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# Prolegomenon to a Logic for the Information Society

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***Abstract:*** *The rapid development of information and communication technologies and their applications has stimulated many definitions of an Information Society (IS), and the related concept of a Knowledge-Based Economy (KBE) from the technological, political and economic standpoints. The ethics proposed for the emerging IS has concentrated on reducing inequalities in access to technological developments.*

*In a key Report, "ICTs and Society", Hofkirchner et al. (2007) insist that a new evolutionary, descriptive and normative theory "for, about and by means of" the IS is necessary to support emergence of a moral, ecologically and globally sustainable information society - GSIS.*

*This paper proposes a new kind of logic, a non-propositional, dialectic "Logic in Reality" (LIR), applicable to real systems and phenomena, as the "missing ingredient" required for such a theory. LIR provides new interpretations of morality, self-organization, communication and conflict, grounding them in physical reality and an appropriate information theory.*

*As a "logic of transdisciplinarity" in the Paris school acceptation, also directed toward the unity of knowledge, LIR confirms that the techno-social field of study of ICTs and Society is a transdiscipline, with direct implications for sustainable development. LIR moves debate beyond the limits imposed by naïve pragmatism and conservative ideologies and can be an essential component of a critical theory.*

**Keywords:** Cognition; communication; contradiction; dynamic opposition; information and communication technologies (ICTs); information society; logic; morality; reality; society; sustainability; systems theory; transdisciplinarity

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## 1. Introduction and Outline

**This paper** proposes the inclusion of a new logical, structural and functional principle in the theory of the structure, functioning and objectives of the developing Information Society (IS), and in models of selected initiatives for application of that theory. This principle states that the communication, information and knowledge processes in the various domains of the Information Society are *logical*, in the sense of a new extension of logic to the real world.

The current literature on information, computation and their expression in society, which reflects the explosion and fragmentation of knowledge, is vast. Any analysis purporting to identify any generally applicable principle can only refer directly to a minute percentage of it. On closer inspection, however, theories of the IS tend to repeat a relatively small number of underlying ideas or concepts. These include spontaneity, simultaneity and self-organization which play key roles in the description and explication of the partly intuitively perceived interactions between agents and processes at various levels of complexity. Although many theories do not use standard bivalent logic or its modern modal or deontic versions as such, the basis of reasoning remains that of classical logic, through the use precisely of classical notions of categorial separation, causality, determinism/indeterminism and space-time.

The rapid and largely anarchic development of information and communication technologies and their applications has stimulated many formulations and definitions of an "Information Society" (IS) from, especially, technological, political and economic standpoints (Knowledge Politics, 2007). Theorizing about the IS and the related concept of a "Knowledge-Based Economy" (KBE) has focused on these aspects. An ethics for the emerging IS has also been proposed by collective work, especially at the government level (World Summit on the Information Society, 2005) which, however, generally concentrates on bridging inequalities in access to necessary technological developments.

In a key Report (Hofkirchner, Fuchs, Raffl, Schafranek, Sandoval, & Bichler, 2007), "ICTs and Society" (below ICTs&S), Wolfgang Hofkirchner, Christian Fuchs and their colleagues at the University of Salzburg have insisted that a new evolutionary theory "for, about and by means of" the IS is necessary and must be both descriptive and normative. In other words, the major objective of the theory is its ultimate use as a tool for development of a moral, ecologically and globally sustainable information society – GSIS (Fuchs, 2006b).

The objective of this paper is to propose that a new kind of logic, applicable to real systems and phenomena, is the "missing ingredient" required for a rigorous theory that meets these requirements. I suggest that such logic is the non-propositional, dialectic "Logic in Reality" (LIR) that I have recently described (Brenner, 2008a). In my opinion, this would be an advance on currently available theoretical foundations of a GSIS which use or refer to theories of society, information and economics in which the underlying logic is essentially bivalent classical logic, a logic of "exclusion". Indeed, Barinaga and Ramfelt (2004), quoting Castells, stated that one of the challenges of the "network society" is that it's very *logic* is based on an idealized, one-sided conception of society that excludes an important part of the world population. In contrast, Fuchs (2006a) suggests the need for a new functional "logic of self-organization" in another recent paper in this *Journal*. Otherwise expert and comprehensive analytical models of the KBE (Leydesdorff, 2006) fail to deal with normative aspects of development, so that the "meaning" of the meaning of information remains ambiguous, without a moral dimension.

In this paper, I describe the essential components of my "logic of and in reality", LIR, and show that it has the capability of addressing and illuminating issues raised by Hofkirchner et al. in their evolutionary "Salzburg Approach", as outlined in the ICTs&S document. Starting from basic principles, it founds a logical approach to a theory of systems applicable to both groups and individuals and their interaction, and to the negative as well as the positive aspects of current technological developments. It thus supports efforts to disentangle ethical and technological issues (Tavani, 2007). LIR provides a new logical interpretation of key concepts in social theory including morality, self-organization, cooperation and conflict, grounding them in physical reality and authorizing logical inference. The term "evolutionary" itself is discussed in terms of similarities and differences with biological evolution. LIR offers a logical explication and expansion of Fuchs' statement that nature and society are both identical and non-identical.

The Logic of and in Reality proposed in this paper (LIR) permits new descriptions of the underlying reality that current theories of the individual and society purport to describe, as well as the structure of the theories themselves. It is hoped that the interpretations provided may serve as *templates* for the ordering by specialists in the various fields and sub-fields of both theoretical and practical, action-oriented approaches to societal issues. Because this logical system is grounded in and reflects the dualistic structure of fundamental physical reality, it incorporates a degree of transdisciplinary generality that may 1) simplify certain problems by resolving stalled debates about opposing concepts; and 2) provide in addition, through a more general and "public", non-sectarian concept of the origin of morality, scientific support for an appropriate ethics for the IS; and 3) authorize the inclusion of concepts from both scientific and non-scientific disciplines in a transdisciplinary approach to a unity of

knowledge. The latter objective is in my mind an essential part of a critical theory for the development of the Globally Sustainable Information Society.

Section 2 of this paper provides a brief summary of the components of Logic in Reality – its axioms, calculus and related ontology and their integration into a two-level framework for analysis. For detailed applications in philosophy and science, the reader is referred to the indicated publication. Since it is proposed that the study of the complex field of ICTs & Society is best regarded as a transdisciplinary entity or transdiscipline, Section 3 provides a view of transdisciplinarity of which the LIR logic is one of the conceptual pillars. LIR is a "logic of transdisciplinarity" (Brenner, 2008b) in the Paris school acceptation of transdisciplinarity (Nicolescu, 2002). As such, LIR further supports the proposal that the techno-social field of *study* of ICTs and Society is a transdiscipline or transdisciplinary, as it also is directed, ultimately, toward a unity of knowledge. In my view, integration into the study of the concepts of logic and transdisciplinarity in these senses is necessary to raise the debate about the Information Society beyond the limits imposed by naïve pragmatism and conservative (not to say neo-liberal) ideologies toward a compassionate science.

Section 4 provides the LIR view of systems and systems theory and shows that this approach explicates and confirms many of the systems-theoretic points made in the "ICTs&S" document. With these tools in hand, Sections 5, 6 and 7 show the application of the LIR logic and ontology in three domains that are critical to a TIS, namely, Morality, Meaning and Conflict. These domains correspond roughly to the three "pillars" of a theory for the Information Society in the Salzburg Approach – that of this *Journal* – Cognition, Communication and Cooperation. As will become even clearer, none of these domains can be considered in isolation from the others, and LIR provides a language for discussing their relations in a rigorous manner.

## 2. Logic in Reality (LIR)

### 2.1. Components of LIR

LIR is a new kind of logic (Brenner, 2008a), grounded in quantum physics, whose axioms and rules provide a framework for analyzing and explaining real world entities and processes. 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

LIR is based on the original work of Stéphane Lupasco (Bucharest, 1900 – Paris, 1988) based in turn on the quantum mechanics of Planck, Pauli and Heisenberg, and subsequent developments of 20$^{th}$ century quantum field theory. LIR states that the characteristics of energy - extensive and intensive; continuous and discontinuous; entropic (tendency toward identity or homogeneity – 2$^{nd}$ Law of Thermodynamics) and negentropic (tendency toward diversity or heterogeneity – Pauli Exclusion Principle) - can be formalized as a structural logical principle of dynamic opposition, an antagonistic duality inherent in the nature of energy (or its effective quantum field equivalent) and accordingly of all real physical and non-physical phenomena – processes, events, theories, etc. (Lupasco, 1987). The overall theory is thus a metaphysics of energy and LIR is the formal, logical part of that metaphysical theory. LIR is a non-arbitrary method for including contradictory elements in theories or models whose acceptance would otherwise be considered as invalidating them entirely. It is a way to "manage" real contradiction, in a manner different from that of paraconsistent, inconsistency-adaptive and

ampliative-adaptive logics, which deal with formal contradiction alone.

The key postulate, as formulated by Lupasco, is that every real phenomenon, element or event "e" is always associated with an anti-phenomenon, anti-element or anti-event "non-e", such that the actualization of "e" entails the potentialization of "non-e" and *vice versa*, alternatively, without either ever disappearing completely. The point of equilibrium or semi-actualization and semi-potentialization is a point of maximum antagonism or 'contradiction' from which, in the case of complex phenomena, a T-state (T for "*tiers inclus*", included third term) emerges, resolving the contradiction (or 'counter-action') at a higher level of reality. The logic is a logic of an *included* middle, consisting of axioms and rules of inference for determining the state of the three dynamic elements involved in a phenomenon ('dynamic' in the physical sense, related to real rather than to formal change, e.g. of conclusions).

Based on this 'antagonistic' worldview, I have proposed the following axioms which 'rewrite' the three major axioms of classical logic and add three more as required for application to the real world:

**LIR1:** *(Physical) Non-Identity*: There is no A at a given time that is identical to A at another time.

**LIR2:** *Conditional Contradiction*: A and non-A both exist at the same time, but only in the sense that when A is actual, non-A is potential, reciprocally and alternatively.

**LIR3:** *Included (Emergent) Middle*: An included or additional third element or T-state (T for "*tiers inclus*", included third term) emerges from the point of maximum contradiction at which A and non-A are equally actualized and potentialized, but at a higher level of reality or complexity, at which the contradiction is resolved.

**LIR4**: *Logical Elements*: The elements of the logic are all representations of real physical and non-physical entities.

**LIR5:** *Functional Association*: Every real logical element **e** – objects, processes, events – is always associated, structurally and functionally, with its anti-element or contradiction, non-**e**, without either ever disappearing completely**;** in physics terms, they are conjugate variables. This Axiom applies to the classical pairs of dualities, *e.g.*, identity and diversity.

**LIR6**: *Asymptoticity*: No process of actualization or potentialization of any element goes to 100% completeness.

The real-world elements involved are commonly termed 'facts' or extra-linguistic entities or processes in standard conceptions of reality.

In the LIR calculus, the reciprocally determined 'reality' values of the degree of actualization A, potentialization P and T-state T replace the truth values in standard truth tables. These values have properties similar to non-standard probabilities. When there is actualization and potentialization of logical elements, their non-contradiction is always partial. Contradiction, however, cannot take place between two classical terms that are rigorously or totally actualized or absolute, that is, where the axiom of non-contradiction holds absolutely. The consequence is that no real element or event can be rigorously non-contradictory; it always contains an irreducible quantity of contradiction.

The semantics of LIR are non-truth-functional. LIR contains the logic of the excluded middle as a limiting case, approached asymptotically but only instantiated in simple macrophysical phenomena and abstract contexts, e.g., computational aspects of reasoning and mathematical complexity.

The third major component of LIR is the categorial ontology that fits the above axioms.

## ***Categories of LIR***

**Material**

**Energy/Quantum Field**

**Formal**

**Process**

- Emergence, Closure and Downward Causation

**Dynamic Opposition**

- Separability and Non-Separabilty

**Subject, Object and Subject-Object**

**T-state**

In this ontology, the sole material category is Energy, and the most important formal category is Dynamic Opposition. From the LIR metaphysical standpoint, the elements of real systems, phenomena or processes in which real dualities are instantiated 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. The most useful categorial division that can be made is exactly this: 1) phenomena that show non-separability of the terms of the dualities as an essential aspect of their existence, at their level of reality; and 2) those that instantiate separability.

LIR 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, and so on. This is a 'vital' concept: to consider process elements that are contradictorially linked as separable is a form of category error. I thus claim 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.

Stable macrophysical objects and simple situations, which can be discussed within binary logic, are the result of processes of processes going in the direction of non-contradiction (cf. Section 8.4.2 on "frozen" dialectics). Thus, LIR should be seen as a logic applying to processes, to trends and tendencies, rather than to "objects" or the steps in a state-transition picture of change (Brenner, 2005).

LIR is thus a valid logical system with a formal part –axioms, semantics and calculus; an interpreted part – a metaphysics, categorial ontology and a contradictorial, two-level framework for analysis with applications in philosophy and science. I distinguish LIR from logics that employ standard linguistic concepts of truth, falsity and logical operations. Despite its application to the extant domain, LIR is neither a physics nor a cosmology. It is a logic in the sense of enabling stable patterns of inference to be made, albeit not with reference to propositional variables. LIR resembles inductive and abductive logics in that truth preservation is not guaranteed. The elements of LIR are not propositions in the usual sense, but probability-like metavariables as in quantum logics. Identity and diversity, cause and effect, determinism and indeterminism and time and space receive non-standard interpretations in this theory.

LIR thus applies to all real dualities, between either classes of entities or two individual elements. Inter and intra –level examples are theories and the data of theories, or facts and meaning, syntax and semantics. Others are interactive relations between elements, relations between sets or classes of elements, events, etc. and the descriptions or explanations of those elements or events. To repeat, LIR does not replace classical binary or multi-valued logics, including non-monotonic versions, 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 adequately contradictorial interactive relationship. Such relationships are characteristic of entities with some form of internal representation, biological or cognitive.

### 2.1.1. Other Logics

Of all existing logics, Logic in Reality is perhaps closest to those of relational quantum mechanics, in which provision is made for a superposition of states that is something like an emergent included middle, and which involve non-standard probability distributions of variables. Closer to the themes of this

study, however, is the natural logic of Grize (1996), defined most simply as a logic used spontaneously for customary reasoning performed by means of everyday language. The domain of application of natural logic is 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. Grize also proposed natural logic as a tool for the sociologist to help in the understanding of his own dialogue, as well as its differences with those of the physical and natural sciences (Grize, 1994).

Fuzzy logics have been used in sociology to some extent. However, compared to LIR, they are still propositional logics centered on truth values, subject to the same linguistic paradoxes that are a consequence of the need for a "limit" between truth and falsity. They will not be discussed further here.

### 2.2. Philosophy: The Non-Reductionist Determinism of LIR

The philosophy of LIR can be very rapidly characterized as a non-naïve dualism that assumes a real, interactive relation between all the classic dualities when they are instantiated in reality. The simplest statement of the LIR view is the following: 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. I cannot state what, at the nuclear level, the potentialities are that are operative in radioactive decay in the same way as I can describe the potential of the carbon atom for forming covalent bonds, or for people getting married. The apparent ubiquity of such potentialities suggests their existence at this level as well, but this does not affect the further argument. The key idea here is that of the 'influence' of the quantum level. It is the potentialities that are the carriers of dynamic opposition to higher levels and not actualized quanta. In any event, effective indeterminism at this level does not preclude determinism at any other, but only that it is, effectively, potentialized.

Other randomness is epistemological and the cognitive result is a deterministic reality – classically, necessity – dialectically linked to the appearance of chance. Feedback loops that result in the emergence of new qualities or entities are not inconsistent with deterministic causation since both determinism and cause and effect must not be understood classically, but in new, logical terms (Brenner, 2008a).

Further development of LIR as a philosophy or metaphysics is not possible here. 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. Zimmermann (2008) indicates that the theory of evolutionary systems still needs a *metaphysics*, a more general and intrinsically speculative theory that would serve as its foundation, and I believe LIR could provide one.

## 3. Transdisciplinarity

In what follows, I will show how my logical system applies to issues in the theory of the Information Society (TIS) by resolving some of the familiar "classic" dichotomies and paradoxes that appear in the sociological and systems literature. First of all, however, I wish to show how LIR supports the transdisciplinary approach to a TIS outlined in the ICTs&S document. Several definitions of transdisciplinarity exist, notably the one of Gibbons and of Novotny and her colleagues at the University of Zurich. This is a pragmatic view centered on approaches to solving concrete problems.

Transdisciplinarity, in the more universal definition of Nicolescu (2002) concerns that which is at the same time between, across and beyond all disciplines, the things they have in common. Its objective is the comprehension of the current world, of which one of the imperative necessities is a unity of knowledge. It is a theory that places the human being at the center of its preoccupations, and, in my opinion, this view

has greater generality and is the one more suitable to discussing issues in education, ethics and other aspects of social theory. For example, a key event in the application of transdisciplinarity in education was the International Congress in Locarno in 1997: "What University for Tomorrow? Towards a Transdisciplinary Evolution of the University." This event was sponsored by UNESCO and The International Center for Transdisciplinary Research in Paris.

The three conceptual "pillars" of transdisciplinarity in the Nicolescu acceptation are 1) levels of reality; 2) complexity; and 3); a logic of the *included* middle, from which LIR has been derived. The key relation between disciplinarity and transdisciplinarity is that disciplinary research tends to involve just one level of reality, while transdisciplinarity is concerned with the dynamics resulting from the interaction of several levels of reality or complexity at the same time. A good model is in the work of the sociologist, biologist and philosopher Loet Leydesdorff on the interactions between the economic, political and knowledge-based sub-systems of society (2006) to whose theory of the Knowledge-Based Economy I will refer later.

Logic in Reality, as discussed, is a logic of transdisciplinarity in the acceptation of the Paris Group. It is therefore a natural candidate as an additional tool for research in ICTs and society if this field, adapted to the needs of contemporary society, is indeed a transdiscipline. The unique function of this logic and its ontology would be to establish the structure of the relationships between competing theories and disciplines and thereby bridge the gap between them. In this "logic of transdisciplines", disciplines such as humanities and social sciences are not conflated in a differentiated unity but are dynamically connected epistemologically, changing one another and giving the opportunity for the emergence of new concepts.

The various applications of transdisciplinarity to the development of the TIS, such that ICTs and Society (ITCs&S) can be framed as a "critical transdiscipline", will become apparent in what follows. I wish to re-emphasize however, that the objective of application of the theory should be to further the normative development of a Globally Sustainable Information Society (GSIS). If transdisciplinarity as such becomes more visible as a consequence, this is probably desirable and does not need to be separated from the primary objective.

The distinctions made by Hofkirchner et al. between multidisciplinarity, interdisciplinarity and transdisciplinarity are fully consistent with LIR, and are in fact essentially the same as those laid out by Nicolescu in his *Manifesto* of transdisciplinarity (Nicolescu, 2002). However, in significant contrast to other proponents of transdisciplinarity, and I think to his credit, Nicolescu lays the groundwork for progress in the morality and ethics of the GSIS. Chapters in the *Manifesto* deal not only with the pragmatic opportunities that can result from application of a transdisciplinary approach, but its implications for a needed feminization of society, the deviations and wrong turns that are possible, the requirements for scientific rigor as well as tolerance of opposing views and the concept of a trans-cultural trans-humanism. The advantages of the *combined* use of transdisciplinarity and its logic will emerge in the subsequent discussion.

As a final introductory note, I should mention the Charter of Transdisciplinarity which was promulgated at the 1st International Congress on Transdisciplinarity held in Arrabida, Portugal in 1994. Article VII of the Charter states that transdisciplinarity is not a new discipline, nor a new religion, new philosophy, new metaphysics nor a new science of sciences. It can be considered as a process, a logical framework, a logic of human experience, a rigorous way of thinking about the relations and implications between events and people's actions, a language and an approach. As Nicolescu states further, the deontology of transdisciplinarity is based on the inalienable rights of the inner person in the context of the irreducible scientific and cultural novelties of today's world. Transdisciplinarity is a coherent terrain in which effective political will can be transformed by and into poetical or artistic will, a true politics of civilization, a civilized politics.

Today, initiatives in education based on this view of transdisciplinarity are in progress in

Brazil, Romania and the Republic of South Africa, among others. At the University of Stellenbosch in South Africa, a firm link has been established between transdisciplinarity and sustainable development, in that it is one of the first universities in the world to establish a Ph.D. program in sustainability for which the theoretical approach is transdisciplinarity and complexity (Sustainability, 2008).

By incorporating the principle of dynamic opposition (PDO) and LIR into the design and construction of a theory of the Information Society and its methodology, the theory can be grounded in real social phenomena. Transdisciplinary properties can be more easily recognized and hence are available in the formulation of the theory, avoiding excess detail but facilitating consensus.

## 4. LIR and Systems Theory

The purpose of this Section is to present a model of social systems that incorporates the transdisciplinary logic of/in reality, starting from the basic physical principles originally formulated by Lupasco. Like the LIR logic itself, the model is grounded in the fundamental dualities in nature and provides for the emergence of new entities. The LIR model of society is consistent with the basic aspects of systems theory and views of logic in relation to them expressed in the *General Systems Theory* of Ludwig von Bertalanffy (1969).

The advantage of the LIR systems model is that it provides (at least) one more fundamental level of explanation to the far-better known theories of Morin, Maturana, Varela and their followers, including Eric Schwarz, originator of the rather complete "Neuchâtel Model" of autopoiësis and autogenesis. Many of these intuitions are correct, but my concern is that they can have no significant impact on the way society develops unless they are invested with an additional scientific component. The major criticism that I level against the systems theoretic notions of Maturana, Varela and Morin is that precisely because there is no physical grounding for, for example, intersubjectivity, the physical basis for morality is absent. This is perhaps most striking in Morin (1986), whose approach, like LIR, also combines logic, epistemology and notions of the basis of ethical behavior.

LIR would thus appear to be consistent with the systems-theoretical approach of De Vree, mentioned by Hofkirchner et al., in that it also starts from physical considerations and also avoids "cutting society free from the material-energetic world", a mistake made by Luhmann. Because it is totally unfamiliar to people accustomed to talking about thermodynamics, however, I wish to re-emphasize here that LIR incorporates an *additional* key physical consideration, namely the Pauli Exclusion Principle for electrons. This Principle accounts for the potential for formation of complex physical and biological structures starting with atoms and molecules and accordingly operates in a direction and manner opposite to that of the 2nd Law of Thermodynamics. In my *Logic in Reality*, I show that thermodynamics alone, as proposed by Prigogine and his followers using the concept of dissipative systems far from equilibrium, is insufficient to ground emergence of systems at higher-level biological, cognitive and social levels.

### 4.1. Systems in LIR and Other Logics

The LIR ontological approach to reality, as originally laid out by Lupasco (1986), starts from its simplest aspects, the existence of more than one thing, of many things and of their collection in more or less stable groups or systems. I define systems as elements linked by either some internal property, or by the forces or operations that they express of which they are or could be the agents. From the dynamic view of reality discussed here, the appearance of a principle of contradiction (or its equivalent) in this line of argument, that is similar to the one derived from considerations of the dualistic aspects of energy as such, supports the idea that there is something of fundamental theoretical importance about contradiction or antagonism, physical dynamic opposition, throughout nature.

There are three points to be made regarding the existence of systems:

1) systems are not possible if there is no force of repulsion or exclusion between elements which prevents their "agglomeration"

into an undifferentiated mass, and not possible if nothing attracts or associates two or more elements; they all fly apart, so to speak. (I consider here that repulsion; exclusion and dissociation are equivalent terms.) Accordingly, for a system to form and exist, its constituents must be able, at the same time, to both attract and repel one another, associate and dissociate, to integrate and disintegrate. Every system is therefore a function of two antagonistic forces, linked to one another, constituting a relation of antagonism. Every interacting system, be it nuclear, atomic, molecular or at the level of the macroscopic objects of our senses is always, in this view, a function of, in its constitution, this relation of antagonistic or opposing forces.

2) The second argument is similar to the first: a system would not be possible if all its constituents or elements were strictly identical, strictly also meaning with relation to their location and configuration in space-time. They would be "confounded" in the same continuity or homogeneity. No system would be possible, either, if all elements were totally heterogeneous, without some degree of homogeneity that would prevent this diversity not only from not being a system, but even a class or set. Every system thus implies at the same time homogeneity and heterogeneity. The relation of contradiction is maximal as identity and diversity approach equality. The relation of non-contradiction thus depends on the levels of both antagonism and identity. As antagonism decreases, non-contradiction increases and contradiction decreases.

3) The third concept that every system *requires* the energy involved in its dynamic relations in order to exist. All its constituents and elements, according to the equivalence of mass, energy and information, must consist of energy[1]. Lupasco developed his "logical algebra of energy" as a chain of implications expressing the above, with the addition of another key concept. Every energetic process (or phenomenon) passing from a potential state to an actual state finds itself necessarily, at a certain moment in an intermediate state T, called the T-state, where it conflicts with the antagonistic process passing from a state of actualization A to one of potentialization P, as indicated above.

Each of these three elements is an antagonistic energetic duality or alternatively an antagonistic conjunction. Each is a system, and all more complex systems are generated by such antagonistic dynamisms. Two types of system imply a progressive actualization of non-contradiction, and a third an actualization of contradiction and potentialization of non-contradiction, that is, movement toward an emergent entity. These logical systems of energy apply to all phenomena or aspects of experience, from microscopic to macroscopic, if it is agreed that antagonism and contradictory values are irreducibly constitutive of all real events. These logical systems are the basis for the generation of systems of systems, formally, by the extension of the concept of actualization, potentialization and T-state to the operation of implication itself.

The first of these corresponds to progressive homogenization, i.e., the 2nd Law of Thermodynamics; the second to the progressive actualization of heterogeneity, a "systemogenesis" of living matter or life, based on the existence of atoms and molecules ultimately due to operation of the Pauli Exclusion Principle for fermions; and the third to the situation of maximum contradiction applying to the quantum, cognitive and social levels of reality. Finally, all these chains of systems and systems of systems can be considered as constituting dialectics and dialectics of dialectics, generated by the contradictory nature of energy and its principles as outlined above. The critical property of this model for this study is that it includes, *ex ante*, a dialectic interaction between the individual and the social group to which he belongs.

The advantage of LIR for a theory of systems, applicable to the reality of the Information Society, is thus that it provides at least a partial answer to the question of why some systems self-organize, or display autopoiësis, and others do not. Two concepts

[1] The exceptions are the elements of classical mathematics and all other abstract elements, including semantic elements, such as paradoxical sentences, in which the quantity of energetic interaction is nil.

adduced as attempts to ground these phenomena recur frequently: the concept of "spontaneity" and the related concept of ontologically random behavior, with some form of combinatorial selection to insure a minimum incidence of emergence. This displaces the problem: 1) it requires both random and deterministic processes, without explanation of why two should exist, tied back to a still arbitrary "Big Bang"; 2) to define, as Morin does, 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. Kauffman and his colleagues have proposed (Kaufman, Logan, Este, Goebel, Hobill, & Shmulevich, 2008) that it is the smallest system capable of executing one thermodynamic work cycle, but the origin of this capability remains unclear. I will not speculate here on the relation of these views to some perhaps partly unconscious bias to avoid determinism. This might be an underlying dynamic in combinatorial views of the structure of the universe (Kauffman, 1995) or of ontology (Jacquette, 2002) but these will not concern us here.

Morin (1986) describes a logic, "dialogic", that includes an element of Lupascian antagonism: "Order and disorder are enemies: one abolishes the other, but at the same time, in certain cases, they collaborate and produce organization and complexity. The dialogic principle allows us to maintain duality at the heart of unity. It associates two terms that are at the same time complementary and antagonistic." His corollaries from this picture are well known: recursion, non-linear cause and effect, and a "new" part-whole relationship. "Not only is the part in the whole, but the whole is in the part."

In another attempt at description of a system, Morin suggests that the concept *homo* is a triadic polysystem whose terms (connected by single arrows) – Individual, Species, Society – are at once complementary, concurrent and antagonistic. However, he then says that the "idea of organization is a logical simulation, but as it comprises a-logical elements (antagonisms, emergents), it is equally the reflection of what it simulates and what simulates it". This assignment of a non-logical character to antagonisms is, of course, unnecessary in my expanded definition of logic.

Another logical system to which reference is often made in the systems literature is the "logic of forms" of Spencer-Brown. The new "virtual logic" described by Kauffmann (2002) can be interpreted as a logic without a law of the excluded middle. It is capable of handling or systematizing a wide variety of problems related to imaginary values in (Boolean) mathematics and the geometrical constructions of both Peirce and Spencer-Brown ("Logic could be an encoded form of geometry.") In my view, the Kauffmann discourse takes place in the domain of classical logic, in which there is no basis for giving meaning to the otherwise correct statement that the system and its observer are neither separate nor coincident.

Without going in this *Prolegomenon* into the full history of logic in systems theory, the absence of an appropriate physical basis for the interactions described in the above selections constitutes a weakness for their application at the level of society. The purpose of my critique is not to deconstruct the often insightful remarks by Morin and others on biological principles playing out at the level of individuals in society. Morin is correct when he calls for a meta-point of view due to the inevitable self-reference ("self"- is correctly used here; see next Section) of the sociologist's being embedded in the society, as well as self-observance and self-criticism to achieve a degree of "complex thinking". However, by excluding the necessary dynamic physical grounds of the interactions involved, Morin and his followers have not only reduced their credibility of *their* systems approach, but attempts to use it to ground an appropriate morality for an evolving society fail at the same time.

### 4.2. Self-Organization and Determinism

One concept to which the rigorous logical approach of LIR can be applied is that of self-organization. If I assume 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 ontological sub-category of Non-separability.

In a standard discussion 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, however, 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. However, that is just *all* they are – ways of showing how ideal objects can organize themselves into more complex states or structures. These will not be discussed further as I consider that they are not relevant to my current critique of a principle of self-organization that allegedly applies to physical, spatio-temporal entities.

Under these circumstances, 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 involving alleged self-organization also involve some degree of organization-by-external-agent, with the two are, again, in the LIR view, dialectically related. Varela refers to something like my view of self-organization (1999) 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 correlate.

In the further dynamical systems language used by Varela and also by van Gelder, a satisfactory description incorporates a role for both stability and instability, defining both stable and unstable regions in the phase space of the system. However, the system then, allegedly, flops *spontaneously* (emphasis mine) between them even in the absence of external driving forces, and by definition, of any internal physical attractors.

One is left here with process concepts that fail to describe the structure and the dynamics of the relation or correlation. I suggest 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.

I believe 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, see below). To repeat, 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.

### 4.2.1. The Neuchâtel Model of Schwarz. Autopoiësis

Schwarz (1997) has presented a succinct summary of the development of systems theories, starting with General Systems Theory. The further evolution of cybernetics, due to the generalizations by von Foerster toward second-order cybernetics, the cybernetics of observing systems and the elaboration of the notion of *autopoiësis* (self-production) by Maturana and Varela have all led to substantial new insights into the "structure" of existence. Again, though, von Foerster (Van de Vijver, 1997) talked only of "circular causality" as a source of dynamic development and self-organization and did not propose mechanisms about the way spontaneous (sic) order can emerge in nature. The "Neuchâtel Model", proposed by Schwarz, places all these concepts, plus those of *autogenesis* (the self-production of rules of its production by an entity), in terms of planes (or levels) of structures, information and a totality. Schwarz' model is useful in that

objects and laws are not separated and do not appear to operate within the constraints of a static, binary Aristotelian logic, but form complex wholes which are existing (non-physical) entities. His ontology generates three basic epistemological categories for the study of natural objects: objects, relations and wholes.

However, Schwarz' models are epistemological, not ontological, the "idealized patterns of a meta-language". This language does not apply directly to concrete real-world systems, but rather represents the "production processes by which the systems of the world are made." In contrast LIR, in particular in its oppositional-energetic aspects, is intended to apply to the real world *directly*. Through the alternation of actualization and potentialization of a phenomenon and its opposite, one can give a reasonable basis for the dynamics of the whole, self-referential or not, to which Schwarz refers.

### 4.3. An LIR Model of Society Self-Organization and Determinism

The reader may have remarked the absence of any references to a literature of logic in reality or of the detailed work of Lupasco from which I have derived LIR, let alone any application to current sociological issues. The explanation is simple: apart from the adaptation by Nicolescu and its incorporation into his approach to transdisciplinarity, there is almost none of value.

The thesis of the sociologist Marc Beigbeder (1971) is the exception. It is the *only* book length work ever published that is devoted solely to the theory of Lupasco and its applications. Chapter VII, which occupies more than half of the book, is a still fascinating analysis of sociology and the logic of social systems. Beigbeder presents pertinent accounts of Lupasco's work in relation to that of Marx, Freud, Sartre, Lévi-Strauss, Foucault, Althusser, Deleuze and Derrida, among others. He praises the work of the latter four, in particular, as contributing more or less consciously and more or less directly to the deconstruction of the prevailing paradigm of a logic of macrophysical non-contradiction. (Despite the clarity of these authors, Beigbeder felt that in the absence of more explicit references to the relation of logic and their philosophy, "they leave us in a fog, unless they convert us to some sectarianism.")

Beigbeder showed that the Lupasco logic resolves the need for a separate psychology and sociology, one for the individual and one for the group. Due to the dynamic relation that exists between them, neither individual nor group should have their usual meanings; the group is as much an identity as an individuality, or set of individualities, and vice versa. Both are dependent on movements toward identity (homogenization) and toward diversity (heterogenization), and as these tend toward equal strength, both individual and group can move from predominantly subject or object and toward becoming a "subject-object", the locus of a degree of consciousness of consciousness, or of what one might call "group-individual consciousness". I feel this is quite a common experience. In the dynamics of the group, the concept of a pure individuality is a fiction, like that of an isolated particle or member of a set. The group – individual couple defines, and is defined by their contradictory link, the structure of a system of "individuals"; a functionally antagonistic dualism whose equilibrium, always in question, is made of the dynamics of the conflict/cooperation between the collective relative to the "individuals" and the individual relative to the collective. The higher the degree of internal conflict, provided it is manageable, the greater may be the creativity of the group. A society has a comparable dialectic contradictory complementarity between it and the sub-groups and individuals that compose it[2].

These ideas are supported by current work in philosophy and metaphysics on a re-definition of the individual, individuality and discernability (Ladyman & Ross, 2007). As I show elsewhere (Brenner, 2008a), the non-separability of quantum particles, the fact that they are both individual and non-individuals,

[2] In a context of a standard logic of knowledge, Rescher wrote "…it is by no means easy to describe how group knowledge is related to individual knowledge (2005)". LIR explicates the relation, cf. Section 6. on Knowledge.

has its counterpart at the social level for human beings, who physically individual but socially and economically "non-separable". This has immediate consequences as a logical basis for "individual" moral behavior. We can now see that LIR offers a logical explication and expansion of Fuchs' statement (2006a) that nature and society are both identical and non-identical.

### 4.3.1. "Man and his Three Ethics"

Three types of societies, each with its corresponding ethics, were described by Lupasco as current (Lupasco, 1986b): totalitarian societies and those "inspired by Marxism" that are based on an ethics of homogenization; democratic countries based on an ethics of heterogenization. Totalitarian regimes potentialize the ethics of heterogenization and T-state, generating conflicts that stimulate movements seeking individual liberty and human rights, as well as spiritual and religious needs. In democratic countries, the ethics of the T-state, together with that of homogenization, are also often potentialized, provoking a search for community life and greater general social justice, as well as, again, a spiritual life. The latter can be viewed as the source of the attraction of all kinds of traditions, both in legitimate and illegitimate forms (such as sects). Democracies and dictatorships today thus resemble one another in absolutizing one form of ethics to the detriment of the two others, potentializing an emergent equilibrium. As a third category, societies that are liberal (in the U.S. sense) are, certainly, more correct and balanced but also focus on the concept of "mass" and the privileging of social categories, professions and patterns of consumption.

Under these conditions (Nicolescu, 2002), individual evolution and social evolution condition one another. Individual evolution does take place even in the absence of social evolution, but social *revolution*, toward greater balance between opposing forces, is inconceivable without individual evolution. Nicolescu stated that the contradictions within democracy itself, which should be apparent, require study and new forms of expression to bring them into the collective consciousness. "The challenges of all kinds – be they irrational conflicts that permeate social life, the destructive conflicts that menace the life of nations, or the danger of destruction of our own species – can be solved if the individual and social co-evolution is respected."

A social revolution, as referred to above, is probably not possible in its "classical" form. But the new availability of ICTs is of no use in daily life unless accompanied by a revolution in intelligence. Such a revolution "transforms our individual and social life into an esthetic as well as an ethical act, an act that unveils the poetic dimension of existence. In our time, an effective political will can only be an affective poetic will." Comprehension of the transdisciplinary logic of reality, which includes and explicates such a dimension, is relevant to this objective.

### 4.4. An Evolutionary Model of Society. Altruism

The biologist E. O. Wilson has developed a model of social evolution, based on insect, animal and human data that accounts in its current form for most of the dynamics of individual and group selection. Most importantly for this study, it describes the origin and relative evolutionary success of altruism or groups in which altruistic individual predominate. His theory clearly acknowledges the dialectic character of the situation in his dictum: "Selfishness beats altruism within groups. Altruistic groups beat selfish groups. Everything else is commentary" (Wilson, 2007, p. 346). I call the attention of the reader to the obvious, but usually ignored concept that nothing in this picture is 100% true or applicable in all cases; the LIR Axiom of Asymptoticity holds.

A typical objection made against Wilson is his claim that all phenomena, up to and including the working of social institutions, are ultimately reducible to the laws of physics. In contrast, Mayr (2004) said that none of the autonomous features of biology (and hence the more complex ones of society) could possibly be unified with any of the laws of physics. It should be easy to see that the only problems here lie in the definitions of the laws of physics and of what constitutes reduction. The LIR principle of dynamic opposition is

simply an aspect of laws of physics that has been neglected, not something outside of them; the principle explicitly excludes "unification" as a criterion of application; and reduction does not mean elimination of the emergent aspects of biology, none of which are completely "autonomous" given their physical base at a lower level of reality.

It is also necessary to see that some of those emergent aspects can involve the dialectics of appearance and reality. The balance between truth and manageable falsehood, as Changeux has pointed out, is what constitutes the reality of political dialogue. It is a commonplace that politicians lie, to a greater or lesser extent, every time they open their mouths. LIR explicates this phenomenon in logical terms, pointing the way toward its more formal recognition and possible reduction of the impact of some demagogues.

### 4.5. What is Evolution and Evolutionary Theory?

The proposal of an evolutionary theory, in this case, of the Information Society, should in my view incorporate a definition of evolution itself that reflects its dialectical and contradictorial aspects. An evolutionary perspective means more than a temporal succession of phases shown by "self"-organizing systems. It implies the presence of additional features that *found* the process of evolution: continuous as well as discontinuous processes; the importance of context; and both analog and digital codes.

The concept of code-duality as outlined by Hoffmeyer (2000, p. 180) claims that the dynamic mode is basically a semiotic mode. What is essential is the "interdependence of the analog and the digital as two equally necessary forms of referential activity arising like twins in the individuation of that logic we call life." Digital codes provide stable access to the temporal world, and analog codes provide the basis for interaction with the world, other-reference and preference.

Through the introduction of the concept of tacit cellular knowledge, Hoffmeyer provides an antagonistic mechanism for the evolution and higher development of living systems that embodies some of the key concepts of LIR. The tacit knowledge aspect of cellular (or organismic) activity, the recognition capabilities of macromolecules, Hoffmeyer argues, is "the strangely overlooked key to biosemiosis." In the LIR view, it is the inherent potentialized chemical properties in molecules that correspond to 'tacit knowledge', as well as the relations. They are arbitrary, in a sense, but they are tied back to the antagonistic categorial processes that pervade existence. From this standpoint, *even* digital codes have some residual potential semiotic character, and one would be ill advised to make the separation too absolute. The 'interdependence' of analog and digital, is an example of contradictional dynamic opposition, one aspect being temporarily and alternatively actualized at the expense of the other, with the emergent organism playing the role of an included middle.

Aerts has also applied his concepts, in particular that of context-driven actualization of potential (CAP) to a theory of evolution (Gabora & Aerts, 2005). The basic idea is that all entities evolve through a reiterated process of interaction with a context. As before, the interaction between context and entity leads to indeterminism that defines a non-Kolmogorovian distribution of probabilities. This is different from the classical distribution of chance described by a Darwinian theory of evolution based on natural selection alone. The Darwinian view is seen as materialist, selection for "forms of concrete and actual matter" - materially actualized states.

It is important to point out where classical Darwinism is not incorrect. As Mayr has shown, none of the major controversies in evolutionary biology involving adaptation, epigenesis, and the gradualness of evolution bring into question the basic Darwinian paradigm, since they deal with individuals or populations, not with genes. But we are concerned here, of course, with populations; it should be clear that both processes are operative (Mayr, 2004).

In this more general theory of evolution, potentiality states, defined with respect to a given context (superposition states in standard quantum mechanics) co-exist with actuality as the basis for context-entity interaction, making possible in turn different

pathways for evolution that do not exist in the classical sense. The general evolutionary process is broadly construed as the incremental change that results from recursive CAP. Aerts believes that this theory of evolution provides explanations for the non-code-dependent processes of real evolution, including other non-Darwinian, that is, non-selective processes such as autopoiësis, emergence and symbiosis, noting that the concept of natural selection offers little in the way of explanation for why biological forms and phenotypes arise in the first place. A model of an evolutionary process may consist of both 1) deterministic segments, where the entity changes state in a way that predictably follows given its previous states and/or the context to which it is exposed; and 2) non-deterministic segments where this is not the case.

The 'pure' randomness or indeterminacy that is a necessary condition for Darwinian natural selection is incorrect, but it is so not because it does not exist, but because it is not absolute. As we have seen, in LIR, potentiality and actuality do not just 'co-exist', they mutually determine one another, and potentiality is not a formal superposition of states, but a property of matter that, with actuality, can define a third state as an included middle/emergent process. Finally, potentializations, as energetic phenomena, should not be considered as non-material, simply because non-actual.

Aerts correctly calls attention to CAP as describing evolution in other domains, for example creativity and culture, as requiring a non-classical formalism given the possibility for inheritance of acquired characteristics. The consequence is that an evolutionary theory of society, that is, one that describes how society evolves, should also evolve according to the same principles. Keeping in them in mind facilitates their application. LIR supports the view of Leydesdorff (2006) that models of society no longer need to be solely historical or grounded in an evolutionary metaphor of survival.

As one saw the more-or-less rational forces in play in the 2008 United States presidential campaign competing with obscurantism, one might ask if *any* scientifically valid social theory could have the slightest effect on the dynamics of this process. The question contains its own answer. One may take hope from the thought that responsibilization of people is also an on-going process that does not always fail, and that the "means of the Information Society" provide a rapid mechanism for circulation of the most necessary information for political evaluation. Any evolutionary theory of the TIS should be able to explicate the dynamics of such processes, including development of identity as a counter to globalization in the sense of Castells (2004)[3].

## 5. Morality and Ethics: Cognition

In this and the next two Sections, I will illustrate the application of the LIR logical system in the three broad domains of interest of Cognition, Communication and Cooperation. It should be clear, especially in view of the categorial feature of non-separability in my ontology, that the division is for purposes of descriptive clarity and convenience, and that each of the three "C's" is in a dialectic relationship with the other two. Thus although morality has its basis in the cognitive structure of individuals, it is the basis for cooperation, and obviously is dependent upon communication.

There are many theories, far too many to even catalogue here, that describe the structure and evolutionary development of the Information Society. With regard to ethical principles, however, many of these theories fail by excluding normative aspects completely, or by providing only a formal, mathematical basis for them that occults their dynamics. I will refer to some of these in Section 7 below on Conflict and Cooperation.

[3] The major three-volume work of Castells, published at the end of the last century, entitled *Information Age: Economy, Society and Culture*, has proven extremely prescient. He sees society as a complex system of networks that are a consequence of the new information and communication technologies. His views are very relevant today in the LIR context because of their reference to a "logic" of the network society and of its dynamics.

### 5.1. Creativity, Love and Freedom

An obvious requirement of any analysis relating the development of the information society to human values is a restatement of those values. The normative aspects of any theory should have these in the foreground and not as a by-product of the analysis. I have accordingly used the sub-title of the book by Bhaskar, *meta-Reality* (2002), as the title of this Section, since these are certainly values everyone should be able to agree upon.

The work of Bhaskar and others has been subsumed under the term of critical realism, seen as a non-Marxist continuation of the Frankfurt school of philosophy. While the objectives of this movement are laudable, I see a structural weakness in their method, namely, a form of transcendentalism that, to a hardened (non-reductionist) realist like myself, seems naïve. According to LIR, if dualism is "hard-wired" into reality, then the solution to the problems of society cannot lie in transcending *its* duality but to live it. The former is what has been preached for centuries and is still being preached in a similar form, with the results that one observes.

The systems approach should always include, and can always benefit, from reasoned and earnest restatements of ethical goals. However, the value of such restatements should not be diluted by reintroduction of precisely those abstract elements of binary logic that result in failed explanations of the dynamics of society-in-conflict.

### 5.2. Morality in a Technological World

Any normative theory for the Information Society requires a correspondingly current view of morality and ethics. Following Tavani (2007), I define morality as a system of rules for guiding human conduct and principles for evaluating those rules, and ethics as the study of morality, constituted by ethical theories. Two key issues then appear: 1) are there any unique moral issues associated with new ICT's or "cyber-technology"? 2) How do various ethical theories relate to such technological developments?

The answer to the first question in my view is no. Nothing has "happened" to change the core moral human values of life, liberty and justice. Without going into detail here, the most applicable ethical *theory* is almost certainly a comprehensive one which does not restrict the basis of morality only to inherent virtue, Kantian duty, social utility or social contract but involves aspects of all of them. Once the requirement of absolute non-physical cognitive individuality of human agents is lifted, the overlap becomes obvious and the differences ones of perspective only, as is implied even in Kant: duty promotes utility, but LIR suggests in addition that the contrary is also operative.

In his book whose title is the title of this Section, however, Magnani (2007) discusses the changes that will be required in the application of ethical theory. He calls for a revitalization of research in ethics to achieve a "long-range ethics of responsibility", and deserves credit for accepting, analyzing and trying to prepare for the consequence of technological developments leading to what he sees as a *fait accompli.* He makes the rather unusual argument that since the current tendency is to ascribe high value to things, one should value people as things, inversing the Kantian maxim of the necessity to treat people as ends.

Magnani suggests that the primary impact of technology is effectively to create a man-machine hybrid (human intertwined with non-human in his rather, to me, chilling image). This entity, however, has the same moral obligations, defined as Kantian duties, as humans have always had, but now primarily related to knowledge, far more easily accessible than in Kant's day. People have a right and duty *to* knowledge as such and as a basis for action.

What kind of attitude should one take, then, to people who say (sincerely?) that their virtual "second lives" on the Internet are fuller and more rewarding than their physical ones[4]? We can apply here LIR and the Wilson concept of selfish groups. Internet groups are diversities that approach a limit of non-

[4] Cf. Fuchs' in-depth study of the use of interactive sites by students, which appeared while this document was in proof (Fuchs, 2009).

contradiction where there is a large number of limited real interactions with other groups. With participation benefiting only themselves[5], their future seems one of marginalization, if not extinction. The obvious corollary is that redefinition of the organization and functioning of physical groups, *e.g.* political parties should accompany evolution in cyber-space.

Magnani's idea of treating people as partly the machines that they are partly becoming is worthy of consideration. The objective is clearly not to reduce the human being further to some kind of absolute impersonality, but as a heuristic device (to be used with care) to change fixed mental structures that are non-dynamic and prevent consideration of these necessary, if less attractive, aspects of the current evolution. If the result is that existing and new, more useful ethical relations between people can be developed then the exercise is worthwhile.

In line with the major thrust of this paper, Magnani further points to the need for a new *logic* of morality in a technological context. Simple deontic logic fails to include the relation up to and between internal intensions and external structures on which moral worth has been conferred. Magnani proposes a variety of abductive logic, that is, inference to the best explanation, that he calls *manipulative abduction.* This refers to extra-theoretical behavior involving communication of new experience and its integration into previously existing systems of experiment and theory.

It is clear that appropriate ethical knowledge and proper moral reasoning are the basic conditions for maintaining freedom and taking responsibility for one's actions. Knowledge as duty means here, then, producing and up-dating ethical knowledge as much as any other. The logic proposed is directed essentially at reasoning processes, that is, human intensional states with a propositional content.

My thesis as outlined in this paper introduces the new concept that a logic of non-propositional entities up and including the IS itself is also required, and that it is the relations involved here that establish that ethics. Let us now see how this works out in one of the most difficult of all domains, that of cognition.

[5] One thinks here of the multiplicity of Non-Governmental Organizations competing to participate in relief efforts after natural catastrophes, straining logistic resources.

### 5.3. An LIR Theory of Mind. Free Will

In this *Prolegomenon*, I can only call attention to the obvious point that any Theory of the Information Society (TIS) requires a suitable model of human cognition and mental phenomena. If LIR applies to such a TIS, it (LIR) should incorporate an appropriate theory of mind, but this part of the theory has not yet been formalized in detail. I can nevertheless anticipate somewhat and say the following:

The central problem for a philosophy of mind is to show how physical tokens, the neuro-physiological processes occurring in the brain, can give rise to mental tokens that retain the properties of intentionality, "aboutness", individuality and some level of causal powers or functionality. The weak point in some current views (Esfeld, 2006) is that physical and mental tokens must be identical (identity theories of mind (ITM)). The LIR principle of opposition at all levels of perception, mental processing and action gives the logical and scientific basis for saying that something is the same *and* different, here physical and mental tokens, in dynamic opposition at the same time.

My claim is that the LIR contradictorial picture of consciousness is a *form* of identity theory that avoids the indicated difficulties by the introduction of the principle of dynamic opposition at all levels of perception, mental processing and action. No new, independent entities of the kind postulated in the various forms of representationalism seem to me to be required, due in part to the absence, in such theories, of an adequate categorization of the relation between internal and external. It is the alternating actualizations and potentializations derived from the initial inputs that *are* our ideas, images, beliefs, etc.

In calling an LIR theory of mind a form of ITM, the term identity is not to be understood in some Leibnizian sense – body and mind are identical, or some such interpretation. The terms of body and mind can be retained,

provided that they are placed in the dialectical epistemological perspective I have proposed.

A recent comprehensive systems approach to a logic of mind, which is close in spirit to that presented here, is that of Ignazio Licata (2008). In his *Open Logic of Mind*, he shows that a proper description of mental phenomena as processes constitutes an informal, non-propositional logical system that shares many key features with Logic in Reality, including its transdisciplinary character, with insights from physics, neurobiology and computer science. Thus "The open logic of mind transforms fundamental (Gödelian) incompleteness into the emergent plurality of cognitive strategies (2008, p. xviii)". As in LIR, descriptions of processes are also interactive processes, and there is categorial non-separability between a description and what is described. Complex information (non-Shannon; see below Section 6.1) is always bidirectional and the correspondence between systems bi-univocal. LIR adds the conception of diversity grounded in the Pauli Exclusion Principle and the principle of dynamic opposition. These provide the basis for non-linearity, non-circularity and emergence and explicate, in Licata's phrase, "the non-local aspect of our immersion in the world".

Any theory of mind must, of course, also deal with the *origin* of the intentional uniqueness in first-person experience. At this point in our knowledge, I believe the only honest answer is similar to that of the weak anthropic principle of reality: first-person consciousness (Emmeche, 1997) is an emergent higher order pattern that has both causal power and a qualitative phenomenal aspect. However, in LIR, a *physical* model is provided of the locus of intentionality in the dynamic interpretation of experience, experience of experience and their on-going, continuous and contradictorial interactions.

A significant consequence of the LIR form of determinism is that it provides a basis for morality without "free will" as it is usually defined. My view is that free will exists, but only as an appearance in the conscious mind of an individual in opposition to and because of her unconscious knowledge of her lack of total 'freedom' - isolation from other individuals. The issue of compatibility with a deterministic universe is therefore a false problem; individual responsibility for one's actions *does* exist, but its source does not lie in free will, or the absence of it. There is a reciprocal mutual instantiation of appearance and reality that corresponds to the contradictorial, LIR interpretation: appearance and reality can never both be fully actualized at the same time. The idea of a completely free agent is a delusion, not unrelated to ultra-conservative libertarian ideology.

However, if we as knowers are not totally external to what is known by us, not completely different from it, then I know that there are other knowers that are part of my known and *vice versa.* The source of human dignity *is* in ourselves as knowers, but if we avoid the error of solipsism, the origin of the sense of moral responsibility can only come from the relation to other knowers, in other words, all human beings, and by extension, other beings and perhaps even, as suggested by Magnani, certain non-living entities (Magnani, 2007). *A contrario*, one cannot find responsibility in oneself as an isolated agent. Since we are both a 'not-other' *and* an 'other', a self-interest argument for morality holds.

The LIR position is thus that two or more human individuals are also systems in the category not only of Subject-Object, but that of Non-separability. An individual is no more isolated logically, psychologically and morally than he or she is economically. It is because our will is *not* free that we must try to insure the viability of the environment and so on.

To conclude this Section, a discussion of which is more appropriate - a more conceptual or formal mathematical approach to a theory of the Information Society on the one hand, or a dialectical approach that is context-sensitive on the other - is far from academic. As we have seen above, if one relies solely on a *conceptual* dialectical underpinning of ethics, one is open to the attack that the conclusions, available methodology and derived programs are hopelessly idealized. Such a discipline could perpetuate nothing but itself.

I claim that only a framework like LIR that can include both the conceptual and dynamic systems approaches without conflation can

provide for the actual dynamics of the *werdende* (becoming) Information Society. Continuing Lupasco's initial critique of Hegel as having ignored the *via negativa*, and his insistence on the logical character of messy, unpleasant, and unjust phenomena, my approach attempts to insure that these have a logical and therefore equivalent scientific status to the others.

## 6. Communication: Information, Knowledge and Meaning

A theory of the Information Society (TIS) will obviously incorporate some theory of information and of communication of information. One can distinguish between the science of information and information technology, and a science of an information society. The former are disciplines that can be defined relatively simply. The latter is a transdiscipline, for which the more awkward denomination as a science of a society in which information and communication technologies are dominant is perhaps more accurate. In this Section, I will show that the logic I am proposing can help to disentangle the closely related concepts of information, knowledge and meaning and their roles in the development of a coherent TIS.

The recent definition of the operation of social systems, which began with Giddens' methodological concept of "duality of structure", has received further explication through Leydesdorff's evolutionary substantive perspective. LIR can be seen as a further stage in this intellectual process, as a logical "dynamics of duality". It is a potentially novel way of addressing the interdependence, mentioned by Luhmann, of theories of systems, communication and evolution, without his requirement of self-referential closure (1989).

Communication involves both the information communicated and the communicating system. One may first ask, as I did above regarding morality, if there are fundamental changes in progress in *what* is communicated. My answer, given the outline of the LIR theory of mind, is that the messages have *not* changed any more than has the intentionality of the communicators: lovers communicate love, and haters hate, etc. What *have* changed of course are first the access of individuals to information; the structures of the society and the context in which communication takes place; the technology used and the volume of communications. In addition to these factors, second-order complex phenomena appear due to interactions involving communication systems themselves. I will show that LIR is well placed to describe these phenomena.

As a final introductory point that exemplifies the LIR standpoint, I propose that it can be useful to speak of "communicating" as well as communication, to emphasize its process aspects. Please note that I do not view the two terms as "interchangeable", that I can just exchange one for the other. This is a typical binary interpretation. Both terms are necessary, corresponding to underlying dynamics that are connected dialectically, with one or the other preferred or predominating, as the case may be.

### 6.1. An LIR-compatible Information Theory

The theory of information that I will assume in this paper is compatible with the logic of/in reality and cuts through much of the debate about what information is and is not. The first point is that information is not primitive; there must be physical systems and properties for there to be any information. Information thus both is and encodes energy, and its apparent "insubstantiality" can be rejected since there is not an absolute dichotomy, in LIR, between the abstract and the concrete, between substance and structure.

As is well known, Shannon-Weaver information theory looks only at the capacities of channels for transmitting information in which the quantitative measure is relativized to initial uncertainty in the receiver about the source. To use Ladyman's term (Ladyman & Ross, 2007), I am using a "stringently naturalistic metaphysics" to clarify the conceptual anarchy around ideas of information and Shannon and general thermodynamic entropy. In this book, Collier proposes the term of "logical depth", defined as algorithmic compressibility as studied by computer science to provide a measure of informational non-redundancy.

The addition that I make to the Ladyman-Ross-Collier picture is to extend the concept of logical depth in the direction opposite to that of a solely objective measure of informational content in the abstract non-thermodynamic sense. The values of actualization, potentialization and T-state are also properties of structural models of real patterns, that is, the process entities of interest. In particular, the LIR approach is more general since it refers to real non-Markovian processes involving information transfer (communication) for which algorithms are not available. Elsewhere, I have referred to this domain as one to which a "logic of non-computability" applies, that is, LIR (Brenner, 2008c).

### 6.2. Information – Meaning – Knowledge (Knowing)

In the epistemology of LIR, the principle of dynamic opposition (PDO), applied at all levels to the various entities considered as *processes* defines a hierarchy in terms of complexity of interaction, both internally and externally.

Kauffman, Logan and their colleagues propose a new reading of information that unites matter, energy and information (Kauffman, Logan, Este, Goebel, Hobill & Shmulevich, 2007) that is consistent with this picture. They show that neither the Shannon definition of information as a scalar quantity of bits, devoid of meaning, nor Kolmogorovian information which refers to standard probability distributions of non-interactive systems is applicable in biology. Information should be designated as 'instructional' or 'biotic' in the sense that it carries meaning and consists of constraints or their physical equivalents - boundary conditions that also partially cause events. Most importantly, the coming into existence of the constraint is itself part of the propagating organization of the entity. "Constraints are information and information is constraints." This recursive aspect is characteristic of non-Markov chains, the non-Kolmogorovian probability behavior of two mutually dependent entities to which LIR applies.

Accordingly, one can write:

- Shannon/Weaver Information → Meaning 1 → Knowledge (or Knowing):

- Kauffman/Logan Intensional (or "Biotic") Information → Meaning 2 → Knowledge of Knowledge (or Knowing) → Meaning 3

Meaning 1 is inherent in information as a constraint/potentiality at non-cognitive levels of reality. Leydesdorff calls this a "first codification". Knowledge enables codification of the Meaning 1 of information, and this knowledge can be further codified.

At the cognitive level, information (and its meaning) is organized into knowledge and acquires Meaning 2 that subsumes normative and other values. My logical system applies to both Meanings 1 and 2, since the origin of the former is also in basic physics. Knowledge is however more than just a classification; it is also a process of "knowing", and should not be reified. Meaning 2 will be present not only with knowledge but also within the process of knowing (human and animal). At the human level, one has knowledge of knowledge and knowing of knowing (human only), and meaning of meaning. Knowledge and knowledge of knowledge are related contradictorially, that is, when one predominates (is actualized), the other is predominantly potentialized and *vice versa*, alternately and reciprocally. I associate, with knowledge, Meaning 2 in order to say that knowledge, in contrast to Information, also has higher-order moral or esthetic aspects. By adding the step Meaning 2 --> Knowledge of Knowledge --> Meaning 3, the feeling that Knowledge of Knowledge also has Meaning is captured, without their having to be identical. In other words, at this level, which I insist is not about abstractions but real processes, Knowledge of knowledge and Meaning 3 are themselves in a contradictional interaction, in the sense that when I focus on one aspect, the other is repressed (or potentialized)

LIR brings the "missing ingredient" of dynamic opposition or antagonism that reinforces this picture of information for the evolution of living systems. It provides a

cybernetic explanation of how constraints-as-information in their physical manifestations can be causally effective when identified with the residual potentialities of all material structures more complex than an isolated quantum particle. By locating the causal powers of constraints in the physical potentials available "from the bottom up", one has at least part of an explanation of why structures, up to and including social structures, have the properties they have. The assumption of "auto"-catalysis and totally "spontaneous" processes is unnecessary, as discussed. (In this connection, using the same argument as that presented above, we can introduce the term constraining in addition to constraint, the participle giving a more accurate description as a process.)

Any theory of biological development or becoming must capture the duality of biological systems, that is, the composition of living systems by non-living substrates. This can be presented as the existence, concomitantly and contradictorially, as the presence of a cybernetics of macroscopic matter and one of biological matter. In the absence of a logic that defined their existence, there has been little justification for such a distinction. One can then look at the unique relation between these two cybernetics and the quantity of information present, as follows: in physical systems, with the increase in positive entropy, that is, homogenization, the quantity of variety or information decreases in direct proportion. Biological phenomena, from this standpoint, are highly improbable, and their information content should also increase in direct proportion to the negentropy generated.

From the standpoint of the living system itself, in its dissymmetrical equilibrium with inorganic matter, the production of negentropy has a *higher* probability, and the amount of information should *decrease* in proportion (Lupasco, 1986a). Improbable and hence information-rich 'homogenizing' perturbations provide the information that initiates the control loop, permitting the information-poor system to maintain its heterogeneity (repair itself, etc.).

Information can thus vary directly or inversely with the quantity of negative or positive entropy being produced, according to the relative probabilities of homogenization or heterogenization. At the microphysical and cognitive levels, entropy and negentropy result in increased quantities of information, since the probability of any dominant development of either homogenization or heterogenization decreases or is blocked (but their contradictorial coexistence has a high probability). This is another way of describing the decrease in indeterminacy with increased contradiction that is a corollary of the PDO.

These definitions of knowledge and knowing emphasize, if need be, the limitations of standard conceptions of knowledge. This was illustrated for me at a recent conference (World Knowledge Dialogue, 2008) at which almost all discussions of knowledge referred to more and more complicated ways of handling data and data bases. In the LIR model, in contrast, the formal locus to meaning at the level of recursive knowledge can function as a basis for some form of "wisdom", leading to the possibility of emergence of a "wise" society.

### 6.3. Communication: Knowledge-Based Economy (KBE) and Knowledge-Based Society (KBS)

The third component of the target theory of the Information Society (TIS) is the process by which information, knowledge and meaning, as defined in the previous Section, is created and transferred, that is, communicated in the society The concept of what a society is involves more than communication of information alone by a simple "sender" to a "receiver". This would amount to a static, binary input/output model in which there is no reflexive loop between sender and receiver. The process of effecting any real communication changes both actors[6], and it is this change that confers higher levels of meaning on the message. LIR brings out the dynamics of the communication process, "communicating" and of what is communicated in logical terms.

[6] "Dynamic" propositional or predicate logics of belief change lack the tools to describe such changes.

The evolution of society and the economy from ones in which an information sector became important enough to be defined as such to more complex concepts that integrate the various aspects of information processes and their communication has been carefully studied and documented by Leydesdorff (2006). He provides a sufficiently complex model of the dynamics and sub-dynamics of communication in the KBE and KBS to address all the issues of importance for the target TIS. Concepts and interpretations from LIR complement his theory with the necessary normative principles tending toward a GSIS. First, however, I will add my critique to his of the views of Luhmann on communication and society because it helps to illustrate the LIR standpoint.

### 6.3.1. Niklas Luhmann: Binary Logic Disguised

Luhmann deserves historical credit for his effort to place a theory of society on a firmer basis than that provided by classical "input/output" models or naïve uncritical analogies with the standard terminology of biological evolution. Luhmann gained his reputation through his detailed analysis and description of the key role of information in society ("Society is grounded in communication."), using ideas derived from the systems theory and the autopoiësis of Maturana, Varela and others. He referred, among other things, to the importance of "third or fourth generation cybernetics" and polyvalent logic. However, as Priest has shown, polyvalent logics do not even provide as adequate a description of real contradictions as paraconsistent logics, which themselves retain substantial classicality (Brenner, 2008a).

Thus, unfortunately, Luhmann's interpretation of systems theory of and applications of it to sociology was more dependent on its weaknesses, some of which I have described above, than its strengths. Summarizing very rapidly in LIR terms, Luhmann's functionalist conception of society *as* communication described social systems as consisting of communications and their attributions as actions. Communications are operations which cannot be observed directly, but one can make inferences about them by testing hypotheses against the observable interactions among the agents. The communications and agents are strongly coupled and therefore the states of the agents can be used as indicators of the evolving communication processes among them. This model in terms of isolated (closed, autonomous) sub-systems excludes the human subject and in my view reflects standard categorial notions of exclusivity and exhaustivity.

Fuchs (2006a) makes the statement that "The function of Luhmann's theory for society is that it is completely useless". I note first that Luhmann himself would probably have considered this statement paradoxical, but that it is perfectly logical in the LIR system: the theory's uselessness is predominantly actual, but it has the potential for some function that can become actual under the right conditions.

Extending this view, I find that Luhmann neglected the relation of the dynamics that must be present for a dialectic logic such as LIR to operate. If two elements, processes, theories, etc. are not dialectically interactive, then the applicable logic is binary, bivalent, of an excluded middle, whatever. The whole conceptual structure of Luhmann of meaning as a difference making a difference (see next Section) and related notions seem to me to miss this point. If two notions were *never* in an adequate contradictorial relation, and Luhmann's functionalist definition of isolated systems insures this, then they are not, in my opinion, contradictories at all.

When one states that something (a "ground of being") is *at the same time* potentiality and actuality, this is not LIR but paraconsistent logic. Similarly, meaning cannot be a unity of actualization and potentialization (or re- and re-). In unity, the two lose the necessary alternance. "Society" does not "contain" human beings, but society is a group of human beings, composed of individuals and the group, and their contradictorial relations and dynamics. Luhmann took human beings as agents out of his system, and replaced them with abstractions. As Leydesdorff shows, Luhmannian structures can be defined *analytically*, but that is not sufficient for a TIS.

Just as it is incorrect not to see an interaction where there is one, it is incorrect to talk as Luhmann does about a binary code in connection with self and other, and ignore an interaction that has been present *ab origine*. Luhmann specifically stated that a third term is required in social systems, and the reader's immediate reaction might be that this is an emergent included middle in the sense of LIR! "The logic of the world, however, can only include excluded third possibilities" (Luhmann, 1995). In LIR, however, no "third" has to be "reincluded" since it never disappeared in the first place. In fact, thirds are not things that are "included" as if the term came from the active verb. They are emergent phenomena, "included" only in the sense that one visualizes them in configuration space as positioned somewhere in between the lower level entities.

According to Laflamme (2008), Luhmann's approach provides a basis for morality that would make it significant for this study, as she quotes his grounding of morality in a self-referential processing of meaning into symbolic generalizations "that others accord with the expectations one believes must be assumed for social relations to continue." However, Luhmann stated that these considerations are "functional abstractions", in line with his overall analytical approach.

These limitations appear in another aspect of Luhmann's work that has contributed to its attraction, namely, his analysis of law, that is, jurisprudence (1989). While correctly seeing the systems aspects of the judicial process, rather than some kind of input/output relation, Luhmann's reification of the resulting system and its theory reduces its applicability. "The concept of the autonomy of the judicial system cannot be formulated at the level of (causal) relations of dependence and independence." It describes nothing else than the operational closure of the system as a condition of its openness. Such a theory however cannot be convincing unless it is capable of determining precisely in what the specific closure of the system consists and how this conditions its openness." We can give Luhmann credit for some intuitive notion of the relation between closure and non-closure, except that it leads him to a conception of normativity that is nothing more than an artificial, factitious form.

It is not that Luhmann did not see exceptions or intermediate situations outside his absolute categorizations of closed sub-systems in society; it is that he failed to assign to them any fundamental ontological importance: "One must conclude, in a realist perspective, that the law adapts itself (sic) to dominant interests …" (Luhmann 1989). With such a radical pluralism or dualism, as Fuchs has pointed out, Luhmann was unable to explain how society as a, for him, abstract construction and nature, including human subjects, could be related in the obvious dynamic sense they are. Logic in Reality enables a dialogue on the nature and extent of the dynamic interactions of individuals and social groups, as I have shown. From a technical standpoint, Leydesdorff confirms that the binary codes used by Luhmann are too abstract for sociological analysis (2006).

### 6.3.2. The Dynamics of the Knowledge-Based Economy

Some commentaries suggest that the term "Information Society" is too opaque. Our target theory might be designated as one of a "Knowledge Society" rather than "Information Society". This seems to me an unnecessary complication at this stage, however, provided the broader concept outlined above of information as having (or being) normative meaning is kept in mind. Accordingly, for the purposes of this *Prolegomenon*, I propose to differentiate between the Knowledge-Based Economy (KBE) and the Knowledge-Based Society (KBS) only by reference to the values of the meanings associated with information and knowledge. The KBS is then the KBE plus the information and knowledge components to which an economic value cannot be assigned easily or at all. Consistent with the overall LIR view, neither of these values is "pure", although the coupling, *e.g.* between monetary and esthetic value becomes increasingly complex as one goes to these higher levels of cognitive activity. The basis of the value of works of art is itself an enormous subject that can only be mentioned here. However, to the extent that esthetic values are important as, also, human moral values, they should be included in any satisfactory theory of the Information Society,

and this is of course possible in a transdisciplinary framework.

In his 2006 study, Leydesdorff provides an extensive overview of the historical and technological factors defining the properties of a Knowledge-Based Economy and how it is to be distinguished from its historical predecessors. His analysis starts from the position that the market and the political system contribute two sub-dynamics to the dynamics of our social system. Organized scientific and technological knowledge production and control have by now added a third sub-dynamic. Interactions between these sub-dynamics lead to a complex model due to differing time scales of evolution, historical (for technology) or instantaneous (for the market). Leydesdorff sees the sub-dynamic of knowledge as analytically different and orthogonal to older economic systems and their communication and control structures. The large and rapid influxes of knowledge create an emergent dynamics of expectations or anticipations that determine the further evolution of the KBE. In addition, these interactions in and of themselves contribute to the generation of a knowledge base.

Leyesdorff's thesis is that above a certain level of complexity of interactions, recursive and hyper-recursive processes take place essentially involving only the systems themselves. In particular, communications systems, the "links" of the network, "process" information differently from human action systems considered as the "nodes". The three scare quotes I have placed represent my view that not only should such links and nodes not be discussed as if they were independent, the interactions between links and nodes involves the principle of dynamic opposition, in which one or the other feature predominates.

The processing of information (Shannon-type) and the processing of knowledge exist in a "two-layer" or two-level relationship, dependent on each other because of couplings. The former can be slowed or accelerated by the processing of meaning and knowledge. When the various processes and sub-dynamics are distinguished analytically as independent operations, the respects in which a development is increasingly knowledge-based can be studied.

Logic in Reality contributes to this picture of a "knowledge-dependent" society by placing the processes involved and the terms used in a logical, dialectical framework. For example, LIR defines reflexivity and recursion with reference to the way in which processes develop between contradictory alternatives in both the epistemological and ontological domains. Systems, like the other entities involved, are both real and abstract, like other creations of the human mind. In LIR, the included middle (T-state) that emerges from interactions of maximum contradiction or antagonism immediately enters into dialectic relations as a substrate for further interactions and possible emergence of a T1-state. Thus, the result of an interaction in relation to an event can be considered as another event.

A further contribution that LIR can make is to clarify the relation of the participant in and the observer of the sociological enterprise. Luhmann's communication-theoretical approach in sociology can still be read as a meta-biological model, but the problem remains of finding an adequate meta-biology. As stated by Leydesdorff, Habermas appreciated Luhmann's distinction between psychic and social systems, but he challenges us to bring the critique of metaphysical issues (of providing meaning to events in a dialectics) back into a meta-biological perspective that processes meaning without intentionality, that is, as a scientific objectivation. How can one think both these metaphysical and meta-biological perspectives?

According to Habermas, intersubjectivity cannot provide meaning to events at the supra-individual level when the sociological model is defined only in terms of social systems theory as he knew it. The human subject and the social system are then only coupled in an objectified interaction among these systems. Both Luhmann and Parsons would thus have reduced intersubjectivity to interpenetration as a systems operation without sufficient appreciation of the normative and affective components that bind people together at the communal level. As put by Leydesdorff, the perspective of a meta-biological system and one of metaphysically based intentionality can be seen as the two sides of the interface between social systems

and psychological systems. If the social system is distinguished (considered totally independent of) the psychological units carrying the system, the intentionality at the level of the social system cannot easily be defined, and thus the social system tends to be objectified. As long as society is considered as integrated in persons, the tensions between the two types of meaning processing (that is, of the social and psychic systems respectively) could be resolved as meaning shared *ex ante* within a community, but not necessarily as the result of interaction. However, the sub-dynamics on both sides of the interface contain feedback loops, and thus a non-linear dynamics of meaning can be expected when the two systems bifurcate within the complex overall communications network of the society. In other words, one distinguishes between the reflections among systems and the (hyper-) reflections within systems as different operations[7].

Leydesdorff proposes a mathematical perspective to bridge the gap between the meta-biological and metaphysical perspectives by specifying (describing) the additional degrees of freedom involved. LIR provides a logical bridge. The significance of the Leydesdorff approach in LIR terms is that the hyper-incursive routine of a knowledge-based system remains the result of the intentionality of the carriers. This not sufficient for the emergence of a new form of expectations (or intentionality) at the systems level, but requires dialectical interactions with the weak anticipations in social formations to develop into a differentiated communication structure.

### 6.3.3. LIR as a Normative Logic of Knowledge and Communication

Leydesdorff is aware (2008) that the above theory includes no explicit discussion of normative aspects of knowledge production and communication. Normative aspects have been excluded not because they are not vital, but due to the focus imposed by the methodology. In fact, he follows Luhmann in considering normative properties as associated with (integrated into) only "historical contingencies" such as organizations and individuals. "At the level of the social system, one expects this integration to be counterbalanced by the self-organization and functional differentiation in the fluxes of communication. This changes the notion of intentionality at the supra-individual level. The latter would be analytically orthogonal to individual intentionality". Leydesdorff cites Husserl to suggest that the intersubjective (at the higher level) is qualitatively different from the subjective. Completely?!

Taken to the limit, this analysis would suggest that the social system is a-moral, something that we have produced, worse than a Golem, a system of fluxes over which we have little or no control. Leydesdorff is right in one sense; society does, unfortunately, have these aspects, but they are neither fundamental nor exclusive. It is therefore important not to consider them so if one wishes to have any reasonably positive effect on the course of events, starting at the educational level.

The LIR approach, to take just this specific point, is to insist on qualitative overlaps between individual and supra-individual intentionality, with both being expressible in terms fluxes, trends, tendencies, etc. It is the logical and categorial basis for the non-separability of all the relevant dualities active in the society, knowledge based or not – subjective/intersubjective; individual/group; autonomy/inclusion and even normative/non-normative and knowledge/ignorance. It is this interpretation of all of the normative aspects of information, communication and meaning that should be applied to the direct dynamics of conflict and cooperation.

To repeat once more, the purpose of talking in terms of the logic of/in reality is to help insure a realistic model of the society in which positive and negative tendencies interact and overlap, and that the latter are assigned their proper dialectic role. As an example, I note

[7] Habermas (1985, p. 5) appears to have had a strong intuition of the failure of theories based on separability: "But this concept (the transcendental "ought") only exemplifies the contradictions that the firm distinctions between facts and values, empirical being and transcendental validity, nature and culture, seek in vain to resolve." The LIR approach, summarily, is to change firm distinctions to firm interactions.

two new social-structural trends in the United States, both in principle concerned with the environment: one is the development of Conservancy Groups, the other the so-called Cultural Creatives movement.

The former are relatively informal transdisciplinary groupings of people expert in fields of botany, ecology, economics, finance, management, architecture, education, politics and art history, among others. Conservancies have the objective of preserving significant parts of the commons such as parks (New York, Pittsburgh) and indeed entire ecological regions, as the Conservancy for Western Pennsylvania.

The latter advertises itself as consisting of informal groupings, linked by the Internet, of new political progressives, categorized by the movement's founder as "Deep Green, Against Big Business, and Beyond Left and Right" (Ray, 2002). In the new political compass that is defined, people committed to Saving the Planet, Women's Concerns and a Wisdom Culture Paradigm comprise the dogma of an allegedly emerging majority. On closer inspection, this movement turns out to include a thinly disguised commercial enterprise, whose leaders offer "retreats" for enormous fees on luxury islands. So far, I am not aware of any positive impact of this initiative. Without being overly pessimistic, a critical theory of the Information Society should, in my opinion, maintain a constantly balanced reference to both its positive and negative aspects and their interaction, and LIR provides a logical framework for such an approach.

## 7. Conflict and Cooperation

It is obvious that the existence of new ICT's has resulted in new forms of cooperation as well as the facilitation of old ones. A theory that described only the details of this fact would be trivial. The normative theory that this paper seeks to develop, however, is concerned with the dynamics of cooperation and its relation to the ICT's in the construction of a Globally Sustainable Information Society. Cooperation, like communication and morality, needs to be further defined and grounded.

As an introduction to the discussion of cooperation, I believe that it is essential to distinguish between two forms of opposition or resistance to cooperation, if you like, of anti-cooperation, considered itself as a complex process.

### 7.1. Cooperation and Conflict

Conflict and cooperation are observed in the behavior of all social animals. Models of real human society accept as given the coexistence of individuals and groups in whose genetic makeup a propensity for selfishness and refusal of cooperation has remained dominant and the opposite. The origin of non-cooperation is seen as either "inherent in human nature", a hangover from some Western religious traditions, or in a simplistic conception of Darwinian selection.

The recent work of Wilson in sociobiology (Wilson & Wilson, 2007) explains the details of the evolutionary process by which cooperative social groups should and often do prevail over "selfish" ones, as indicated above. Further explanation seems required, however, to account for the on-going systemic division of human beings into two categories characterized by social *vs.* anti-social behavior or its equivalent, expressed in terms of the narrowness or breadth of kinship or interest groups accepted as such. One failure to recognize such differences, with catastrophic consequences, occurred in the 2000 presidential election in the United States, in which Ralph Nader, running as an independent on the platform that Democratic and Republican policies were the "same", received enough votes from *Democrats* to be a major proximal cause of the Bush victory[8].

In the metaphysics of LIR, two contradictorial tendencies are instantiated in the human beings that constitute society, and this is another reflection, at a social level of reality, of the underlying contradictorial structure of the world. This cleavage (never, absolute, of course) is observed in the cognitive domains of science, philosophy and politics. A benign example in philosophy, at least as contrasted with that in the previous

[8] It is a source of grim amusement to note that the result constituted a refutation of Nader's own theory, but it did not discourage him from being a candidate in both the 2004 and 2008 presidential races.

paragraph, is the apparently irresolvable conflict between realists and anti-realists. A more serious problem, and closer to the issues in this study, is the view of many workers in computer science and artificial intelligence that life eventually can be reduced to a set of algorithms. Such positions, which can also in some cases be described as ideological or fundamentalist, ignore the fact that non-Markovian processes, that is, complex, context-dependent processes whose variables do not depend *simpliciter* on the last state of the system, have been shown to be non-computable. As stated flatly by Leydesdorff (2000), "The social system is non-computable in principle." Mathematical algorithms are adequate for the description of some simple recursive processes, but those of crucial interest to the target theory of this study will not be captured.

## 7.2. Cooperation and Contradiction. Negotiation and Morality

In the complex system that constitutes society, it is inevitable that individuals and groups will have valid *contradictory* objectives. The relationships involved, like those of the previous Section, are also dialectical, and given limited resources (always the case, to all intents and purposes), conflicts will arise over their allocation. Analysis of the issues arising has tended to conflate the two forms of interaction, namely, those related to the existence of two types of individual mentality, and those between two groups or individuals in fair competition, in which both share a minimal adequate degree of altruism.

Recent work on conflict often uses negotiation as the term of art for conflict resolution. One is immediately confronted with the question of whether a negotiation is carried out in good faith or bad faith. In my opinion, negotiation in good faith is equivalent to cooperation. Negotiation in bad faith is conflict, with the objective of maximizing non-social gain as described by standard game theory. It involves the absence of transparency, and one might as well speak of negotiation *tout court.* One therefore has to ask whether negotiation is this sense can possibly be moral. Let us leave this open for the time being, recognizing that the answer will depend on some very fundamental aspects of the model of society that is used.

Like any (good) critical theory, LIR eliminates the necessity for any absolute views or pre-determined idealized structures in society and is in this sense materialistic. But as a realistic but non-reductionist approach, LIR supports the inherent normative transdisciplinary aspects of the ICT&S field that are antagonists of exclusion and domination, while recognizing the concomitant potential for prolonging exclusions and retarding the advent of a GSIS. As I state on several occasions in this paper, understanding and admitting that "the enemy is within our walls" is essential to the instauration of appropriate strategies to combat it.

### 7.2.1. Antagonism and Logic

As reported by Nicolescu (2003), Lupasco experienced strong resistance to the use of the term "antagonism" as being altogether too anthropomorphic and extra-logical. As I have tried to show, however nothing as real as antagonism need be considered illogical in the extended sense of LIR. It is thus an appropriate for further codification of the antagonisms in the social sphere identified by Hofkirchner et al. in the emerging IS: antagonisms between information rich and information poor; inclusion and exclusion; equality and autocracy; scientific rationality and the worst aspects of manipulation by the mass media. In other words, antagonism is present between democratic structures and special interest monopolies at all levels of society, politics and economics. In fact, it is the concrete manifestation of antagonisms in the interplay of the subsystems of the society that in Hofkirchner's view should form the object of critical investigation.

LIR is a system of reasoning that is "totally" realistic about the perennity of the dialectical interaction between people who operate on a basis of integrity and respect for nature or with a tendency toward alienation from nature, especially, today, in regard to the eco-sphere. This will be "nothing new" for Freudians. However, LIR suggests that the death wish in the individual and behavior in the direction of the destruction of the environment are both

examples of the over-expression of the trend defined by the 2nd Law of Thermodynamics of the running-down (heat death) of the universe.

The entire Section in the ICTs&S document on the dialectics of the socio-technological world defines the transdisciplinary context into which any advances in ethical theory and practice must be made. We are again confronted by the fact that the theory and the objects of the theory cannot be totally separate, as in the object-meta-level framework of LIR, and include the study of the relationship between the different disciplines as one of those objects.

### 7.3. Evolutionary Game Theory

In the development of an evolutionary theory of the Information Society (or of other complex systems), I feel that Evolutionary Game Theory provides an inappropriate model. Such theories are generally analytic, discussing abstract, idealized agents and "game" conditions, and, as we have seen in other cases in this paper, with a foundation in standard bivalent logic.

As a more promising example, I have chosen a recent article on an evolutionary game perspective on learning in multi-agent systems (Tuyls, Nowe, Lenaerts, & Manderick, 2004). Agent-based computing, in which 'agent' is understood as an autonomous computational entity with a flexible dynamic behavior in an unpredictable environment is an important new evolving paradigm in computer science. In contrast to the conceptual approach taken by Zimmermann, Evolutionary Game Theory (EGT) can or should assume that games are *not* only played once by rational players, and the players do *not* know all the rules and details of the game.

In principle, EGT can provide a model of how individuals make decisions in a complex and uncertain real world. However, the version of Tuyls et al. looks at discrete-time, homogeneous Markov processes. The mathematical models of the learning process involve binary notions of reinforcement and reward. Accordingly, for an EGT to be an appropriate paradigm outside the domain of computation as such, in my view, requires reference to real actors in real situations. In such circumstances one would generally say that one is not dealing with a game. Not necessarily in the LIR approach: a situation may have some aspects of a "game", provided these are seen as predominantly potentialized. To write Evolutionary Non-Game/Game Theory is far too awkward, but it is in a sense more correct.

### 7.4. Sociology and Contradiction

The dynamic structure of the logic of/in reality makes it eminently suitable for the discussion of issues at the highest levels of human consciousness in regard to individual and collective social behavior, including its pathology. In particular, LIR provides a basis for debate and the rejection of all forms of dogmatism whose origins can be traced to the misapplication of principles of binary logic. Such a discussion would take us too far from the limited objective of this introduction to the LIR system. The interested reader will find a non-technical discussion of social issues in the work of Nicolescu (2002) in which further references to the original views of Lupasco can be found.

The sociology of LIR makes provision for the existence of real contradictions in the world (dialetheias). The resulting contradictorial sociology is certainly closer to that of Marx and his categories of man than that to Hegel and his categories of thought. Both Hegel and Marx (and Engels) accepted the existence of true contradictions, and did not mean something else as many of their interpreters have tried to say, as Priest points out (1989). But in Hegel's final ideal 'synthesis', the contradictions in the real world no longer persist, and, in the final stage of Marx's dialectic the resolution of the contradiction removes it; there is no contradiction between labor and capital in a communist society. It is not necessary to belabor the point that such resolutions are not for the near future.

In today's world in which interdependence of actors is obvious, starting from a standpoint of directing energy and resources toward the more disadvantaged should be an acceptable to a large majority, its origin in Marx notwithstanding. If we agree that a critical

theory contains a certain standpoint, critical ICTs&S research, as Hofkirchner et al. suggest, can be conceived as identifying and analyzing antagonisms resulting from the ICTs, *e.g.* the Internet, and in all competitive and cooperative dimensions of society. Hofkirchner talks about the "colliding forces" of cooperation and competition, but also about their potential, natural in LIR terms, for leading to the dissolution or at least reduction of exploitation and oppression.

LIR thus answers the question posed in critical theory as *why* there is a difference between actuality and potentiality and how this difference might be bridged. Actuality and potentiality are reflections in the physical/temporal world of the underlying duality of the universe, a basis for why something exists rather than nothing. Bridging the gap means, to me, working in the same direction as emergent processes in general, without elimination of the difference, and while recognizing that forces of regression are an equally fundamental part of the total story.

LIR is a useful theoretical framework in which to discuss struggles in society at the individual and group level. It contains a principle of dynamic opposition that *a priori* includes the relationship between the competing and cooperating actors and insures that neither is considered in total isolation from the other. Application of the categorial features of actuality and potentiality to both social actors and social theory could eventually assign values to not-yet realized potentials for social development. From the LIR metaphysical standpoint, the disadvantaged are not only objects that deserve our sympathy and charity, as "second-class" citizens of the society, but subjects that do not deserve to be relegated to some second-class ontological status. They are essential members of the Subject-Object category.

By looking at the contradictorial dynamics of facilitators and inhibitors that condition the design of both ICTs and their social context to achieve a GSIS, LIR provides both a paradigm and a transdisciplinary methodology for *logically* addressing contradictions wherever they are found. This is in total contrast to the perspective of standard logic, which is generally one of strategies to eliminate or "manage" contradictions or deny their relevance, rather than use them to ground emergent possibilities for study or action.

## 8. The Application of LIR to a Theory of the Information Society

We now have the tools in hand to complete the main task of this paper which, to repeat, is to show the utility of LIR in relation to some specific issues and objectives set by Hofkirchner and his colleagues for the "Salzburg Approach" to a theory for the Information Society (TIS).

### 8.1. Scientific Status

LIR, which can be viewed as a meta-logic and a meta-philosophy or metaphysics as well as a logic, nevertheless contributes to the scientific as well as philosophical status of ICTs&S in view of its grounding in physics, as compared to a standard view of metaphysics based on bivalent logic (Lowe, 2006). Thus, bridging gaps between disciplines, and seeing that some form of unity can emerge from their interaction, is viewed as a real, logical as well as an epistemological process. What is alternately actualized and potentialized are the relevant perspectives, say analytical and synthetic, but this can be done with the assurance that, since according to the principles of LIR they share some of one another's properties, neither is ever totally excluded at the expense of the other. In the LIR conception, it is *logical* to look at the beauty of a crystal, or of a highly symmetrical computer program, and then at its diffraction pattern or running time respectively.

### 8.2. The Categorial Feature of Non-Separability

LIR, as the logic of transdisciplinarity, includes the critical categorial feature of non-separability, derived from the axiom of Functional Association. In my opinion, it thus cuts through the debate as to whether such categories as the "Two Cultures", specialists and generalists, or basic and applied research, academics and non-academics can be totally independent or divided – they can

not be. Further, either in their interaction or in the emergence of a third entity (a "Third" Culture), the elements are not conflated, but maintain their logical and methodological specificity or identity. In the LIR picture, this can be taken as a matter of course.

The Mittelstrass triangular model of pure basic research, application oriented basic research and product oriented applied research, quoted by Hofkirchner et al., rather confuses the dynamics of the dualities involved. The major conflict as I see it is what I experienced personally in an industrial laboratory environment. It is between the expenditure of resources (energy) for fundamental understanding or for commercial use, whether product or application oriented. The search for fundamental understanding was potentialized by the need to develop new products for sale, but it could still appear and claim one's attention, albeit for only a limited time.

### 8.3. Science *and* Logic of, for and about the Information Society

While psychological, economic and political factors define the sciences of sociology, economics, politics and so on, it seems too early for a science of the Information Society *per se* to be characterized. Logic, however, has not been widely used as a tool in even these disciplines, for the good reason, in my view, of its inability to describe more than the simplest models of the corresponding processes.

The new kind of logic that LIR represents has this capability, in the sense that it captures at least some significant general features of the underlying dynamics. I therefore see an opportunity for a science and logic of the IS to develop in tandem, constituting thereby a new form of analysis. An important relevant feature of the LIR system is its ability to focus on both inter- and intra-level relationships, in which the same principle of dynamic opposition is instantiated. There is thus no need for an absolute separation between either two "competing" theories, a theory and the data of that theory, broadly, between theory and meta-theory, or between the society and the challenges arising from that society.

The lack of necessity of impossibly clear definitions, including that of the basic prepositions "of" and "for", simplifies the role of science, but places a more stringent requirement on the rigorous use of such a flexible system. Once it is recognized that the principle is embedded in the methodology itself, its advantages in avoiding dogmatic positions should become quickly apparent. It should be natural that a science *of* the Information Society is also a science *for* the Information Society, since a dialectical overlap between the two levels is "built into" the LIR logic and ontology.

"Aboutness", qualia or phenomenal character are terms commonly used in the philosophy of mind to describe the intensional aspects of human thought. The key aspect of human consciousness is its phenomenality, that is, that things have subjective, first-person appearances to people, who cognize them and react as a consequence of the fact that these appearances are *about* something. Brentano had designated this 'aboutness' as intentionality and this thesis of intentionality has given rise to extensive on-going debate as to its purport (Smith, 1999). LIR provides the basic consideration of these terms as real processes rather than abstractions from those processes. If a science of the Information Society is also *about* that society, then LIR anticipates not only the logicality of this formulation, but its ability to subsume normative positions about crisis and conflict and their origins.

### 8.4. The Dialectics of Critical Theory and Society

I have referred above to the concepts of the knowledge-based economy and the knowledge-based society. From the LIR standpoint, the subsequent dialectics of Marx and Engels simply transpose, to the social level of reality, the same Hegelian drive toward a synthesis involving the suppression of, in contrast to Hegel, *all* contradiction.

In this Section, rather than repeat the analysis provided in the ICTs&S document, I have summarized the most important issues in its dialectical model that are either exemplifications of the LIR logic or to which

this logic provides an approach to a resolution.

### 8.4.1. Conditional Contradiction in Action: Unity (Identity) and Diversity

Hofkirchner et al. consider that systematic thinking involves application of a principle of unity-through-diversity enables a synthetic world view required for a theory of the Information Society (TIS). LIR provides the rigorous basis for saying that variety and unity are achievable "at the same time" *via* 1) the LIR axiom of Non-Identity that no concept of any absolute identity can be maintained or used as the implicit or explicit basis for discussion; and 2) the LIR axiom of Conditional Contradiction which states that if any two opposites are present at the same time, it is only in the sense that when one is predominantly actual, the other is (predominantly) potential, and *vice versa*, alternately and reciprocally, in a complementarity that is isomorphous to that at the quantum level. I feel this is rigorously equivalent to the ICTs&S formulation of establishing unity in line with difference, or Morin's ideas of "conjugating parts". LIR helps to focus on these ideas applied to real systems and their changes, and, in addition, for the emergence of a new entity (or perspective). This is my proposal for a "third perspective" through which different value systems can brought together, that is, their legitimate insights used, without conflation.

The relation between methods and theory, between understanding and approach, or between higher and lower levels of abstraction can be discussed within the two-level LIR framework of analysis. The advantage of this is that one has, as a consequence, additional scientific elements of knowledge about such relations that "make explicit what is implicit". In particular, one avoids absolute dichotomies that can falsify analyses of antagonistic tendencies and opportunities for change in society. As it is put in the ICTs&S document, "Dialectic analysis in this context means complex dynamic thinking (JEB: both processes 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.*" The logic of and in reality is a principled manner for understanding how one moves from one element to the other, as all of these elements instantiate the critical ontological aspect of non-separability, and can be the loci of emergence.

To say that contradictory tendencies pose both positive and negative potentials at the same time, that is, of opportunities and risks is, in the theory proposed here, a *logical* statement that can be linked to similar phenomena at all levels of reality. An example of a duality for which an LIR description is not appropriate is that of a surface or boundary, as generally understood. It is certainly not a function of description, nor is it a purely natural thing. Agreed. But regardless of its reality as an entity, a simple boundary between two solid, liquid or gaseous phases or even a frontier between two countries is not a *dynamic process*. It is thus *not* a model for specifying the relations between real systems. As an example to which LIR does apply, one should take the membrane of a cell, or the skin of an animal, boundaries that are three-dimensional, extremely complex and dynamic systems.

### 8.4.2. Conditional Contradiction in Action 2: Agency and Structure. Part and Whole

LIR is a logical method for joining, dialectically, agency and structure, and I propose it as a candidate for a mechanism that makes "social systems and their constitutents tick." In the ICTs&S document, Bunge is quoted as saying that a dialectic is a process whose products "freeze" into structure, which then influences subsequent processes which it both enables and constrains leading to the emergence of new qualities.

In 1951, Lupasco wrote, in a Chapter entitled "The logic of *frozen* (emphasis mine) operations or dialectic stages" (Lupasco, 1987): "The elements (products of logical operations) appear as stops in the dynamics, in the development of an implication,

determined by the discontinuous structure of the contradictory dualities and by the dialectic rhythm they imply. … The element or event signified is at the same time both the point of arrival and point of departure of a further implication[9].” I should remind the reader that for Lupasco, implication was a dynamic process in and of itself, referring to the actual physical deployment of the energies and actors in any complex process.

We have the basis here for the concept of techno-social systems, in which human individuals have sometimes conflicting roles as users and producers of technology, which of course cannot be in a sensible way defined without reference to these individuals in their social role. I simply prefer to see the organization or rather organizing process occurring in these systems as dependent on previously existing potentialities of the social entities and thus not 100% “self”-organization.

In the LIR interpretation of the ancient part-whole problem, parts and wholes are also dialectically linked, sharing part of one another’s attributes. This is a basis for saying that, as in the discussion of downward causation by Heylighen (1995), the parts contribute to the emergence and maintenance of the whole, but the quality of the whole cannot be reduced to any quality of the parts. As Hofkirchner et al. continue, we can now conceive of a real dynamics of the relation between ICTs and society mutually shaping each other in non-linear ways. The language of LIR, however, prefers the *explicit* description of the complex causality involved in the relationship of society and technology as a non-linear *spiral* causality. The use of circular here and in the work of Varela and others is *perhaps* intended to *imply* that autopoiësis never returns to *exactly* the point of departure, but I then see no reason why the inapplicable term of circularity is retained, unless due to a kind of philosophical inertia.

To say that technology represents a potential for the realization of social goals is then not just a metaphor. It *has* this potential instantiated in it during its own construction by people which is the origin of its capacity for change and evolution. By applying the principle of dynamic opposition to the sub-systems involved, one has a basis for continuous *and* discontinuous evolution, that is, qualitative revolution, rather than a simple succession of phases. The location of the evolution in part in the human sub-systems, however, means that one cannot apply a simple Hegelian model. The changes that will result, from an LIR perspective, can *never* be totally positive, only with their negative aspects more or less potentialized. This is important to avoid “eu”-topian formulations.

### 8.4.3. Conditional Contradiction in Action 3: The Evolving Web

The above considerations apply to Internet-human interactions, the former being considered also as a complex process, but I will not go further into these here. There is nothing in LIR that conflicts with the concept of the Internet as a tool for cooperation to achieve the aims and values of a GSIS. I simply wish to confirm that LIR can be used to formalize critical aspects of a logic of “techno-social production and reproduction” that refers to the dialectical relationship between human social agency and social structure as the driving force for social organization *tout court.*

The conception of inter-level interactions in LIR is broadly compatible with the description of the new phases of the evolving Web, involving deepened social exchanges and emergent meaning structures. These meaning structures are new forms of human relations being defined by the very complexity of the interactions possible on the Web, a complexity that has been designated by Berger (2008) as "cyber-complexity". The space constituted by cyber-complex relations has its own properties of transparence and expression of fundamental human values, ethics and affect. The logic of the relationships involved in these structures is certainly not standard binary logic. Some of the interactions will be dynamic and dialectical, best described by "logic in reality", corresponding to exchanges of knowledge or "knowing". The information transferred will contain meaning defined above as "instructional" information because of the instructional function the information performs.

[9] I do not claim that this idea is “totally” an original one of Lupasco’s. According to Plato, the Heracliteans described objects as “slow” actions.

Others will be less so, limited to exchanges of information whose "Meaning 1" refers only to the constraints of its production.

My preliminary answer from an LIR perspective as to whether inference rules could be established for *software* agents that could operate on knowledge distributed on the Web and process it creatively is a negative one. Such rules would, in my opinion, be equivalent to a claim of full computability of natural processes, including of course knowledge representation, which I believe is excluded by the dialectic aspects of knowledge and knowing as processes themselves. Working toward such a goal will undoubtedly produce new and useful technology, but this result should not have as a consequence the devaluation of what is *neither* captured *nor* capable of being captured by such rules.

## 9. Conclusions for a Theory of the Information Society

In this paper, I have made a first attempt to demonstrate the fit between a new kind of logic, a logic of and in reality (LIR), and the major incentives for, and objectives and methodology of, a potential theory of and for the Information Society (TIS). The categorial ontology of LIR, in particular the feature of Non-separability, illuminates the three "pillars" of a TIS, namely, Cognition, Communication and Cooperation and naturalizes (offers a rigorous description of) an interpretation of their internal structure and dynamics as well as their relations to the economic, political and technological realities of the society as a whole. Issues in three critical domains of Morality, Meaning in Communication, and Conflict and Cooperation have been analyzed from this perspective, in which LIR provides a formal basis for talking about interdependence and context.

LIR is a logic of real phenomena, which can include theories, but it is primarily explicative in situations of antagonism or real energetic, dynamic opposition between entities and processes, individuals and groups that are strongly coupled. It permits inferences to be made about the relative and reciprocal and alternating actuality or dominance of one element *vs.* the other, and the potential emergence of a third that resolves the opposition or contradiction at another level of reality or complexity.

LIR supports a "logical social realism" that regards the forces at work in society as real processes and accepts and integrates the aspects of society that have proven recalcitrant to analysis, or have been simply neglected as too uncertain. It points out that a complete theory of the Information Society should include the negative aspects of Information and Communication Technologies for both individuals and society as *logical* elements, therefore scientific, and therefore in principle more amenable to correction.

LIR is a logic of transdisciplinarity. It therefore supports the view of Hofkirchner and his colleagues that the study of the TIS is a transdiscipline, and that this is an essential aspect of its capacity for playing a role in the ethical development of ITC's toward a Globally Sustainable Information Society. LIR supports further integrative ITC assessment and design approaches that incorporate a normative view of technology and society. There is no place in LIR for value-free science; the practitioner is *always* involved logically with the material substrate of his science, whose dynamics and properties he partly shares. As clearly stated by Hofkirchner et al., a normative approach requires "doing justice" to what is both normative and factual, actual and potential.

Much further work is necessary to demonstrate the utility of this logic in the codification of a theory of the information society (TIS), as well as in other domains of science, epistemology and metaphysics. A clear weakness of LIR is its lack of mathematical formalism, and the introduction of an appropriate mathematization that would not contain question-begging assumptions (such as that of inapplicable continuity inherent in differential calculus, a problem with dynamic systems theory) would be desirable. Nevertheless, the metalogical and metaphilosophical validity of the principle of dynamic opposition seems to me well expressed in the realities of the emergent Information Society. This may well be therefore, a preferred domain for future application of the LIR approach.

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## About the Author

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Joseph E. Brenner was born in Paris in 1934, the son of the American sculptor Michael Brenner (Lithuania, 1885 – New York, 1969). After primary and secondary education in New York, he received B.A. and M.S. degrees from the University of Chicago. In 1958, he earned a Ph.D. in Organic Chemistry from the University of Wisconsin, which was followed by post-doctoral studies at the Swiss Federal Institute of Technology, Zurich and the Massachusetts Institute of Technology. In 1960, he joined the E. I. Du Pont de Nemours Company at its Wilmington, Delaware laboratory as a polymer chemist. From 1965 to his retirement in 1994, he was involved in corporate development and technology transfer with Du Pont de Nemours International in Geneva, Switzerland, working primarily in the Middle East, Africa and Eastern Europe. In 1998, he began collaboration with Basarab Nicolescu, Professor (em.) of Theoretical Physics at the University of Paris VI and President of the International Center for Transdisciplinary Research (CIRET) in Paris. The focus of this on-going collaboration has been to make the logical system of the Franco-Romanian thinker Stéphane Lupasco (Bucharest, 1900 – Paris, 1988) accessible to English-language readers. Brenner's extension and up-dating of this work has been the subject of publications and presentations at conferences and seminars in Europe, Brazil and the U.S.A. Dr. Brenner is a member of the American Association for the Advancement of Science; the New York Academy of Sciences; and the Swiss Society for Logic and the Philosophy of Science. He recently joined the Editorial Board of this *Journal.*