission and reception of information. From the standpoint of LIR, all of these entities, especially structures, must be looked at as causally effective processes. Lupasco used the term structuration, “*structuration*” in French, to emphasize the dynamic *process* aspects of complex structures, biological, cognitive or social. The answer he gave to his own question “*What is a structure?*” [Lup67] was that structures are also dynamisms, not to be objectified and reified. In the LIR perspective, structuration is a real operation on the relations between two individuals. Any individual structure is never rigorously actual, that is, absolute in any sense, given the nature and logic of energy. It is a dynamic “structuring” that is always functionally associated with an antagonistic and contradictory potential structuring. Another way of saying this is that a structuring seen externally is a kind of form; looked at internally, it consists of the processes themselves.

The term of structuration was used later by Giddens [Ley09] who related it to his view of the double hermeneutics operating in intentional interactions among human beings, instantiated in observable networks of communicative relations, hence of information.

### 3.3.1. Toward a unified theory of information

We note first that the scheme of principled distinctions proposed by Wu has a relationship to and a place in the conceptual approaches that Hofkirchner has recently listed to a Unified Theory of Information (UTI). Hofkirchner [Hof09] among others has argued for the desirability of a UTI that would encompass the different manifestations of information processes. Such a UTI should be capable of balancing the apparently contradictory properties of information — physical and non-physical, universal and particular — without reduction. Its underlying principle should be “as abstract as necessary but as concrete as possible at the same time”. Hofkirchner considers information as a “superconcept”, which includes a group of overlapping concepts such as message, signal, *etc.* as they apply to communication, cognition and cooperation between human and non-human organisms. Hofkirchner asks how matter and idea, mind, information, *etc.* can be grasped as complements and with them information as a thing (a structure, a flow) or as a human construction. Hofkirchner gives a dialectical answer to the implied division between subject and object, suggesting that mind, and with it information, is of a different ‘materiality’ than ‘non-emergent’ states of matter.

His own approach to a Unified Theory of Information (UTI) is to eliminate the absolute and in our view artificial separation between critical concepts of information in favor of a dialectical relationship similar to the ancient intuition of ‘unity-in-diversity’. Specifically, his “UTI seeks a concrete-universal concept of information rather than an abstract one”. Hofkirchner wishes to avoid reliance on a “formal-logical figure of necessary and sufficient conditions” and use a way of thinking that integrates as well as differentiates the particular and universal”, with which LIR agrees.

From the LIR standpoint, mind and information can be seen as “complements” if ones sees them as processes. Structure, flow and “human processing activity” all follow the same real, physical dialectics. If matter and information are differentiated in a “common genus”, for LIR, *that genus is simply energy, and both follow its logical patterns of evolution*, avoiding the problems of the term “different materiality”. Logic in Real-

ity is, also, a logic of emergence or “emergent materialism”. In this view, information is, *pace* Wiener, an energetic phenomenon that instantiates real contradictions.

Wu and Brenner consider that the “opposites” in information are not captured by the classical concept of a classical, static “unity of opposites”, but by the dialectical interaction of the opposites as classified above. The Wu classification is the critical *first step* in the characterization of the complex phenomenon of information. Further, however, Wu’s classification is based on his general philosophy of natural ontological levels that captures the essence of the properties of information. The resulting doctrine of objective information, subjective information and human information in society that constitutes Wu’s information theory establishes a unified philosophical foundation of information science as a basis for further research.

### 3.4. The general model of information systems

In his General Systems Theory, GST, based on his fundamental research in biology and embryology, von Bertalanffy proposed [Ber69] that the only meaningful way to study organization was to study it as a system, defined simply as “complexes of elements standing in interaction”. The necessity and potential feasibility of the systems approach was recognized only after the developments in theoretical physics and mathematics of the mid-20th Century, despite the fact that they cannot be fully formulated mathematically. Von Bertalanffy saw both the physical and biological world as a play of energies and a flow of processes. There are clearly models, principles and laws that apply to generalized systems and sub-systems, irrespective of their particular kind, the nature of their component elements or the relations or forces between them. As Brenner has shown elsewhere, however [Bre08], since the formulation of GST systems science developed along lines similar to those of standard logic. Systems are often models that operate to exclude the most dynamic aspects of natural processes, simply because the latter tend to be mathematically intractable.

Wu also analyzed the problem of information systems from the point of view, now shared by Deacon [Dea07], that Shannon’s model of communication and information systems, as just a non-feedback, deterministic model of an information transmission and reception system model cannot function as a general system model of information processes. To

establish a general model of a system of information activities one must consider the following aspects: first, the feedback mechanism of information; and second, the simultaneous deterministic aspect of information activities and the non-deterministic nature of their conjunction; third, the dynamic mechanism of the generation of new information; fourth the operation of the dynamic mechanism in the creation of new information by interactive processed converting it to an objective reality.

A satisfactory model, therefore, must include the second-order characteristics of human information activities involved in the establishment and implementation of information systems created to achieve human goals and purposes — frankly teleological in nature.

In Wu's view, the human cognitive activities inside and outside this multi-information model are involved in processes of the mutual selection and matching, reorganization and reconstruction, create, according to the non-deterministic model, new subjective information processes. We designate also as teleological (in the Deacon sense) or purposeful information that created by human beings to achieve or insure the success of practical activities. The human activities of material production, from our informational standpoint, imply the process of planning to implement purposeful, structural information to create material objects (cf. Section 3.5).

Here, we are particularly concerned about the way in which, as stated by Wu, new information is created in the recombination of available modes. In the process of transmission of information from sender (subject) to receiver (object), the teleonomy of the subject implies that its information will be realized in the object. Meaning emerges in this process that we now propose follows the dialectic principles of LIR. The categorial feature of non-separability relates the dynamic categories of subject, object and subject-object.

### 3.5. Levels (grades) of information. Teleonomy

The four kinds of information noted above correspond to the phenomenological characteristics of peoples' processing and understanding of that information, their interactions with the environment, and the social processes in which information is transformed. Wu casts these characteristics into a system of five basic levels of informational activities, as follows:

- activities related to in-itself information,
- intuitive identification or self-awareness of perception,

- memory (storage) of information,
- individual creation of subjective information,
- social “processing” (transmittal and reception) of subjective information.

Wu then analyzes the complex bottom-to-top and top-to-bottom relations between these levels, in which he discerns a dual control process of higher levels on lower levels that are both opposite and complementary that he calls “guidance” and “restraint”. Summarizing rapidly, this picture emphasizes that both high- and low-level processes are mutually conditioned and transformed, constituting the entire, organically-linked whole of the qualitative informational structure of the individual.

Throughout this section of the BTPI, Wu repeatedly calls attention to the process aspects of the complementary *non-separable* interactional relations between the different levels of informational activities, a set of complementary interrelations. As discussed above in Section 3.2 and again in more detail below in Section ??, it is exactly this type of complex interactive processes which LIR designates as logical and for which it suggests the patterns of evolution. Wu uses the four corresponding complementarity laws to show the unity of the complex interactive relationships in which the subject is involved (informational activities):

- an initial *construction* by the subject of information,
- the *movement* from higher to lower levels in a holographic control structure (see the next section),
- the comprehensive *participation* in this process by the subject,
- the *transformation* between levels of information activity.

Wu sees the origin of higher levels or grades of information in the property of a subjective *teleonomy* in human beings. In 1970 [Mon70], Monod introduced *teleonomy* as one of the three fundamental properties of biological objects, together with autonomic morphogenesis and reproductive invariance. Teleonomy was defined as the *apparent* purpose or possession of a project in the organization of a living system. Subsequently, despite some weaknesses of explanation (reference to pure chance), teleonomy became quite popular as a theoretical basis for discussions of mental and other phenomena by Edelman and others. LIR supports the descriptive elements of teleonomy by proposing a modified conception of teleonomy as *both* reality and appearance. We recall that reality and appearance are both real, as are the dynamics of their alternating actualization and potentialization; chance and necessity, determinism and indeterminism have their role to play.

Combining the Wu and Brenner approaches, we re-evaluate the concept of levels of reality in logical and informational terms, such that the higher informational grades or strata also possess in part the nature of the lower ones. In *Logic in Reality*, two important considerations were mentioned: 1) that every phenomenon embodied aspects of the properties of its constituents from a lower level of reality and 2) a real energetic interaction — the Principle of Dynamic Opposition — between subject and object and/or subjective and objective aspects of phenomena was postulated as existing in all complex phenomena. We thus see that the informational picture of Wu is consistent with LIR in its primary description of the functional structure of reality across its different levels.

### 3.6. The relation to Logic in Reality. Process

The reader will have grasped that the Logic in Reality described in Section 2 and applied to earlier topics in this section is fundamentally different from standard logics in the sense that the contradictorial, dialectic formulations, for example, of objective and subjective, or real and unreal (as in art) that are permitted involve real interactions between the two terms. Our preliminary conclusion from the juxtaposition of the two approaches is that the use of standard logic and process logic by Wu Kun is sufficiently comprehensive and adequate for the *classification* of the information field.

Simple classical logics cannot reveal the profound essence of the phenomenon of information, because information is generated in the process of interaction of things, and classical two- or multi-valued propositional logics cannot describe process interactions as Brenner has shown. The logic used by Wu for the re-partitioning of the existence field involved two pairs of contradictory terms: subject and object, reality and unreality. The simple subjective and objective classification method assumes that there are no real contradictions in nature (*dialetheias*). If one use the contradiction rules of classical two-valued logic purely for the analysis of reality and unreality, (which can only express a binary relation), it is impossible to reveal the process of transformation from reality to unreality, making impossible the deep understanding of the information phenomenon, since it ignores the process of contradictory movement and the dynamic relationships between these areas.

Wu Kun uses both subjective and objective, reality and unreality as two coupled categories, and carries out a cross-combination of logical



deductions, which not only shows that the objective world has a real and unreal nature in a doubly contradictory or oppositional movement, but also shows the unreal nature of the information as part of the subjective world. This was originally just a mechanical division of the subjective and objective classification. In fact, the complementarity of reality and unreality, their “cross-classification” yields a new transformational process from the objective to subjective that has a logical intermediary — the “T-state” in Brenner’s LIR.

For Wu Kun, the effect of complex interaction relation between multi-level human informational activities lays the ontological foundation for a holographic theory of process interactions. We repeat that the logic of such processes cannot be a two-valued logic, because they require an intermediary or intermediate state. Also, a simple polarization of opposites does not constitute a process, while the mediated contradictory movement can be described as a real process [Bre05]. In addition, intermediaries also often are multi-level, involving levels of existence and the relationship between levels. Logic in Reality provides the principles for describing the evolution of these mediated interactions, and the complexity of the transformation processes involved. The Wu split level theory of the existential field, and his multi-level hierarchy of information activities, and the complex interaction between the hierarchy is precisely with this multi-level classification, a process of mediated interactions consistent with the principles of Logic in Reality.

The use of the term “holographic” in this paper to describe informational interactions requires some further comment: in Wu Kun’s interpretation, a holographic informational phenomenon is its own structure map, a self-organizing condensation of its internal and external complex multiple information components, their historical and evolving relationships and the results of that evolution, including their loss, distortion or dissipation. The concept of the “informosome” outlined above embodies this holographic principle. A “holographic rule” is a rule that defines the (more or less) coherent mutual dependence of the different types of variables involved. One should consider Wu’s emphasis on, for example, the nature of human information activities as holographic not as metaphorical, but as describing real three- or higher-dimensional dynamic structures. The concept, including a categorial classification of holographic phenomena is discussed in detail in [Wu94-05]. It might be objected that holograms are static objects, only susceptible of being viewed in three dimensions. While this was true of the original holograms

of Gabor and others, technology is now “catching up” to information and moving holograms have begun to be produced (2012).

In the remainder of this paper, we will continue on the basis that the principles of LIR in fact support to the descriptive resegmentation of the existential field (the extant domain) by Wu. LIR makes it “logical” to talk about interactive relations between objective and subjective, reality and unreality, internal and external, direct and indirect and so on, and it does not exclude *a priori* the existence of real contradictions. LIR formalizes and explicates the absence of separation noted by Wu, retaining the consequences for information. For LIR, its “unreality” is only apparent since all information — as sent or received — is the effect of some real causal process. When applied to informational processes or ‘activities’, it aids in the explication of their active non-quantitative and normative properties and the evolution of the latter in their transmission, reception and interpretation.

As indicated in Section 2.1.3, LIR basically defines information as a process as the reality in a physical space of a dialectical relation between sender and receiver, in which meaning and value emerge due to the constraints on the evolving interactions [Bre09]. The conception of information-as-process is central to both the BTPI and LIR views. As stated by Queiroz *et al.* [Que08], the processual approach to information departs from the treatment of information as contained in some (static) structure, but moves in Brenner’s view toward an understanding of information as a dynamic semiotic process, a *non*-Peircean semiosis [Bre11].

According to Wu, information is not only included in the dynamic process of the content presented, but also in the corresponding dynamic of the process that in effect produced that content. The content of the process is reflected in the information field generation and its structure; it is the main form of transmission of information space. The main form of temporal transmission of information is as an *effect* of the process, mainly reflected in the structure of informational reception and transmission.

If the former is mainly reflected as a dynamic process, then, the latter is mainly reflected as a static structure. Of course, the space transmission and time transmission of information are not separated, and the two imply each other, so that the process of dynamic information activities and static structure always complement each other. It is because of this that evolutionary relative variability of information content can be stored, that one can transfer and share relatively stable information content, and distortion can be dissipated.

To understand and grasp the essence of information and its mode of existence one must operate on two complementary static and dynamic levels. Perhaps one should use the two concepts of “structure” and “structuration”, where “structure” expresses that specific information content that corresponds to the coding form of a specific “structure”, while “structuration” means a production of specific content of information that depends on the original “structure” of the instability of the process involved, and becomes a new “structure” encoded form. It seems that these two concepts is the information corresponding to the static and dynamic, combining these two concepts will be good indication united characteristics each other between static and dynamic of information activities. It is also consistent with principle of dynamic opposition proposed in Logic in Reality.

#### 4. The role of “self”-organization in information

As a first example of the application of Logic in Reality to the Basic Theory of the Philosophy of Information, we will analyze the concept of self-organization. Since the work of Maturana and Varela and their followers, it has become customary to refer self-organization and autopoiesis as necessary to characterize the unique properties, including informational properties, of complex systems at biological, cognitive and social levels of reality. However, even if the concept of self-organization is correct in some sense, it can be criticized as being insufficiently rigorous [Col03]. Two concepts adduced in the past as attempts to ground these phenomena recur frequently: the concept of “spontaneity”; the related concept of ontologically random behavior, with some form of combinatorial selection to insure a minimum incidence of emergence. This displaces the problem: it requires both random and deterministic processes, without explanation of why two should exist. To define, as Morin did, that a self-organizing process is one in which each system creates its own determinations and its own finalities raises the further question of the minimum system, which is viciously circular. Stuart Kauffman has proposed that it is the smallest system capable of executing one thermodynamic work cycle, but the origin of this capability remains unclear. The most recent pertinent discussions of chance and spontaneity, such as those of Deacon [Dea11] and Ulanowicz [09] eliminate their

*absolute* characteristics and allow for a dialectic between determinism and indeterminism, as foreseen by Lupasco.

In standard discussions of self-organization, the encounters are, at least, between elements that are really, as opposed to analytically, distinct. The consequence of any self-organizational process is the constitution of emergence of a new form, or of a restructuring, by complexification, of an existing form. The problem is how this comes about in the absence, by definition, of any organizing entity. In LIR, a “logic of emergence”, the causes of emergence can be seen to be the residual potentialities in and of the elements that are the effects of their constitution by prior processes. There are, in addition, mathematical theories of self-organization, but these show only how ideal objects can organize themselves into more complex states or structures. These will not be discussed further as they do not apply to this critique of a principle of self-organization that is said to apply to physical, spatio-temporal entities.

#### 4.1. The Wu concept of self-organization

One of the most important and novel aspects of the Wu approach to self-organization is that corresponding to self-organized activities, there is a process of the structure and the building of non-self-organizing nature, and he proposes the term of hetero-organization to better indicate this process. In further discussion, Wu Kun shows the difference between self-organization and hetero-organization, and the interactive relationships of cooperation and transformation between the two.

For Wu, an ordered structure capable of self-organization is nevertheless dependent on the input of external energy and information for it to form and persist. It is not “spontaneously” generated within the system, even if it “spontaneously” forms. Here, the self-organized “spontaneity” applies only to the model of the ordered structure, rather than to the reasons for the formation of this structure, that is to say, this orderly pattern is primarily generated internally, rather than externally, but the internal generation of ordered patterns is not independent of external factors. Once initiated, the process of self-organization does result in the creation of new entities. However, both self-organization and hetero-organization require new (externally) available energy and information for their further evolution. Self-organization relative to hetero-organizational concept refers to the introduction in the system of a

model of the external information, and the process of organization of the system takes place according to this model.

The rigorous logical approach of LIR can be applied to the concept of self-organization. If one assumes a standard definition of a system, a self-organizing system is defined as distinguished by the formation of some states or entities arising from the reciprocal or collective interactions (encounters) between its components, *quite independently of outside inputs*. LIR theory, however, states that the critical terms of ‘self’ and ‘independent’ involve question-begging assumptions, given its critical categorial feature of Non-Separability (Section 2.1).

#### 4.2. The Brenner critique

Brenner suggested that the critical step in the organization process is not spontaneous, in the sense of uncaused by outside agents, which the use of the particle “self-” without qualification implies. New organizational structures are the effective consequences of the potentialities residing in the components and/or introduced during the original constitution of the natural system or artificial experiment. This view supplements the discussion of self-organization in society proposed by Fuchs, in which the emphasis is on a dialectical, emergent transition from simple elements defined by one or two parameters to more complex process-like entities instantiating quality or meaning. Fuchs [Fuc06] also suggested the need for a new functional “logic of self-organization”. The advantage of LIR for a theory of organized systems is thus that it provides at least a partial answer to the question of why some systems self-organize, or display autopoïesis, and others do not. LIR simply takes the theory of self-organization and grounds it in (at least) one lower level of reality, without the need for invoking any non-causal spontaneous processes.

Wu and Brenner thus agree that the most reasonable view is that self-organization is not, in and of itself, a ‘self’-evident mode of system formation and change. All systems, including the so-called self-organizing systems, in their structure, formation and evolutionary processes, are to some extent dependent on intermediary of external factors. Here we once again encounter the the contradictorial terms of internal and external, conditions based on interaction, following a unified dialectical logic of mutual complementarity.

Varela refers to something like this view of self-organization [Var99] when he states that coupled non-linear oscillators can give rise to kinds

of self-organization that result in the emergence of neural structures from the component level. A local-global interdependence is necessary to understand the emergence. The components “attain relevance” through their relation with their global correlates. At the same time, due to constraints related to the overall relationships, emergence occurs not only occur at the overall level, but also at lower levels, because the overall relationship will in turn effects changes in part in their nature and function. Morin has called this is “double emergence”; Deacon provides a careful, scientific picture of the interactions of the dynamics that are required as one moves up from the thermodynamic, morphodynamic to the teleodynamic levels of reality.

The somewhat reduced role for self-organization as a secondary or derivative phenomenon can nevertheless be combined with the other characteristics of systems, such as internal and external feedback, to give a comprehensive description of the complexity of information science. Wu includes a fundamental principle of internal and external randomness in this picture, however, that implies a role for randomness in the universe at the foundations of a theory of information. We therefore now need to review the basic cosmological concepts and grounding in energy of both the BTPI and LIR theories that will support the claims made above and constrain, from both authors’ point of view, the origins and characteristics of information.

In part II which follows, we will explore both the implications and applications of the logics involved.

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