Information and the Future of Transdisciplinarity

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Transdisciplinarity, in the conception of Basarab Nicolescu, places the human being at the center of its preoccupations. Participation in transdisciplinary research and practice thus is not simply an intellectual exercise but an ethical enterprise whose finality is the furthering of the common good. In this acceptation, a key role is played by a non-standard logic, Logic in Reality, which provides a grounding of ethical behavior in physical science. In this paper, I argue that part of the 'future' of transdisciplinarity lies in the joint application, to problems of the common good, of its core theses together with recent perspectives from the science and philosophy of information. Information and informational processes, in the conception of Wu Kun, are transdisciplinary and can be seen to evolve according to the principles of Logic in Reality. Together these concepts constitute a theoretical approach to a Global Sustainable Information Society that is both rigorous and humanist.

Keywords*:* Common good, information, logic, philosopjy, science, society, transdisciplinarity.

1 Introduction

In today's world, I believe that philosophy has a critical social function in contributing to some minimal practical improvement in the human condition. The investigation of theoretical transcendental ramifications of thought has its own value and should continue. However, philosophy should also in part justify its existence and claim on resources by making some contribution to correcting problems of society. My first task in supporting this concept is, therefore, to explain my idea of what is the most positive actual and potential aspect of society, namely, the common good.

1.1 What Has Happened to the Common Good?

In speaking about the common good, one should first distinguish between three different major, albeit closely related aspects: one is the informational environment, defined by the revolution in the information and computation technologies (ICTs). The increase in the negative pervasive and invasive aspects as well as the positive aspects of the ICTs calls for new non-technical as well as technical approaches to managing them to serve human interests. The second is the natural global environment which, apart from some very local improvements, is undergoing massive and possibly irreversible degradation. The third is the local socio-economic environment in which individual human beings evolve.

Wolfgang Hofkirchner, in particular, has addressed the first aspect in his examination of the requirements for the development of a Global Sustainable Information Society (GSIS) [1]. Approaches to the second are if anything even more complex, since

they involve, directly, the degree of individual and collective commitment to social responsibility, maintaining the global environment as part of an overall ethical attitude. This brings us, unavoidably, into the field of individual and social psychology. There is general agreement that the objective of new science and technology is to promote advances in human civilization, civilized behavior and well-being. However, the large literature devoted to describing the problems, for example [2] whose title is, literally, "Why technology won't save us or the environment" does not propose many non-technical ways of approaching them. Thus what is new and requires the attention of philosophers and logicians is not technology science and engineering per se. What is new is the ever-increasing space, material and mental, that is abusively occupied, in the local environment, by the artifacts of technologies and their misdirection to individual selfish goals.

François Flahault is a French philosopher without illusions about the current direction of society. In his recent book [3], whose title is that of this introductory section, he shows that social reciprocity and coexistence are the essential requirements for a satisfactory individual life, defining the real, non-economic "common good". However, the necessary codification of the rights of individuals, in the Universal Declaration of Human Rights in the aftermath of World War II, is now interpreted in an overwhelming context of market-driven globalization of the new information and communications technologies (ICTs), leading to a drastic and inhuman devaluation of the common good. Unless logic and philosophy, in conjunction with science, address these issues, they will have failed to address the reality of our world.

No paper like this one could present a formula or method for the establishment of a 'better' society that would somehow be widely adopted. However, I consider that a more scientific description of the grounding of ethical human ethical behavior is not just an intellectual exercise but a moral obligation. The two related tools that I see as having become available for this task are transdisciplinarity and informational science and philosophy. A necessary component of both is the non-standard logic of transdisciplinarity originally proposed by Lupasco [4] and up-dated by me and made available to English-language readers as Logic in Reality (LIR) [5]. In this view, part of the 'future' of transdisciplinarity lies in a synergetic relationship with information leading to a better understanding of physical and cognitive phenomena and their evolution in informational terms. Such a combined theory may support non-technical solutions to the problems of the emerging information society.

1.2 Outline of Paper

In the next Section 2, I provide the briefest possible overview of transdisciplinarity and its logic. I do the same in Section 3 for the philosophy and metaphilosophy of information and their relation with the former as the scientific basis for this paper. In Section 4, I review and criticize a few technologically oriented approaches to the organization of knowledge directed at increased social responsibility. In Section 5, I discuss recent developments in non-technical theories in the areas of ethics and environmental and social responsibility. Section 6 describes in more detail the Hofkirchner concept of a Global Sustainable Information Society. I conclude that inclusion of a transdisciplinary, informational perspective in theoretical and practical approaches to both knowledge and social problems is a methodological necessity.

2 Transdisciplinarity

The emergence of the concept of transdisciplinarity, and the field of transdisciplinary studies has come in response not only to the proliferation of disciplines and the need to manage their practical applications, but to the crisis in the related philosophies of science and knowledge in general. Transdisciplinarity is not a new discipline but a philosophical movement which, through its non-standard logic of human experience and human intelligence, can provide a new approach to on-going problems and paradoxes of human thought, science and philosophy.

2.1 Transdisciplinarities Today

Since the publication in 2002 by Basarab Nicolescu of his *Manifesto of Transdisciplinarity* [6] and in 2008 of his compendium *Transdisciplinarity – Theory and Practice* [7], applications of transdisciplinarity in both areas have greatly increased. Organizational networks devoted to transdisciplinary research and publication such as *td-net* in Switzerland, The*ATLAS* [8] and *INIT* provide centralized sources of information and opportunities for exchange of

ideas, correlating scientific capabilities with human individual and social needs.

The difficulty of capturing the complex concept of transdisciplinarity in a single definition is well-recognized. Nicolescu has recently summarized [9] the thinking behind three major forms of transdisciplinarity: theoretical transdisciplinarity, phenomenological transdisciplinarity, and experimental transdisciplinarity. He gives examples of each which will not be repeated here. The three forms of transdisciplinarity are by no means totally separated or independent but overlap and inform one another.

In the most general way, one may say that the practice of transdisciplinarity consists in application of the theory and methodology of transdisciplinarity to 1) the understanding of the relations between specific disciplines; 2) the solving of specific practical problems and 3) the understanding of the relation of transdisciplinarity to structured human thought, philosophy, logic and epistemology. In this paper, I will focus on the third area, in particular regarding the emerging science and philosophy of information as conceptual structures directed at similar objectives.

2.2 The Logic of Transdisciplinarity. Logic in Reality

In previous papers, both Nicolescu and I have discussed the Logic of Transdisciplinarity, one of its 'pillars'. We have showed its origin in the logic of the included third of Stéphane Lupasco, and I have also discussed in some detail my interpretation of the Lupasco system as a non-truth-functional, non-linguistic extension of logic to real systems (Logic in Reality; LIR).

I simply emphasize the point here, critical for the discussion of information and the future of transdisciplinarity, that both approaches include the emergence of new states through the principle of dynamic opposition, the dialectic and interactive relation between the dual elements of all real processes. The difference, very briefly, is that Nicolescu looks 'upward' toward the transcendental aspects of existence while LIR focuses on the explication of the evolution of complex real systems, such as those involved in information processes.

My view of transdisciplinarity and its relation to a logic is similar to the discussion by Roderick Lawrence in his paper "Transgression of Disciplinary Frontiers" [10]. In particular, he cites the statement by Thierry Ramadier that the specificity of transdisciplinarity consists in simultaneously integrating two contradictory movements (emphasis mine) of disciplinary logic, that is, the fragmentation of knowledge and the relation between the"fragments", in order to do research into the connections possible between the (forms of) knowledge produced". These are the kinds of movements, including their connections to the fundamental physics of our world, which Logic in Reality can describe.

2.3 Complexity

The reviewers of a previous version of this paper suggested 1) that too many subjects were being dealt with and 2) that complexity, one of the pillars of transdisciplinarity, is not found in the real world but is a human agent-dependent concept. In my view, both points can be addressed by noting that if the concept of complexity is not taken an abstract mathematical entity, but a statement that all natural processes are constituted by multiple, co-evolving and partly retrograde sub-processes, then this multiplicity is not mind-dependent. To the extent that reality involves the interactions involved in these processes, described by Logic in Reality, reference to a multiplicity of subjects to gain a new and adequate perspective on phenomena is almost inevitable.

One role of transdisciplinarity, then, is to provide a framework for the analysis of different complex process phenomena that enables constants in their components to be, at least, recognized. One example is the relation between a general tendency toward altruistic behavior and a predominantly progressive political orientation. The relations elite – stability:: people – change; elite – material values:: people – sensitivity to fundamentals [11] are obviously oversimplified, but their discussion would require reference to all the sciences from physics and cosmology to psychology. I return to foundational questions of ethics in Section 5.

2.4 "Cyber-Space-Time" and Cosmodernity

These two concepts are relevant because they refer to the direction in which Nicolescu has taken the acceptation of transdisciplinarity. In particular, "Cyber-Space-Time" (CST) was presented by Nicolescu [12] as a new level of reality. For Nicolescu, the source of CST is the quantum world, which is ruled solely by the non-classical logic of the included third.

Causality in CST is causality in an open loop, ruling the man-computer interface, and the interface with other partners. "CST is neither deterministic nor indeterministic. It is the space of human choice. To the extent that CST permits the bringing into play of the notion of levels of reality and the logic of the included middle, it is potentially a trans-cultural, trans-national and trans-political space."

Nicolescu recognized the emergence of CST as a consequence of the ICTs even before the explosion of the social media of that last few years. His view, however, emphasized only the positive characteristics of CST, by now familiar, of some kind of collective mind or intelligence. In his latest book [13], Nicolescu uses the term'cosmodernity' to express the idea of a new era, founded on a new vision of the contemporary, transdisciplinary and transnational interaction between science, culture, spirituality, religion and society. Reality is plastic and people are active participants in the cosmos.

In my interpretation of the Lupasco logical system, somewhat greater emphasis is placed on the current evolution of dynamic physical and mental processes than the transcendental aspects of man's existence. Not everyone has the same desire and/or capacity to rethink 'everything' and act in consequence within a transdisciplinary framework. One should not lose sight of the resistance and barriers to achievement of such a desirable result. As Nicolescu himself has said, transdisciplinarity is always accompanied by an anti-transdisciplinarity. There will always be selfish, 'non-cooperators', people who will place their own well-being or that of their group above the common good, and I see their existence as another instance of the basic dualities of the universe that are the basis of Logic in Reality.

This interpretation notwithstanding, given my basic agreement with the finality of transdisciplinarity, it was for me an exciting discovery to find a complement to transdisciplinarity in the science and philosophy of information. These insights into the 'workings of the world' in informational terms are the work of the Chinese philosopher and scientist Wu Kun.

3 The Philosophy and Metaphilosophy of Information

3.1 The Philosophy of Information

In parallel to the development of transdisciplinarity, the last decade has also seen major developments not only in the information and communications technologies, but in the science and philosophy of information. As I will show, recent theories of information science and philosophy have a close relation to transdisciplinarity.

Starting in 1980 from philosophical considerations of the essence of information, Wu Kun, working at the Jiaotong University in Xi'an, China, developed a Philosophy of Information (PI) that included information ontology, an informational theory of knowledge, evolution, value, an informational thinking', social information theory including a rigorous conceptual system for the natural properties of information and an interpretation of its biological significance, methodological aspects and social value. Wu Kun published more than 330 papers on the Philosophy of Information and related areas in Chinese, plus several books and a 14-volume monograph. A small fraction of this work began to be available in English only in 2010 in a monograph presented at an International Conference on the Foundations of Information Science in Xi'An ("The Basic Theory of the Philosophy of Information" (BTPI) [14]).

This work was completely independent of the concomitant development of a Philosophy of Information by Luciano Floridi [15], working at the University of Hertfordshire in the U.K. The differences in the two approaches are philosophical: Floridi's theory is basically epistemological, seeing the operation of information from the perspective of the human observer-reasoner. The theory of Wu is ontological, better ontological-epistemological, without absolute separation between the domains. In this, again, Wu rejoins the basic conceptions of transdisciplinarity.

The basic insight of Kun Wu's Philosophy of Information is that the concept of objective reality = objective existence is too poor to describe a world which is the sum of processes of production, reception, storage and processing of information. A proper new ontology and worldview is needed to describe the phenomenological characteristics of that existence. The approach of Wu to information was to start with existence constituted as objective and subjective from a standard phenomenological viewpoint. He then placed the critical terms of existence, objective and subjective, reality and unreality, and direct and indirect in a framework in which each combina-

tion of terms defines a path leading to matter-energy on the one hand and information on the other.

The principles of LIR support Wu's resegmentation of the field of existence (the extant domain) [16]. LIR makes it "logical" to talk about interactive relations between objective and subjective, reality and unreality, internal and external, direct and indirect and so on, and it does not exclude a priori the existence of real contradictions. Wu's view of information as involving interactive processes is not new as such. What in my opinion needs to be emphasized is the way in which internal and external factors must be understood. These include the multi-level nature and characteristics of the actual and potential (virtual) interactions that mediate the construction and transformation of information in which they (the interactions) evolve logically and dialectically. A key methodological conclusion is that the Wu approach contributes to recovering dialectics as an appropriate strategy for philosophy and science, including social and political science.

3.2 The Metaphilosophy of Information. Phenomenology

In his Metaphilosophy of Information, Wu Kun positions information as a critical component of all disciplines, beyond the formal content specific to them. A summary of his views in English can be found in [17]. At the heart of Wu's theory is a necessarily alternative worldview that emphasizes its relational and process aspects completely in the spirit of Lupasco's (*toute est relation*; everything is relation). We move from a quantitative, "technological" conception of information to what may fairly be called a transdisciplinary one.

In the light of information theory, the weaknesses of modern philosophy, from Kant through Husserl become apparent. It is the existence of information, even more than, but in concordance with, Logic in Reality, that breaks the traditional absolute separation of subject and object. Although Husserl found a way of beginning to describe the reality of consciousness, his one-dimensional phenomenological reduction maintains, in another form, the disastrous (for human society) polarization of standard bivalent logics. From a Lupascian standpoint, Husserls bracketing is thus fundamentally flawed as a hermeneutic process.

In place of standard phenomenology, Wu proposes an informational ontology in which we as humans have (self-evidently) access to "things-in-themselves". He emphasizes that his philosophy of information and logic in reality are not phenomenology because phenomenology is the subjective intent of interpreting the structure of the world. We live, however, also as indicated in the dialectics of Lupasco, by adhering to route on which "the natural noumenon's own movement explains the world". Articles in the major 1999 compendium, edited by Jean Petitot and Francisco Varela [18], Naturalizing Phenomenology fail to reach the minimum complexity required. The implications of this view for phenomenological transdisciplinarity are most interesting, but outside the scope of this paper.

While standard functional and operational definitions of information have their role to play in practical applications, they fail to capture both the intrinsic dynamics of complex processes and the nature of information itself which is instantiated in them. Thus, in the understanding of knowledge and knowledge propagation, drastic modifications of points in standard epistemology have to be made, with consequences for the dynamics of the emergence of new entities and meaning, in the contradictorial relationship that is formalized in LIR.

Using an informational paradigm illuminates work such as that of Lakoff and Johnson [19] on "The Embodied Mind", in which the physical and physiological structures of the mind and body interact in an informational complex. Many workers in transdisciplinarity refer to some such concept as a way of better describing mind-body interactions in a non-reductive manner. To talk about information at any but the lowest computational level requires attention to the entire objective dynamics and subjective idiosyncratic patterns, consistencies and inconsistencies, styles of the human actors involved in its generation and reception, its historical dimensions, and so on. Wu has called this informational complex, constituted by the complete set of all of the informational processes and interactions of an individual, past, present and potential as the "informosome". Anticipating the concept of the informosome, in a prophetic insight in 1975, the complexity of the informational processes in which the individual is immersed was described by the Swiss philosopher and mathematician Ferdinand Gonseth [20] as part of his 'open methodology'. "Experience shows that no information is received in a pure state but only via the intermediary of a certain repertory of signs, sym-

bols, notions, ideas, etc." The result for knowledge is that it is subject to the modalities of incompleteness, pattern and revisability. Gonseth called for a critical examination of these modalities as protection against the "intense flows of information" that tend to reach us without one.

Taking into consideration the complex informational properties of existence is a difficult task for science, but it is the more correct position from which to start. To quote Wu: "Informational activities have their origin not in the pure "life world" of an idealized subject, but in the objective world of their own interactive existence and evolution." One must maintain in the forefront of one's mind the synergy between the physical form and the informational form and the rules of their evolution to fully understand their unified relationship.

Lupasco provides the basic formalism for discussing the "intertwining" of internal and external, present and potential (or absent) awareness and interactions, the "subjective active and the objective passive", ultimately of man and nature in their unity-in-duality noted by Hofkirchner [21]. Application of the philosophy of information thus brings out an ontological domain, which Wu has called that of indirect existence as part of total existence, something that is objective and complex, having meaning and value and thereby constituting the elusive thing-in-itself that does not require further empirical proof in the reductionist classical sense.

3.3 Transdisciplinarity and Informational Thinking

It is perhaps a first indication of an approaching maturity of the field of information that, based on the contribution of Wu Kun, one can talk about the metaphilosophy of (a theory of) information in a social context. One of the consequences of the comprehensive nature of such a metaphilosophy establishes the role of those involved in them in the social and ethical aspects of the informational components of existence.

The Metaphilosophy of Information requires attention to the informational aspects of complex processes as a methodological necessity, in a process that Wu calls Informational Thinking. Informational Thinking (IT), as conceived of by Wu [14], refers to a way of grasping and describing the essential characteristics and attributes of things by reference to the structure and dynamics of the information involved in their evolution, from their historical origins to future possibilities and probabilities. However, as noted, the doctrine of Wu, unlike that of Husserl, does not have to be "naturalized", that is, brought into the domain of natural science. It is already there in what I claim is a transdisciplinary configuration. Wu discloses directly the mechanisms of the processes involved in an individual's understanding at the level of the integrated object and subject, with internal and external interactions providing the necessary multi-level objective and subjective mediation.

In this sense, all of the cognitive issues addressed by Wu, especially informational values, valence and social evolution, have implied the use of Informational Thinking for their analysis. IT requires the abandonment of thinking in traditional, absolute material terms while retaining its original foundations. IT is basically a methodological concept that, via the definitions of carriers and codes of information, enables inferences to be made about the historical and potential or probable future states of an information system. IT dialectically unifies energy factors and informational factors, determinism and indeterminism, internal and external feedback processes, independence (autonomy) and interdependence. LIR provides the additional logical structure for the dialectic interpretation of such a unified approach, based on the impossibility of any total logical or physical separation between these dualities. In fact, Informational Thinking is the Metaphilosophy of Information in other terms.

To the extent that Informational Thinking requires the consideration of all the philosophical and scientific facets of information, we believe that we are close to a new scientific (and logical) paradigm in which Informational Thinking, as opposed to thinking in terms of entities, results in new interpretations of, among other things, traditional disciplines and their theories. Above all, we see the (meta-) philosophy and (meta-) logic of information outlined here as a contribution to revealing the essence of information as a natural process. In other words, by seeing the relations between the changes in values that take place in human informational activities and the forms of society, a more profound understanding of information is possible that could be a contribution to overall progress and sustainable development of human civilization. Information Science, Metaphilosophy, Metalogic and Thinking may

thus facilitate what Wu calls for, namely, a change in the commitment to and the interpretation of the dynamic oppositions in all complex natural processes in informational terms. This is thus a transdisciplinary doctrine *par excellence*.

Through the study of information as one of the most basic features of existence, and the formalization of informational activities, the Metaphilosophy of Information of Wu can and should change the way basic philosophical – metaphysical, epistemological and ontological – issues are discussed. The Philosophy of Information supported by the new extension of logic to the same processes that it discusses, could be a "comprehensive revolution in philosophy", which I consider to be transdisciplinary in character.

Informational Thinking not only includes Systems Thinking as it is currently conceived but goes beyond it, much as transdisciplinarity goes beyond multi- and interdisciplinarity. In the spirit of LIR and this paper, no invidious message of exclusion is intended here; as perspectives on knowledge, Systems Thinking and Informational Thinking too are related dialectically, and one can look, for example, at the interactive patterns of organizational structure and relational networks with a greater or lesser emphasis, depending on the objective, using the informational philosophical underpinning that Wu's new illustrations of existence can provide. Nevertheless, it is Informational Thinking, including a logic of the included third, that is primitive and provides the framework for an improved understanding of systems.

In view of the rich space of possibilities for advances in philosophy and science offered by the concepts we have defined of Information Thinking, I hope that it may be possible to move the focus of debate away from the details of the formal, mathematical conceptions of information toward a more holistically natural, human and social approach. Wu's term - the "informational rescientification of science" - is not intended to exclude any less rigorous criteria for the physical and logical validity of current science but increases the required degree of scientific and ethical responsibility of its practitioners. We should realize, only, that standard conceptions of logic, systems and information are a priori inadequate for this purpose.

3.4 The Informational Stance

Wu's concept of Informational Thinking, like transdisciplinarity in the acceptation of Nicolescu, defines an attitude in which rigor, opening and tolerance are both scientific and moral necessities, augmented by the feeling for information as a constituent of existence from the lowest to highest levels and having value as a consequence.

Informational Thinking in fact further describes a stance, the Informational Stance, a philosophical position and attitude that is most appropriate for, and above all not separated nor isolated from, the emerging science and philosophy of information itself. The Informational Stance [22] is an attitude that requires attention to the informational aspects of complex processes as an ontology that goes beyond the empirical epistemological formulation of van Fraassen [23].

Transdisciplinarity supports a humanistic worldview that is similar to Wu's Informational Stance. I note, as originally formulated by Wu, the nonseparability of metaphysics, epistemology, value theory and social issues; "we should have a metaphysical picture of the world to discipline scientific methodology, and science and education policy". The Informational Stance is an interactive process, in which the human individual or group is engaged morally and politically, as well as being an epistemic observer in the standard philosophical sense. In fact, consistent with my overall logical approach, it is not necessary to make absolute separations between an informational stance, thinking, philosophy and the ethical dimension. It is rather an integrated or integrating position with alternating focus. The right integrative property includes complexity, because the origin of the basic emergent character of complexity requires only the prior multiplicity of difference and identity. Of course, emergence occurs not only at the integrative level, but also at the partial level, when the informational dimension is introduced, producing the holographic property of the general informational nature of entities, that is, the "informosome" referred to above.

In summary, the Philosophy of Information has transcended its origins in information and computation science and technology. It is not only that the Philosophy and Metaphilosophy of Information refer to the standard disciplines that makes them transdisciplinary but that they contain, like transdisciplinarity in general, what lies in, between and

beyond the different conceptions of information – an attitude, a stance and an ethics.

These recent developments in the Philosophy of Information thus go far beyond the standard conceptions of philosophy. They establish the Philosophy of Information as a framework for the understanding of both philosophy and science in what may be termed a new knowledge paradigm directed toward the common good. In contrast even to the Philosophy of Information, the philosophy of technology [24], including information technology, remains underdeveloped outside the global concepts of Wu Kun discussed above. Discussing any one initiative in detail would be beyond the scope of this paper, but it is useful to see how the problems of the common good are (or are not) formulated in all of them.

4 Organizing for Change

In this Section, I list a few recent approaches and initiatives directed toward a more effective organization of knowledge and action in the context of the information revolution. The participants include academic, industrial and political centers of competence and excellence as well as individuals. The multi- and interdisciplinary aspects of such technologically-oriented initiatives are accepted, almost without analysis, but the less obvious transdisciplinary implications for their possible successful implementation are rarely referred to explicitly.

4.1 Tech*NO*fix

The title of this sub-Section refers to a 2011 book by Michael and Joyce Huesemann [2] whose sub-title is Why Technology won't Save us or The Environment. As might be imagined, the book presents a detailed refutation of the myth that advanced technology alone will extricate us from "an ever increasing load of social, environmental and economic problems". On the other hand, its methodology falls very rapidly into a kind of anti-scientific mode that represents the only suggestions the authors make for any minimal improvement in the commons. It is important to be explicit here: improvement in the common good, today, cannot be achieved without the new ICTs.

We thus have here another example of what is missing: some framework in which a conceptual repositioning of the ICTs can be achieved, going beyond the technology itself. Such a framework, in my view, can only be a transdisciplinary one that includes the philosophical and logical dimensions outlined here.

4.2 Tech FuturICT

The concept behind the FuturICT initiative [25], in the framework of the European Union is clearly multi-disciplinary: "We think that integrating Information and Communications Technologies (ICTs), Complexity Science and the Social Sciences will create a paradigm shift, facilitating a symbiotic coevolution of ICTs and society. The objective is also clear: it is to understand and manage complex, global, socially interactive systems, with a focus on sustainability and resilience. "Revealing the hidden laws and processes underlying societies probably constitutes the most pressing scientific grand challenge of our century and is equally important for the development of novel robust, trustworthy and adaptive information and communication technologies (ICTs) based on socially inspired paradigms." In this formulation, the major output of new technologies would be further new technologies capable of exploring economic and social life and discovering options for a sustainable future.

This is fine as far as it goes, but in my view it does not go far enough. It is, exactly, a trans-disciplinary perspective that is missing, one that looks beyond the 'power of information' to the problems in using that power for which people are responsible. Even if this is understood implicitly, I believe it is part of the scientific perspective to refer to it explicitly

4.3 ICES

ICES stands for International Center for Earth Simulation, recently established as a not-for-profit Foundation in Geneva, Switzerland [26]. In contrast to the previous conception, although it has as members many of the same centers of excellence as FuturICT, it will have the advantage when operative of being a physical entity. The scope and vision of ICES is the following:

Our vision is to create an *international resource centre* dedicated to simulating the dynamic Earth System as a Whole. We have set out to build a hub for *global innovation and public good*, using deep scientific understandings combined with advanced modeling, simulation and visualization technologies. To do this, ICES will install and continually upgrade

one of the world's fastest supercomputers; improve the numerical models for the various dynamic natural subsystems of the planet; assimilate and synthesize data sets from regional and national research partners;

Thus, the sponsors of ICES recognize that at some time, the *output* of the computer or computers will have to be accepted by the society-at-large as a contribution to the common good,*explicitly.* At this stage of the process, non-technical, philosophical and psychological issues will have to be addressed [27]. It is at this stage, if it is reached, that both transdisciplinary and informational approaches may make a contribution to understanding and evaluating alternative courses of action.

4.4 Crowdsourced Democracy

Disenchantment with the current system of two political parties in North America and Europe has suggested to some the use of the ICTs in the political arena. In fact, an 'Information Party' is in the process of being formed in the United States [28]. By definition, the objectives of 'crowdsourced democracy' should be the same as those of any democracy – the common good. However, the only thing that can be said at this time is that the platform of this party will be determined by the positions of the majority of its members, voting on-line.

The criteria for membership in the party are not yet clear; if it is open, these positions would simply reflect those of the prevailing majority, perhaps biased to somewhat higher educational and economic level than that of the average population. (Other attempts at electronic Town Halls' have been made that are simply part of the current 'blogosphere' and will not be discussed here.) It therefore remains to be seen what further social value, if any, an Information Party may generate in comparison with traditional parties.

5 The Common Good

A transdisciplinary philosophy and culture, which supports what is called here the common good, has been outlined by Nicolescu in [6]: a philosophy of the underlying unity of knowledge and a culture of openness and tolerance of opposing views combined with rigor in analysis. These views are restatements of basic ethical principles in other terms, but placing them in the framework of a methodology of transdisciplinarity helps to insure that they are discussed with the adequate rigor.

5.1 Social Responsibility and the ICTs

The most appropriate source of concepts for a better use of information science and technology for the common good should be information scientists themselves. I am convinced that negative attitudes toward technology as such are to be avoided, like all absolutist doctrines. As the information scientist and philosopher Gordana Dodic-Crnkovic puts it [29], "the question is not how to get rid of technology but how to get better technology that promotes human values and a sustainable society". The target for dialogue is, then, the technologist to demonstrate to him or her that present technology is not socially sustainable and that improvement in social sustainability is both desirable and possible. Necessarily, it will be the engineering community that must constructively contribute to the sustainable development of society by designing and constructing devices that will better reflect our cognitive, social, emotional and informational needs.

But this is clearly only part of the answer. The process by which technology affects society and *vice versa* is never ending, but no single technical solution is final. Society as a living organism is in constant development, and the integration of any technical solution will lead to a change in the habits and behavior of society, for which the previous solution becomes inadequate. Society, to be considered here from the standpoint of these non-technical components, must be able to demonstrate the limitations of technical solutions suggest the need for non-technical ones and propose at least some reasonably rigorous conceptual framework for them as well. The prestige of information science suggests that it has the credibility to define necessarily transdisciplinary non-technical solutions and contexts that could be accepted by 'technology'.

It is important, in such a discussion, to include and even focus on basic scientific concepts that have direct implications for the social value of technology. The ecologist Robert Ulanowicz has shown [30] that attempting to resolve society's predicaments through the search for ever-increasing efficiency becomes equivocal in a world of limited resources in which entropy exists in two forms. Raising the efficiency of a given system beyond a critical point

leads to catastrophes that tend only to restore the system to its original narrow range of operation.

5.2 Ethics and Environmental Responsibility

Another major area of the common good, as indicated in the Introduction, is the natural global environment the threats to which do not need to be repeated here. In the picture of that environment as a web of physical interactions which are also logical, ethical value is ascribed to the inanimate world by conscious humans as being that by which they are constituted, down to the quarks of atoms or whatever might be at a still lower foundational level. In Floridi's Philosophy of Information, value is ascribed to the informational aspect of existing entities [31]. The basic thesis of the Philosophy of Information is that all real processes, especially cognitive ones, are informational in nature. To the extent one is talking in an ethical context about real people, individuals and groups, one therefore needs to talk explicitly about an informational psychology as well as an Informational Philosophy. This area is being currently addressed by Zong-Rong Li and his associates [32]. Li has suggested the term 'Informationalism' to capture the controlling function of informational existence in which information science and material science explain individual and social phenomena. This approach permits, among other things, a reformulation and interpretation of psychology and its history into a specifically Informational Psychology.

In my view, these two perspectives are compatible, valid ways of providing a scientific underpinning of norms for ethical behavior. In a sense, the electrons of which I am composed are an ultimate, essentially inaccessible 'Other', at the same time as being 'Self'. Self-respect is the (linguistically) self-referential process of recognition of this relation and the basis for 'Other-Respect'. Instead of life (biocentrism), one refers to the antagonistic dynamic relations between informational entities, without falling into pan-psychism. Note that in this analysis, it has been neither necessary nor desirable to insist on the physical-ontological to the exclusion of the informational-ontological. Both inform and confirm one another and the choice of emphasis and the movement from predominantly one to the other and back can follow the actualization-potentialization scheme that is codified in Logic in Reality. Some such an approach is necessary to counter the direct result of centuries of dogmatic thinking based on linguistic, bivalent logic that is in fact inapplicable to the complex, recursive dynamics of the real world.

As discussed above, the link between Informational Philosophy and transdisciplinarity is the logic of and in reality (LIR), which is, also, the logic of transdisciplinarity. A basic tenet of this logic is a respect for the other, as stated by Nicolescu in his Manifesto [6]. The other in the broadest sense is not only female vs. male in a male-dominated society and racial and ethic minorities in general but human and non-human, that is, the total physical environment. In the LIR view of ethical behavior, the same metaphysical but also physical principle of dynamic opposition provides the basis for both 1) a generally applicable antagonistic psychological typology of responsible and irresponsible behavior toward the environment; and 2) the origin of environmental responsibility and in fact moral responsibility in general. Morality in the generally accepted sense of responsibility toward others as well as oneself and the environment is thus logically and ontologically grounded, as are other universal aspects of human behavior, both positive and negative. Environmental responsibility can be considered as scientifically valid and not dependent on transcendental assumptions that serve only to weaken its purport. Strategies to strengthen awareness of and positive response to environmental threats should thus emphasize common humanity and a common psychological structure across cultures as well as enlightened self-interest.

In other words, LIR and its non-separable categorial structure provides a scientific and normative rationale for the intuitive values of a universal human morality; resource conservation; and the related issue of sustainable development which facilitates control of climate change. If survival in any society requires coming to terms with the existence of opposition and conflict, this is perhaps especially true in an Information Society dominated by the ICTs that offer only partial formal and technological solutions to environmental problems. As Herman Tavani [33] has shown, however, nothing has 'happened' to or in society that has changed the universal core moral human values of life, liberty and justice. The most applicable concept of morality is one which is not based solely on inherent virtue (virtue ethics), 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 or real 'internalization' of the other becomes obvious and the differences ones of perspective or description. By providing a more general and public, non-sectarian concept of the origin of morality, transdisciplinarity supports the necessary attitudes of openness and acceptance of the other's position, and provides a basis for avoiding simplistic Manichean dogma, including the ideology of unlimited economic growth.

5.3 Toward a New Democratic System

In the applications suggested by Wu Kun for his theory and philosophy of information, no specific comprehensive economic-political model is suggested, but he does call for a "new democratic system" that would permit maximization of the benefits from the new information technologies. It would include an informational perspective for studying social phenomena and provides a social information theory based on his concept of the essence of information in a social evolutionary context.

As shown by Wu [14], forms of human civilization can be differentiated according to their different ways of creating, processing, dissemination and development of information. Only human beings can create information. Human production and productivity are essentially only information production and information productivity, and models of the economy and market activity are informational models. The expanded role of social role of information is accompanied by the development of networks for its dissemination resulting in (slow) disappearance of centralized nation and global hegemony. In this process, information creation, processing and dissemination of the network approach becomes a technical prerequisite to building a new democratic society.

Human interests should be at the heart of any proposals for change in a society defined today by the evolution of its information processing modes in the scientific, economic and social domains. However, any theory or model of such changes cannot ignore (see my interpretation of the Lupasco logic above) the fundamental embodiment of contrary, anti-social and anti-civilizational forces in the society that make the "common struggle" for common good and implementation of the human values a struggle indeed. An "ideal" Information Society would require, Wu suggests, the emergence of a diversified, non-authoritarian network involving a modern form of the atrophy of centralized natural systems. In any event, proper attention to the informational aspects of any politico-economic model is necessary, and would be the consequence of the Informational Thinking and Informational Stance described in preceding Section 3.

5.4 Transdisciplinarity and the Common Good

As an example of the relationship between transdisciplinarity and the common good, I note a recent *ATLAS* paper by Christian Pohl [34]. He first describes alternative combinations of four characteristic features of transdisciplinarity, namely (a) to relate to socially relevant issues, (b) to transcend and integrate disciplinary paradigms, (c) to do participatory research, and (d) to search for a unity of knowledge.

Pohl has established a concept of the function of a new transdisciplinarity network in Switzerland, the td-net, namely, to add additional features to the recent concentration on participatory research as the finality of transdisciplinarity. His concept "endeavors to frame, analyze, and process a socially relevant issue in such a way that the research project (1) grasps the complexity of the issue, (2) takes the diverse perspectives on the issue into account, (3) links abstract and case-specific knowledge, and (4) develops knowledge and practices that promote what is perceived to be the common good." He then goes on to say that "the promotion of the common good or, more generally speaking, the evaluative component of transdisciplinary research – is rarely stated explicitly in definitions of transdisciplinarity even though an evaluative component is inevitable in order to know what an improvement of the current situation might look like." Later he says: "...one of the challenges for transdisciplinary researchers is to clarify underlying value systems by jointly developing the concrete meaning of, for example, sustainable development for the research project's specific context". The Logic of Transdisciplinarity, unlike standard logics, is not topic-neutral or morally neutral but founds an ethics. It is my hope that a transdisciplinary ethics, which has not yet received a minimum necessary codification, may develop from this work.

I agree with Pohl's overall thesis as stated in these sentences, but I disagree with his choice of emphasis. In my opinion, the purport of the terms common good, peace, ethics and sustainability go beyond

research and researchers in these fields toward the more general substantive meaning of the subjects of research, the necessity for their implementation and the barriers to that implementation. Accordingly, a next step, in my opinion, is to include, in transdisciplinarity practice, a greater explicit commitment toward the actual nature of the objects and processes under study.

I therefore discuss below some further issues in the area of ethics and the common good to which the transdisciplinary attitude may make a contribution. In my opinion, participating in "transdisciplinarity as a philosophical movement" is not politically neutral, since any orientation toward a common good implies, more or less directly, some rather fundamental changes in social, political and economic values and priorities. As noted, it is perhaps in the area of information that a further functional role for the transdisciplinary attitude and transdisciplinary thinking is beginning to take shape.

The new social media enabled by the new ICTs are only partly and superficially effective in creating new ties, since the overwhelming emphasis is on the new capacities available to (some) individuals, seen as their rights, with very little about their duties, the other half of the dialectic of the common good. (The positive role of these media in pathological socio-political situations is not in question here.) Flahault shows that the concept of the common good is anterior to that of individual rights, but pious statements about the need to "work together" and "love one another" are inoperative. In order for the balance of power at the political level to further the common good, a new more scientific basis for the ties between individuals must be found than the market relations, the economic-social contract of individual consumption that relieves buyer and seller of all moral obligation.

Logic in Reality provides this: Two or more human individuals and their relations constitute interactive systems in the LIR categorial sense of non-separable subjects and objects, sharing in part one another's characteristics. An individual is no more isolated logically, psychologically or morally than he or she is economically. Logic in Reality thus supports the relation between what was called pre-scientifically "natural law" and the conception of human society as necessary to human psychological existence, the real common good.

Neglect of the informational, and accordingly of the logical (in the above sense of the logic of the included third) and transdisciplinary aspects of thought may insure the purity of some academic research, but it also insures its irrelevance. In contrast, no scientific and technological work is without some redeeming actual or potential value to the community and hence has ethical entitlement to its share of limited resources. In this respect, the role of information and its technology in this respect has been clearly outlined by Rafael Capurro [35].

6 The Global Sustainable Information Society

In the domain of information per se, my major source is the recent work in both information and the ICTs by Wolfgang Hofkirchner and his associates in Salzburg and (now) Vienna. Their concept that the study of the emerging theory of the information society is transdisciplinary, and in particular the new field of research in the Information and Communication Technologies (ICTs) and Society is a transdiscipline, was proposed in 2007 [36]. This definition is consistent with the functional definition of a transdiscipline in the basic charter of ATLAS [8].

The key aspects of a transdiscipline for Hofkirchner et al. are its scientific status and its potential societal function. As regards the scientific status of the field, a transdiscipline does not mean a mere combination of existing disciplines but a transgression of their traditional borders and their transformation into something new with its own identity. Its terminology should overarch the terminologies of the single disciplines it departs from. A transdiscipline therefore is expected to bridge several gaps: the gap between the two cultures of (natural) science and social and human sciences as well as the gap between specialists and generalists as well as the gap between applied research and basic research. It is the result of a process that departs from mono- or multidisciplinarity and transcends interdisciplinarity.

Hofkirchner argues that to the newly established field of ICTs-and-Society research must thus inhere transdisciplinary features, if it is to 1) be critical of current socio-economic developments; 2) aim for the establishment of a GSIS (Global Sustainable Information Society); 3) tackle the complex problems of society and technology; and 4) use social-scientific and technological, empirical and theoretical methods

in a proper way.

Logic in Reality (LIR), supports this transdisciplinary view in general, involving integrative ICT 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 normative and factual, actual and potential.

The term "transdiscipline" should thus be adopted in discussions of transdisciplinarity where it brings out better the issues under discussion. The conclusion of an on-line debate on this question in regard to ICTs-and-Society was generally favorable. Whether the use of the term conflicts with a definition of transdisciplinarity which is also supposed to be beyond all disciplines is for me a secondary question, perhaps best answered pragmatically by reference to transdisciplinary openness itself.

If it is the aim of an as-yet-to-be-developed science of and for the Information Society to help govern society when confronted with the well-known global challenges, it is the aims of transdisciplinary research to contribute to bringing about a Global Sustainable Information Society (GSIS). A GSIS can be defined in a normative way and technology (the ICTs) can be assessed according to how they facilitate society to live up to these values. This is in sharp contrast to either undertaking research solely for reasons of curiosity or being instrumental to whatever is demanded by parts of society. In contrast to the ideology of value-free science, here the normative criteria are laid down to which ICTs as well as society should be subject. A state of future society is envisioned in which these criteria are met.

7 Summary and Conclusions

In summary, I have argued that one of the most if not the most important aspects of the concept of transdisciplinarity is its relation to the field of information and information science. The presentation of these concepts here is based on my belief that a new way of looking at thought and the traditional disciplines can make a contribution to a better anticipation of the future.

7.1 Transdisciplinarity and Its Logic

The role and function of the logic of transdisciplinarity, originally proposed by Stéphane Lupasco and up-dated in some of my other publications as Logic in Reality, is to support, philosophically and scientifically, the transdisciplinary approach or attitude toward current issues in philosophy and science and to provide new insights into the qualitative, ethical aspects of the informational evolution of science and society. The presentation of these concepts here is based on my belief that a new way of looking at thought and the traditional disciplines can make a contribution to a better anticipation of the future.

It has become a commonplace to say that the future in contained in and/or anticipated by the present. To understand how this is the case is difficult if one tries to apply methods of analysis or inference based solely on the existence of actualized aspects, properties or parts of the phenomenon in question. Logic in Reality, as logic of transdisciplinarity, offers an organized way of looking at the current existence of future states in terms of potentialities.

7.2 The Philosophy of Information

Following Wu Kun, I have shown that the Philosophy of Information is a metaphilosophy that includes various philosophies as its branches [17]. This Philosophy of Information also makes possible a new conception of nature, understanding, society and values and actively promotes the development of human information society, and a more civilized and democratic social polity, economic and cultural new order. His theories constitute part of a new transdisciplinary paradigm, in which information has a central role in the transformation of the society and its approach to knowledge and the classical separation of the academic disciplines.

In this paper, I have argued that the major 'future' of transdisciplinarity and transdisciplinary studies may be in the construction, together with information studies, of a new concepts and contexts for favoring the common good and the development of a Globally Sustainable Information Society. To repeat, the inclusion of transdisciplinary and informational perspectives in scientific or philosophical work is not simply an intellectual exercise but a social and moral imperative.

I do not wish to imply that the combination

of transdisciplinarity, Informational Thinking and Logic in Reality automatically provide a way of solving individual and social problems. However, by calling attention to their common dynamic structure and pattern of evolution, it suggests an attitude of openness and tolerance. New ideas and solutions may emerge as the (actual and potential) interactive transdisciplinary relations and oppositions between different approaches are maintained in the forefront of discussion.

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Since our first meeting in 1999, Professor Basarab Nicolescu has been a constant source of energy and inspiration in support of my effort to make accessible, in English, the fundamental logical philosophy of Stéphane Lupasco and his own contributions to it. I had agreed with Nicolescu that this logic was the Logic of Transdisciplinarity, as discussed in 2005 at the 2nd International Conference of Transdisciplinarity in Brazil. In the next phase of my work, transdisciplinarity became to a certain extent secondary to establishing the legitimacy of Lupasco's Principle of Dynamic Opposition and the Logic of the Included Third (Logic in Reality; LIR) in current philosophical-metaphysical terms. However, as my interest then turned to the application of LIR in the most currently significant fields of systems science and information, the necessary functional role of transdisciplinarity and the transdisciplinary attitude, in the complex acceptation of Nicolescu, became again clearly "actualized". In this, I am also very grateful to Professors Wolfgang Hofkirchner in Vienna and Wu Kun in XíAn. Both have encouraged the application of LIR to their theories and philosophy of systems and information in which appear their own visions of transdisciplinarity. This paper is a first attempt to show not only the convergence of these two lines of thought but their common objective of contributing to the common good

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