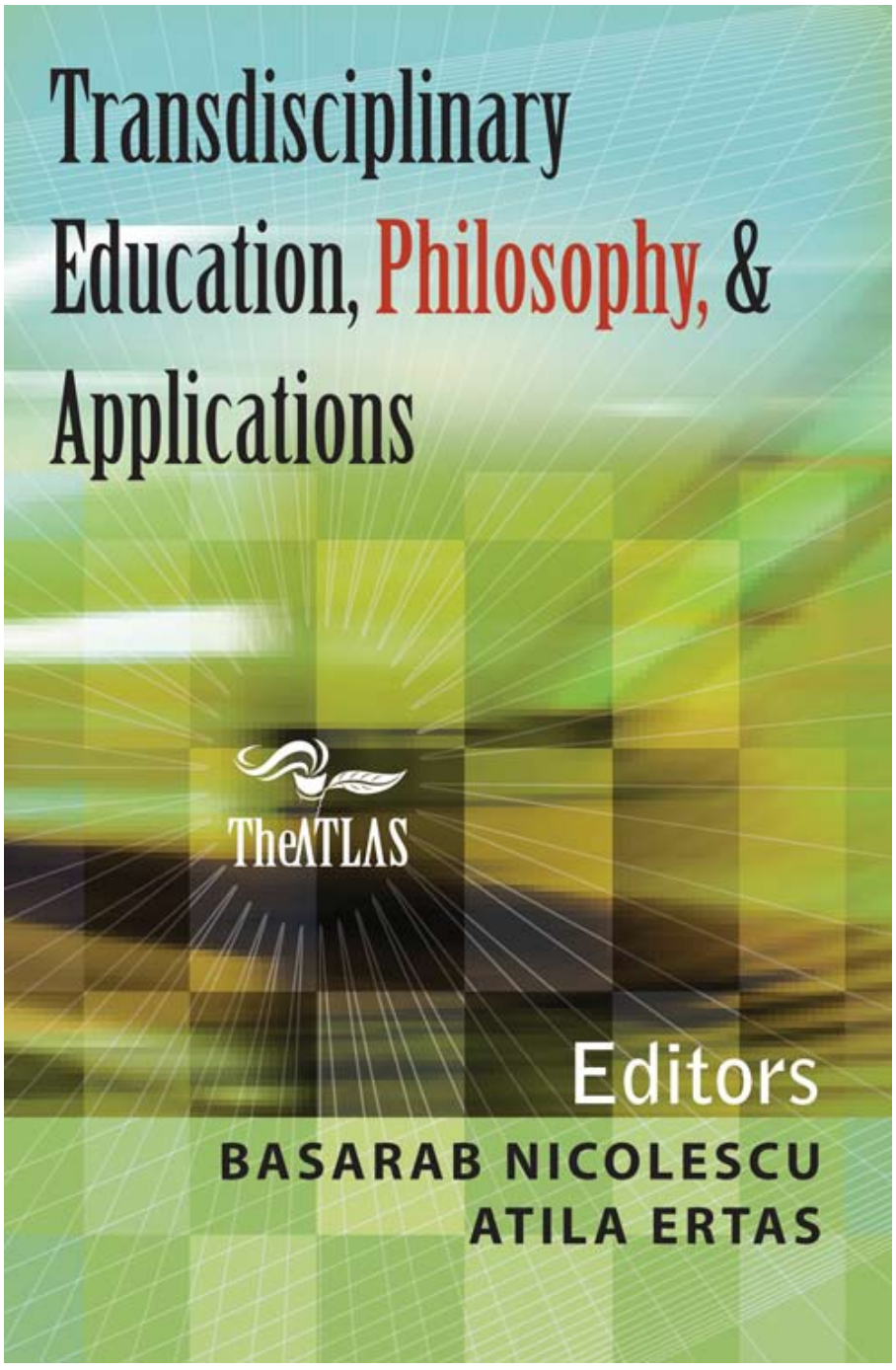
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Editors
BASARAB NICOLESCU
ATILA ERTAS

Transdisciplinary Education, Philosophy, & Applications

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Editorial

This issue of the JTSE includes contributions from authors in Australia, Romania, France, Switzerland, Canada, Brazil, and the USA. Authors of this issue of the journal addresses numerous topics including: Transdisciplinary education, transdisciplinary methodology in research, Healthcare, art and transdisciplinarity, metaphysics and transdisciplinarity, biological systems, Transdisciplinary Pragmatism, and science and philosophy.

The first paper by Joseph E. Brenner summarizes some current views of transdisciplinarity, in particular the theory and methodology of transdisciplinarity in the approach of Basarab Nicolescu. In his paper he suggested that transdisciplinary practice and informational thinking are essential ways of furthering the common good.

The next paper by Marc-Williams Debono is to evaluate the ability of plant kingdom to treat information without nervous system. In his paper he stated that "providing the great value of early sensory processing in plants is accepted, the only way to progress would be to read the emergent behaviors of complex informational systems co-creating the world through a transdisciplinary framework."

Third paper by Paul Ghils discusses some aspects of knowledge adopted in European history, politics and philosophy, in contrast with its own past and with other cultural areas. Some conclusions from various subjects of research in social sciences are commented upon with a view to assessing the relevance of a transdisciplinary perspective.

Sue L. T. McGregor presents the emergent movement towards integrating transdisciplinarity with biomimicry. Her paper provides an overview of the biomimicry approach, including discussion of its three basic dimensions: (a) nine principles of life; (b) nature as model, measure and mentor; and, (c) the Design Spiral methodology. She stated that "If the intent of transdisciplinarity is to understand the world in all its complexities, and the world includes humans, non-humans and nature, then it makes sense to gain insights from non-humans (other species) and nature, the intent of biomimicry."

Maria F. de Mello et al., in their paper they carry out an ongoing exploration of a phenomenon they chose to name Transdisciplinary Pragmatism/TD-P. They stated that transdisciplinary phenomenon is a continuous unveiling, an opening, a movement towards a reality that is by nature muti-dimensional and multi-referential. They view TD-P as an event of appropriation: a creative and free act, original, present since forever, open to possibilities, but yet to be unconcealed. TD-P demands the articulation of the phenomenal method and the "trans" dimension inscribed in the transdisciplinary system of thought.

Eric L. Weislogel's paper shows the parallels between metaphysics and transdisciplinarity, both in terms of their aims and methods and in terms of their place or role in academic institutions. He attempts to define metaphysics, addresses criticisms of metaphysics, and indicates the necessary relationship

of metaphysics to transdisciplinary endeavors.

Paper by Doru Costache presents three samples of transdisciplinary-like approaches within patristic Byzantine tradition, namely, Chalcedonian Christology (in conversation with Lucian Blaga's notion of dogma), the multilevel interpretation of Scripture in St. Maximus the Confessor, and the Maximian and Palamite ideas of the rapports between science, technology, theology and the spiritual life. The contention of his article is double. First, it proposes that within Byzantine tradition there can be traced a series of transdisciplinary features, which up until recently have remained unknown and which, to be rightly appreciated, require a new appraisal through the lens of current transdisciplinary methodology. Second, and related, it contends that contemporary transdisciplinarity has deep roots within the Christian tradition, as exemplified by the Byzantine antecedents analyzed herein, and that in order to understand better the cultural process that led to transdisciplinarity such roots can no longer be ignored.

Danielle Boutet presents the practice of art as a form of knowledge and asks: What can one know through art? What does art contribute to transdisciplinarity? From an epistemological point of view, what is the nature of knowledge available through art? Here, art is described as a material, aesthetic, experiential and visionary form of knowledge, sharing similarities with alchemy. While science studies facts, art creates meaning using metaphors and correspondences. This paper also discusses modes of knowing: physics and biology, for example, belong to the scientific mode. Psycho-analysis and mythology use a hermeneutic mode. Furthermore he stated that "to approach transdisciplinary complexity, a dialogue between and across modes of knowing is more difficult, yet as important as dialogue across disciplines. Art is a significant source of knowledge, and a transdisciplinary conversation needs artists as much as scientists and philosophers."

In her paper, Antonella Verdiani claims that education can bring humans back to their true nature, which is joyful. She stated that ducating for the sake of joy is possible; many experiences exist that can be reproduced. Her article highlights those offered by a system known as "integral education".

The next paper by Liviu Drugus sums up some of his previous ideas on transdisciplinarity applied during the last years. His pedagogical experience enriched with situations solved by him through transdisciplinary methodology/ thinking, i.e. the levels of reality paradigm, theory of Complexity, and the logic of the third included. These three pillars of transdisciplinary methodology are used in the sense described by Basarab Nicolescu.

Mirela Mureşan stated that everybody knows that the present educational system is mostly built on disciplinary teaching-learning basis: disciplinary curriculum and assessment, disciplinary specialization of the teachers, disciplinary diplomas etc. The topic of her paper offers the opportunity to look for some proper answers to the following problems: could the transdisciplinary methodology be applied within the frame of a disciplinary system of education? How could it be done? What would be its challenges, limits and perspectives? The

paper prepresents the transdisciplinary didactic experiments conceived and performed at "Moise Nicoara" National College from Arad, Romania, during the last five years. She used the term and concept of "transdisciplinarity" as it was defined by Professor Basarab Nicolescu.

The main objectives of T. Batuhan Baturalp's paper are to demonstrate the necessity of patient handling/transfer assistive devices, explore the economic benefits of them, review current assistive patient transfer devices, and investigate design parameters of an ideal patient handling/transfer assistive device. His paper also focuses on the importance of the transdisciplinary collaboration in developing and designing patient handling/transfer assistive devices.

Finally, the last paper by Simona Modreanu expresses her feeling about literature and language which plays an important role in our lives.

We wish to thank all the authors for their important and valuable contributions. We hope the readers find this issue of the TJES useful, interesting and thought provoking.

Basarab Nicolescu and Atila Ertas

CHAPTER 1

Systems and Information: Transdisciplinary Study

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This Chapter summarizes some current views of transdisciplinarity, in particular the theory and methodology of transdisciplinarity in the approach of Basarab Nicolescu. His conception of the Logic of Transdisciplinarity suggests that explicit reference should be made to it in transdisciplinary studies. I first develop this idea in a critique of current systems science and thinking. Nicolescu has stated that transdisciplinarity is not a paradigm. However, transdisciplinary methodology may nevertheless be an essential part of an emerging informational paradigm. In this Chapter, I claim that in fact information cannot be properly understood without using what is effectively a transdisciplinary methodology. I describe the philosophy of information of Wu Kun and his concept of informational thinking and contrast it with standard systems thinking. In Wu's approach, the philosophy and ethics of information are eminently transdisciplinary. I suggest that transdisciplinary practice and informational thinking are essential ways of furthering the common good.
Keywords*:* attitude, common good, contradiction, information, logic, systems, transdisciplinarity.

1.1 Introduction

1.1.1 Transdisciplinarities Today

Since the publication in 2002 by Basarab Nicolescu of his *Manifesto of Transdisciplinarity* [1] and in 2008 of his important compendium *Transdisciplinarity–Theory and Practice* [2], applications of transdisciplinarity in both areas have greatly increased. Organizational networks devoted to transdisciplinary research and publication such as *td-net* in Switzerland, *TheATLAS* and *INIT* provide centralized sources of information and opportunities for exchange of ideas. The major task of transdisciplinarity is generally understood as a new

way of potentially correlating scientific capabilities with human individual and social needs. Nevertheless, the scope and value of transdisciplinarity remains problematic for many people.

The difficulty of capturing the complex concept of transdisciplinarity in a single definition - a similar situation obtains with respect to information - is well-recognized. Nicolescu has recently restated [3] his conviction that our formulation of transdisciplinarity is both unified (in the sense of unification of different transdisciplinary approaches) and diverse: unity in diversity and diversity through unity is inherent to transdisciplinarity and its logic. It is thus best to start from the position that there are three major forms of transdisciplinarity: *theoretical transdisciplinarity, phenomenological transdisciplinarity, and experimental transdisciplinarity.*

The word theory implies a general definition of transdisciplinarity and a well-defined methodology. Phenomenology is used here to imply the building of models that connect the theoretical principles with observed experimental data in order to predict further results. The word experimental implies performing experiments following a well-defined procedure, justified when it results in an acceptable level of reproducibility to the scientific community. From this perspective, the work of Michael Gibbons, Helga Nowotny and Atila Ertas can be classified primarily as phenomenological transdisciplinarity, and Nicolescu's, together with that of Jean Piaget and Edgar Morin, as theoretical transdisciplinarity. Experimental transdisciplinarity refers to the large amount of experimental data already collected not only in the framework of knowledge production but also in fields such as education, psychoanalysis, medicine, art, literature, history of religions, etc. As Nicolescu states the reduction of transdisciplinarity to only one of its aspects is dangerous because it could transform transdisciplinarity into a set of more or less fashionable doctrines. It should be clear that simultaneous consideration of theoretical, phenomenological, and experimental transdisciplinarity could permit a unified, non-dogmatic treatment of transdisciplinary philosophy, theory and practice, coexisting with a plurality of transdisciplinary models. The three forms of transdisciplinarity, following the Logic of Transdisciplinarity (see below), are by no means totally separated or independent but can and should 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 Chapter, I will focus on the third area, as it may provide a basis for further progress in the usefulness of the transdisciplinary approach.

In the acceptation of Atila Ertas [4], the transdisciplinary model for, specifically, education and research transcends the artificial boundaries imposed by traditional academic organizational structures and directly addresses the problems arising in the satisfaction of human needs, especially in the process of implementation of the major recent advances in science and technology.

These in turn are related to the solution of large and complex problems by teams consisting of many people from diverse backgrounds. The essence of transdisciplinary education, research, and development processes lies in the common ground built on the foundation of design fundamentals and process development and management. This "common ground" is a good example of something that "lies beyond" individual disciplines as in the theoretical transdisciplinarity of Nicolescu.

The supporting transdisciplinary philosophy and culture that Ertas calls for has been pointed towards by Nicolescu: 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 the logic and methodology of transdisciplinarity helps to insure that they are discussed with the adequate rigor. I propose this paper, accordingly, as a contribution to the domain of theoretical transdisciplinarity in the sense of Nicolescu.

1.1.2 Rationale and Objective of Chapter

The basic thesis of this Chapter is that *if in fact* theoretical and phenomenological transdisciplinarity are to be accepted simultaneously and rigorously, their essential components must also be accepted and used and not only more or less explicitly stated. If, as is often the case, transdisciplinarity is claimed to derive from and/or exemplify theories of systems and information, such claims most be considered vacuous unless the theories concerned embody the necessary features of a relevant transdisciplinary logic and methodology.

In this Chapter, I will use the term of transdisciplinarity as referring to a complex corpus of knowledge and a set of attitudes constituting an operator that has or can have a *functional* role in human society. I note, however, that Nicolescu has stated clearly that transdisciplinarity is not a paradigm. This does not mean, however, that a transdisciplinary attitude or "mind-set" or transdisciplinary thinking may not be an essential part of or support to a new paradigm that has appeared, namely that of information. I suggest that the information paradigm may be essential for the development of the common good in what has been called the emerging information society.

1.1.3 Outline of Chapter

In the next Section 2, I first present a summary of the methodology and logic of transdisciplinarity according to Nicolescu. This logic is the original logic of the included third, the major contribution of the Franco-Romanian thinker Stéphane Lupasco (Bucharest, 1900 – Paris, 1988) [5], to which Nicolescu added the features of complexity and levels of reality. My recent restatement and elaboration of that logic [6] is discussed. As an introduction to the discussion of systems and transdisciplinarity, Sections 3 and 4 summarize briefly some additional theoretical work of Lupasco, Section 3 his dialectical method-

ology and Section 4 his foundational work on the origins of systems in physics, as well as some of the problems in using current concepts of systems, systems science and systems thinking. The alternative, proposed in Section 5, is to use current much deeper views of information theory and science, which turn out to have a close relation to the Logic of Transdisciplinarity. In Section 6, I develop further the concept of Informational Thinking and the role of the philosophy of information. The final Section 7 addresses in more detail questions of ethics and the common good, and in which I show that all three key perspectives – ethical, informational and transdisciplinary - come into play.

1.2 Transdisciplinarity in the View of Nicolescu

1.2.1 The Nature of Transdisciplinarity

At the beginning of his *Manifesto* [1], Basarab Nicolescu describes transdisciplinarity as a new philosophical movement. Transdisciplinarity is not to be considered a new discipline, but rather possesses a number of characteristics, and can accomplish a number of things, of which the following are a brief and highly personal selection of mine:

- Transdisciplinarity is a **process** that offers a new vision of nature and reality.
- Transdisciplinarity provides a **platform** for expressing and reinforcing the hopes and aspirations of mankind.
- Through its **logic** of human experience and human intelligence, transdisciplinarity provides a new *approach* to age-old problems and paradoxes of human thought, science and philosophy.
- Transdisciplinarity is a **method** for thinking about the relations and implications between human actions and events and about how to include emotional, artistic and philosophical elements in discussion of solutions to practical problems.

1.2.2 The Pillars or Methodology of Transdisciplinarity

As proposed by Nicolescu, transdisciplinarity can be described as being supported by three major conceptual "pillars": complexity, levels of reality and the logic of the included middle or third. The general methodology of transdisciplinarity is based on these three pillars, as they have emerged from the study of modern science, especially, of quantum physics, but also of molecular biology and cosmology.

To begin with, an important distinction needs to be made regarding the pillars: they are, and should be considered, as different kinds of things, albeit closely related ones:

- Complexity is a *property* which is exemplified or attached in some way to its instances, the things or systems that are complex, and to a certain extent codified in the *discipline* of complexity science, the study of complex structures;
- Levels of reality is a *categorical concept*;
- The logic of the included middle or third is a *discipline* as such.

More recently [3], Nicolescu has reformulated the methodology of transdisciplinarity in axiomatic terms, as follows:

1. **The Ontological Axiom**: *There are, in Nature and society and in our knowledge of Nature and society, different levels of reality of the Object and, correspondingly, different levels of reality of the Subject.*
2. **The Logical Axiom**: *The passage from one level of reality to another is ensured by the logic of the included middle or third.* (Such a passage implies to me a dynamics, that is, a real energy flow that takes place at both the lower physical and higher cognitive levels.)
3. **The Complexity Axiom**: *The structure of the totality of levels of reality or perception is a complex structure: every level is what it is because all the levels exist at the same time.*

The first two get their experimental evidence from quantum physics, but they go well beyond the exact sciences. The last one has its source not only in quantum physics but also in a variety of other exact and human sciences. All three are in agreement with traditional thinking present on the earth since the beginning of historical time. It is for this reason, among others, that I believe that Nicolescu considers it is inappropriate to talk about transdisciplinarity as "paradigm", a term developed by Thomas Kuhn in the 1970's to apply to distinctions between current social and natural science.

For the purposes of this discussion, I suggest that above Axioms of levels of reality have two major aspects:

- In our *knowledge* of Nature and society, according to the ontological Axiom, what Nicolescu defines as the transdisciplinary Object and its levels of Reality, the transdisciplinary Subject and its levels of perception, and the Hidden Third define the ternary transdisciplinary *model* of reality.
- Nature and society themselves, however, following the logical Axiom, also define subjects and objects linked causally by the Lupasco Principle of Dynamic Opposition that also defines a ternary *structure* of reality.

Based on these ternary models and structures of reality, one can deduce other ternaries of levels that are extremely useful in the analysis of concrete situations by contextualization. Nicolescu provides the following list, which I have separated in two for purposes of discussion. The placing of a) in both groups is intentional:

- Logical
  a) Levels of objectivity – Levels of subjectivity – Levels of complexity
  b) Levels of organization – Levels of structuring – Levels of integration
  c) Levels of confusion – Levels of language – Levels of interpretation
  d) Physical levels – Biological levels – Psychical levels
- Ontological
  a) Levels of objectivity – Levels of subjectivity – Levels of complexity
  b) Levels of knowledge – Levels of understanding – Levels of being
  c) Levels of materiality – Levels of spirituality – Levels of non-duality

In the remainder of this Chapter, I will be focusing on the analysis of the phenomena of systems and information with reference to the *Logical Axiom* of the methodology of transdisciplinarity. For this purpose, we will need to look more closely at the Logic of Transdisciplinarity (LOT) itself. I wish to make it clear that all further references to LOT in this Chapter refer to the Nicolescu acceptation of transdisciplinarity. (It is difficult to conceive of a specific non-standard logic of phenomenological transdisciplinarity in the Gibbons-Nowotny construction. The dynamic elements of this theory are essentially classical, and standard logic is, accordingly, applicable to them.)

1.2.3 The Logic of Transdisciplinarity and Logic in Reality

In Nicolescu's most recent summary of the Logic of Transdisciplinarity [3], the emphasis is on the major revision of the 3rd Axiom of Aristotle by Lupasco to allow a third term T (the "T-state") which is at the same time A and non-A. This existence of this third term is completely clarified once the notion of "levels of Reality", not existing in the works of Lupasco, was introduced by Nicolescu. In Nicolescu's view, "If one remains at a single level of Reality, all manifestation appears as a struggle between two contradictory elements. The third dynamic, that of the T-state, is exercised at another level of Reality, where that which appears to be disunited is in fact united, and that which appears contradictory is perceived as non-contradictory. It is the projection of the T-state onto the same single level of Reality which produces the appearance of mutually exclusive, antagonistic pairs (A and non-A). A single level of Reality can only create antagonistic oppositions."

In addition, however, Lupasco clearly described a modification of the 2^{nd} Axiom, that of non-contradiction, by seeing the elements of a real system in opposition as partially actual and partly potential, in what he called contradictorial conjugation. The elements are what would be called today conjugate variables in a system of non-standard probabilities (the limits are > 0 and < 1). Thus the antagonistic oppositions remain, without self-destruction, exactly because they are, as Nicolescu says, connected to a higher level of reality. A

and non-A are indeed present at the same time but only to the extent that when A is actualized (but always less than 100%), non-A is potentialized (but always less than 100%), alternately and reciprocally, unless and until conditions favor the emergence of a new entity from the T-state. I have proposed this modified interpretation as a Logic of and in Reality (now, LIR) first in a paper presented at the 2nd International Congress of Transdisciplinarity in Vitoria, Brazil in 2005 and in the Nicolescu Compendium [7]. The differences, very briefly, in the two approaches is that Nicolescu looks "upward" toward the ontological included middle and the Transdisciplinary Subject and Object and further toward the hidden included middle, while LIR remains as a logical tool for the explication of the evolution of complex real processes and systems, such as those involved in information.

The view expressed of transdisciplinarity and its relation to a logic is supported by Roderick Lawrence in his paper "Transgression of Disciplinary Frontiers" [8]. 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 to which the Lupasco logic and LIR apply.

1.2.4 Logic in Reality and Information

The best expression of the situation is thus perhaps to say, in the spirit of the original dialectics of Lupasco, that Logic in Reality (LIR) and the Logic of Transdisciplinarity (LOT) are the same *and* different. LOT reproduces the original change proposed by Lupasco in the third of the three fundamental axioms of Aristotle; LIR does also but restates Lupasco's Principle of Dynamic Opposition (POD) as three additional axioms. This enables the non-linguistic terms of the Lupasco system to be seen not only as a logic of the included middle (or third), but also as a logic of conditional contradiction and a logic of emergence of new entities. I have included functional references to Logic in Reality, and thus indirectly to Lupasco and the Logic of Transdisciplinarity in a series of recent papers [8], [9] dealing with its application in the field of information theory and philosophy. I will return to aspects of LIR as they become useful in the more detailed discussion of systems and information that follows.

1.3 The Dialectical Methodology of Lupasco

Lupasco made two major applications of his logic and its principles which are perhaps less well-known but which in my opinion are relevant to the practice of transdisciplinarity. The first of these is outlined in a late book *The Psychic Universe* [11].

The dialectical methodology proposed by Lupasco involves looking, in any process, 1) for the logical elements that are in real interaction or opposition, actively "overlapping" and then 2) to what extent each is actualized and/or potentialized by the other, following the Principle of Dynamic Opposition. It is the physical movement involved in these interactions that are the basis for the existence of systems as discussed below. Lupasco uses the neologism dialectology as the theory of such processes. In this approach, the probability for synergy as well as opposition of the energies involved also exists, resulting in the emergence of new entities at the "T-state" as described by the Axiom of the included third.

I will not follow Lupasco further here in his application of these ideas, unfortunately little detailed, in the areas of psychology, normal and pathological, and religion. To the extent that transdisciplinary methodology involves integration of critical aspects of these disciplines, the use of the Lupasco concepts could also constitute a significant way of organizing them.

1.4 Systemology. the Origin of Systems in Basic Physical Principles

I have previously discussed Lupasco's "systemology" in [6], but I believe that it is relevant to the applications of transdisciplinarity that are subject of this paper and summarize them briefly here. The originator of General Systems Theory (GST), Ludwig von Bertalanffy [12], defined systems simply as "complexes or sets of elements standing in interactions or interrelations," but GST was supposed to be capable of giving exact definitions of and even quantifying complex concepts. As stated by von Bertalanffy himself, however, he provided no axiomatic basis for his theory of systems, and failed to see beyond differential calculus, the basis for current so-called Dynamic Systems Theory, as a basis for systems theory.

In one of his last articles, "The History and Status of General Systems Theory" [13], von Bertalanffy wrote that ultimately all the boundaries of real objects are dynamic rather than spatial. "Hence an object (and in particular a system) is definable only by its cohesion in a broad sense, that is, the interactions of its component elements".

Totally independently of von Bertalanffy, despite the fact that they were contemporaries, in his "Notions of General Systemology" [14], Lupasco set forth the principles underlying all of his work in terms of systems. These principles constitute an alternate expression of his non-propositional, non-truth-functional logic that enables an interpretation of the dynamics of "cohesion and interaction".

1.4.1 Axiomatic Statements

The Relation of Antagonism

Lupasco's first axiomatic statement is that 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, both to attract and repel one another, associate and dissociate, integrate and disintegrate. The constitution and evolution of every system, be it nuclear, atomic, molecular or at the level of the macroscopic objects of our senses is always a function of this relation of linked antagonistic or opposing forces, constituting a relation of antagonism. Systems which tend towards an equality of tension, such as hadrons, will be more stable and resistant to disintegration than those in which one dynamism is heavily favored over the other.

The Relation of Contradiction

The second axiomatic statement has a similar form: a system is not possible if all the constituents or elements involved are 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 is possible, either, if all elements are totally heterogeneous, without some degree of homogeneity that would prevent this diversity not only from not being a system, but not even a class or set.

Every system thus implies at the same time homogeneity and heterogeneity, identity and diversity. The relation of contradiction is maximal as identity and diversity approach equality, as in the notation by Lupasco for "systemogenesis" [6].

The Principle of Antagonism applied to Energy

The third axiomatic statement is that every real 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. Lupasco developed his "logical algebra of energy" with the addition of another key concept. Every energy (or phenomenon) passing from a potential state to an actual state finds itself necessarily, at a certain moment in an intermediate T-state (see above), where it conflicts with the antagonistic energy passing from a state of actualization A to one of potentialization P. This is an alternative statement of the Axiom of the Included Third.

Each of the three elements (A, P, T) is an antagonistic energetic duality or alternatively an antagonistic conjunction. Each is a system, and all more complex systems are generated by concatenation of such antagonistic dynamisms.

Logical systems of energy thus apply to all phenomena or aspects of experience, from microscopic to macroscopic, since 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 that of implication, considered, with the other logical operators, conjunction and disjunction, as real processes themselves.

In these principles, I see a basis for von Bertalanffy's concept of continuous multivariable interactions as well as their modern formulation by Hofkirchner and others of meta-system transitions [15]. Already in 1962, Lupasco related the concepts of feedback and a non-Shannon type of information. Lupasco noted that any cybernetic system has the capacity for *feedback* or "counteraction", initiated by some perturbation. The key point, according to Lupasco, is that the interactions are not only associative and epistemic but physical. In order for real processes to evolve, there must be a driving force that is primitive, and this in fact is a consequence of the existence of duality or polarity at the most fundamental physical level. "Self" - organization can only occur in systems that are already sufficiently complex to have the potential for the organizing process to occur.

In my opinion, these principles exemplify the Logic of Transdisciplinarity and point toward the need to consider its implications in the understanding of the evolution of real complex systems. In particular, in my view, it is the above systems view that insures the foundations in reality of the recursive aspects of complex processes described as loops or circuits (cf. Hofstadter [16] and Morin [17].)[1]

Von Bertalanffy stated that the development of GST could lead to the unification of science, a science of the future that could play a role similar to Aristotelian logic in the science of antiquity. At a Symposium on Lupasco in 2010 [18], I showed that his extension of logic to encompass reality effected a metalogical rejunction, restoring logic to its original role, in antiquity, of a science of nature. A major conclusion of this study is thus that the logical approach of Lupasco might provide a unique framework for accomplishing the task that von Bertalanffy set for his General Systems Theory. Logic, in the extended Lupasco sense, could be an integral part of what is now called Systems Thinking (see below Section 4.4).

1.4.2 Systems Science and Complex Systems in Morin

Edgar Morin has given his own, highly personal and humanistic readings of systems theory since its codification by von Bertalanffy. He has developed

[1] David Pouvreau has studied the importance given by von Bertalanffy to mathematics in the GST. In my view, although standard mathematics is necessary, it is not sufficient to capture all of the non-Boolean, non-Markovian aspects of systems. This is where the Lupasco approach may be useful. However, to make a satisfactory comparison, a mathematization remains to be made, in more familiar terms, of Lupasco's calculus of chains of chains of implications as describing the evolution of real processes.

his own logical framework, dialogic, and showed how it can apply to complex phenomena, leading to his fundamental principle of complexity – the ecology of action – in a new epistemology of complexity (see also Section 4.5 below). The relation between complexity and dialogic is that the latter is one of the principles of the former: 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.

Another expression linking systems and complexity is that "extremely complex systems (are those) where the part is in the whole and the whole is in the part". One is beyond holism and reductionism in a recursive relational circuit in which parts and wholes "explain" one another, neither term being reducible to the other (Morin's "holographic" principle of complexity). Three terms, for example species, individual and society, also can refer to one another in a circuit that itself is the true system: its three terms are at the same time concurrent and antagonistic.

Morin collaborated with Lupasco and Nicolescu, in the foundation of the International Center for Transdisciplinary Research in 1984, and it was primarily Nicolescu, after Lupasco's death in 1988, who made the major effort to develop the critical notions of theoretical transdisciplinarity.

Unfortunately, neither Nicolescu nor Morin has reviewed the notions of Lupasco summarized above of a general dynamics of the origin of systems. Systems science developed after General Systems Theory from the interaction of standard information theory and cybernetics. One definition of *systems* science is therefore the following[2]: "A new discipline that combines theoretical, practical and methodological approaches relative to research topics that are recognized as being too complex to be accessed in a reductionist fashion, and that pose problems of 1) boundaries, internal and external relations, structure and laws or emergent properties characterizing the system as such and 2) modes of observation, representation and model building or simulation of a complex totality."

Systems science thus overlaps complexity science, in that the latter is based on a definition of the complex systems that are the objects of systems science study, albeit from a less computational standpoint. A complex system is loosely defined as constructed by a large number of simple, mutually interacting parts, capable of exchanging stimuli with its environment and of adapting its internal structure as a consequence of such interaction. The non-linear interactions involved can give rise to coherent, emergent complex behavior with a rich structure. Key concepts in complexity science are, for example, the coexistence of diversity and stability, for which LIR provides an interpretation. Complexity science also looks at the dynamics of systems in transition regions of self-organized criticality. Schematic systems are used to investigate self-organization, but without the grounding in dynamic opposition and potentiality that I have proposed as necessary to explain the functioning of such

[2]French Association of the Science of Cybernetic, Cognitive and Technical Systems (AFSCET), 1994.

organization, as well as the ambiguity in the term 'self'.

As stated at a Congress in 2005[3], the major objective of systems science today is to provide a consensual, transdisciplinary approach to the increasingly complex problems faced by workers in all areas of society, with the laudable intention of 'placing man at the center of its preoccupations'. Models and strategies are designed to develop effective operational tools as well as conceptual and philosophical ones.

Systems science includes aspects of such a diversity of sciences and disciplines that makes it difficult to capture in a few words. One example is the science of ago-antagonist systems (SAAS), developed by Bernard-Weil, which bears a superficial resemblance to Lupasco's principles. SAAS purports to identify and take into account, in concrete systems, pairs of elements that are both conflicting and cooperative, either at the same time or alternatively. This theory, like many others in systems science, has practical applications as a step in understanding the role of pairs of antagonists in living cells, the human body, business enterprises, etc. As I have shown, however [6], it is necessary to specify more completely what is meant by 'at the same time' or 'alternatively' and to look for the origins of both conflict and cooperation in the potentialities of the systems' elements.

1.4.3 Systems and Emergence

By taking a minor step back from the debates about systems, emergence and complexity, it becomes fairly obvious that they are not independent concepts but that their usual definitions are closely entangled, not to say circular. Another major problem is that much of systems science and complexity theory is cast in epistemological terms, referring to more or less abstract observers and models.

As one example of such an approach to systems and emergence, I cite the work of Minati, Penna and Pessa [19]. These authors do show that the usual picture of systems is too limited to deal with logically open systems, in which the internal state of a system, as well as its environment, need to be taken into account. The major strategy of Minati is to establish a principled role for the observer that defines epistemological levels of logical openness.

However, for many complex phenomena whose description and overall dynamics have not been captured by current theories, such as information, change, intentionality, etc., an account in which the observer has an epistemological role needs to be supplemented by an ontological non-conceptual account in which the rules governing the real interactions between entities, including the observer, are also applied. In LIR, the observer is in an *ontologically prior* dynamic relation with the observed of which he is a part. One such relation is that between the scientist and his experimental configuration. In the view of LIR, real-world processes are emergent not, or not only in an epistemological but also in an ontological sense.

[3]6th European Systems Science Congress, Paris, September 19 – 22, 2005.

1.4.4 Transdisciplinarity and Systems Thinking

Systems Thinking, like phenomenological transdisciplinarity, has been defined primarily as an approach to problem solving: it views problems as features of an overall system which are best understood in the context of relationships with each other and with other systems, rather than in isolation. In principle, Systems Thinking techniques may be used to study any kind of system - natural, scientific, engineered, human or conceptual. The difference and advantages of Systems Thinking *vs.* traditional forms of standard analysis are clear.

In practice, two things are missing that are necessary, in my opinion, to give Systems Thinking the necessary depth: one is an adequately grounded definition of a system in the first place, in which contradictorial interactions are present constitutively. I suggest that this has in fact been provided by the Lupasco systemology. The second is a proper conception of how the *qualitative* properties of systems may be expressed.

In her 2005 paper, Debora Hammond [20] summarizes developments of Systems Thinking since the establishment of its categories of application – technology, science and philosophy – by von Bertalanffy. We can all agree today with his conception of GST that emphasizes a more holistic and humanistic approach to knowledge and practice, while deploring the fact that such an approach has not materialized.

I consider this article a very accurate reflection of the "state-of-art" of Systems Thinking. Starting with von Bertalanffy, the author points to many significant contributions to a systems view, which she defines: "The systems view reinforces a constructivist orientation to knowledge as a dialectical, pluralistic and participatory process that emphasizes the importance of mutual understanding, meaning and values." All of the well-known difficulties in achieving such goals are indicated, the fragmentation of knowledge, the use of systems thinking for social control and that indeed "we have yet to discover the appropriate approach to systems". I of course consider the Lupasco grounding of systems in the inherent physical antagonisms of matter-energy, formulated in 1962 [13] as one such approach.

On the other hand, the approach of one of the most influential systems thinkers, Peter Senge [21], amounts to not much more than an exhortation to look at the "whole", at an organization as a holistic, dynamic process and to balance short-term and longer-term cost-benefit parameters. This is fine as far as it goes, but no one can say today that it goes far enough.

Hammond's statement of objective merits repetition here: "Perhaps the primary challenge for systems thinkers in the 21st Century is to find ways of integrating the insights emerging out of the various branches of systems thinking over the past fifty or sixty years." She proposes that it will be some form of new thinking emerging from the *new informational paradigm* that will suggest new ways of accomplishing this integration, despite the difficult defragmentation of knowledge that must take place. I consider this an excellent expression of one of the tasks facing transdisciplinarity.

Azad Madni has stated that what distinguishes transdisciplinary system science-oriented thinking from traditional approaches is that transdisciplinary thinking emphasizes lateral or associative thinking [22], often relying on metaphors and analogies to enhance problem understanding. In particular, transdisciplinary approaches employ integrative (or synthetic) problem solving as opposed to analytic problem solving typically employed by reductionist approaches. He compares and contrasts analytic and synthetic problem solving that underlie traditional (reductionist) and transdisciplinary (holistic) approaches. In the view developed here, these considerations are necessary but not sufficient. If the language used is of an opposition only with separation, it can lead only to persistence of a philosophy of separation. The reciprocity of reductionism and holism was noted early by Hofstadter [16], but it failed to yield useful further results in the absence of a framework for comprehending their interactive dynamics.

System Dynamics

System dynamics is an approach to understanding the behavior of complex systems over time. It deals with internal feedback loops and time delays that affect the behavior of the entire system. While the approach is in principle applicable to ecosystems and political systems, in fact it can only be used for the most mechanical, quantitative features of such systems, capable of being modeled in causal loop diagrams. Accordingly, system dynamics adds nothing fundamental to the understanding of information or other complex phenomena as such.

With hindsight, the notion of applying systems theory to the solution of practical problems, for example, those of organizations, is neither more nor less than common sense. The unfortunate state of the world, however, is a demonstration that such solutions have been limited in scope. As a systems scientist, in his major book on the relation of systems, semiotics and information, Sören Brier [23], clearly shows the limitations of a systems theory such as that of Niklas Luhmann, in which the subject is lost in functionalism that is not adequately grounded in an external reality and a proper philosophical framework.

1.4.5 Complexity

It is often suggested that notions of complexity provide substantial additional insight into the nature of systems and real processes. On closer inspection, it turns out to be easy to show that current relatively rigorous notions of complexity are all tied back to computer science, specifically, algorithmic information theory, as in the Kolmogorov complexity of an informational object. I believe, however, that none of the existing approaches based on systems or standard computational notions of complexity are adequate to define the unique ontological status of information.

While the lack of formalism in the complex systems approach serves to differentiate it from strictly computational ones, the lack of foundations diminishes the value of its humanistic and ethical characteristics. The only complex systems studied in detail seem to be those simple enough to be computationally tractable. If the essence of complexity is *non*-computability, then the right of such systems to be called complex is open to question.

From the LIR standpoint, the Morin notion of complexity suffers from being, like the views of systems outlined above, not sufficiently complex! In our view, the lack of grounding of all of the systems approaches or "ways of thinking" has blocked its further as a way of gaining further insights into nature. Thus the "systems thinking" in this case assumes *ab origine* a mathematical structure of reality which it may not have, or have only in the case of simple processes that take place "spontaneously", that is are highly linear.

Morin's system of logic, dialogic, which is often referred to in systems theory bears some relation to that of Lupasco, with whom as noted he had been associated. To repeat, Morin [17] defines a "dialogical principle that allows us to maintain duality at the heart of unity. It associates two terms that are at the same time complementary and antagonistic." However, neither this principle nor the basis for its operation is grounded in physics. The Lupasco Principle of Dynamic Opposition describes not the abstract elements or concepts of complexity, philosophical, political, *etc.*, but the instantiation of the complex elements in reality.

My tentative conclusion is, therefore, that Systems Thinking, even enhanced by this concept of complexity, neither further defines information or how it can be both a constituent of reality and a display or representation of reality. We will therefore look more closely at the concept of information as a domain to which the application of a transdisciplinary approach may be fruitful, and which may in turn inform concepts of transdisciplinarity.

Simplexity

Although this overview cannot mention all current work that tends to confirm the relevance of Lupasco's vision to transdisciplinarity, I should mention briefly that of Alain Berthoz [24]. Berthoz was driven to the concept of what he calls simplex systems by observation of the way in which neural processes operate cooperatively, integrating spatial and temporal elements. The body finds simplex solutions to problems that more rapid and efficient by "detours" through (configuration) spaces of higher complexity. Berthoz insists on the modularity of the simplex responses at the level of body and mind, as a way of simplifying the necessary neurocomputations.

Berthoz feels it necessary to "oppose" the concepts of simplexity and complexity, but this should not detract from the significance and utility of either. The preferred methodology would be to relate complexity to simplexity, dialectically, as situations in which simplexity can emerge from complexity and *vice versa*. This is, of course, where concepts from the Logic of Transdisciplinarity

are useful in the discussion of the dynamics of the changes involved. Nicolescu has shown [1] that there are degrees of transdisciplinarity. Thus, to the extent that simplexity instantiates a higher level of reality than complexity, one may say that it is "more' transdisciplinary.

Berthoz concludes with a *credo* that I feel can be useful for anyone convinced of the importance of transdisciplinary thinking (my translation): "Simplexity is a way of living with one's world. It is elegance rather than sobriety, intelligence rather than cold logic, subtlety rather than rigor, diplomacy rather than authority ... It is adaptive rather than normative or prescriptive, probabilistic rather than deterministic". These ideas are of course related to prior work by Sartre, Merleau-Ponty and Morin, as well as Nicolescu, but using, that is taking the best parts of complementary views is itself a form of simplexity.

1.5 An Informational Paradigm

1.5.1 Transdisciplinarity and Information

By any definition, the domain of information, consisting of information theory, science and technology is clearly transdisciplinary. The disciplines involved include (at least) philosophy, epistemology, mathematics, logic, psychology, electronics, computer science, electronics and the social, political and economic sciences. This being so, the difficulty of trying to capture information within a single definition or category is understandable.

In the view which I have expressed, [25], information is best viewed as a conjunction of the energetic processes involved in the transmission and reception of meaning and that meaning, such that information cannot be separated from the underlying physical processes of its generation. If this hierarchical picture is partially correct, however, information is constitutive of the disciplines but not reducible to them, since it is present in all human activities, creative, emotional and so on. We may thus say that information is something that lies within, between and beyond all disciplines, a phrase that exactly parallels the Nicolescu definition of transdisciplinarity.

The first corollary of this position, following my thesis as expressed in the Introduction (1.2), is that the logic of information and the methodology of understanding its operation might be something like those of transdisciplinarity; in particular, the logic of the included third or Logic in Reality (LIR) should be applicable. Applicable here means permitting stable inferences about the evolution of the concepts, processes and events under consideration, provided they are sufficiently complex for their elements to be in some dynamic, interactive relation.

1.5.2 What is Missing from Theories of Information?

There is general agreement that information is a complex but perhaps unifying concept that nevertheless comes in a wide variety of forms. One version of the problem is that information clearly has an energetic substrate that can in part be quantified (bits), but it has proven difficult to explain its being somehow associated with a qualitative, higher level of meaning dependent on its interpretation by a receiver, human or other. The current set of assumptions about its nature, still based largely on computational extensions of Claude Shannon's original ideas, is sufficient to explicate its minimal physical characteristics but insufficient to define its representational character or its functional, qualitative and normative value.

Terrence Deacon has proposed a new approach to information as a process instantiating a complex dynamics that starts with thermodynamics and continues throughout higher ontological levels of form (morphodynamics) and intentionality (teleodynamics). In his *Incomplete Nature* [26], Deacon extends a thermodynamic concept of energy derived from statistical mechanics to yield a description of complex processes in which *absence* plays a critical role in the emergence of living systems, mind and information. Deacon shows how an *interactive* operation of both Shannon entropy and Boltzmann entropy must be taken into account in information. (The title of this Sub-Section is that of another important paper by Deacon [27].)

Deacon shows that the hallmark of information processes is its absent content, a resultant function of their necessary physicality, and LIR shows that presence (actuality) and absence (potentiality) in such processes must be related dynamically. While the importance of a concept of absence for information was indicated by Marijuan and others some ten years ago, it is Deacon's detailed current development that now calls for our attention.

Due to its own rigorous ascent from the properties of matter-energy as first described by Lupasco, Logic in Reality provides a reconciliation of the logic of physical science and the logic of living and mental teleology and can link energy, form and information, using potentialities to achieve teleological properties from unambiguously non-teleological starting points. Despite the prestige of Norbert Wiener and John Wheeler, it is becoming clear that their – related - statements to the effect that energy is not information and that information is primitive to matter-energy ("it from bit") have been profoundly misleading.

The relation of modes of information to meaning, Deacon's approach to dynamics and Logic in Reality (LIR) accomplish several objectives: first of all, they ground and extend a concept of the relativity of information, in that information is not only not an invariant quantity, but a process or set of processes of processes. In this concept of information, biological or cognitive meaning is defined by interaction with the context (or environment) that interprets the information.

From the perspective of this Chapter, information or better information-as-process becomes an integral part of a broader transdisciplinary view of both

knowledge and the finality of knowledge. Let us now look more closely at how information can be related to the discussion of systems above.

Information and Communication Technologies (ICTs) and Society: A Transdiscipline

Before leaving the domain of information *per se*, readers of this *Journal* may be interested in 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 [28]. In my opinion, this paper is completely consistent with the functional definition of a transdiscipline in the basic charter of ATLAS [4].

By the term transdiscipline Hofkirchner et al. mean something distinct in two respects: its scientific status and its potential societal function.

a) Scientific Status

As regards the scientific status of the field, the concept of a transdiscipline does not mean a mere combination of existing disciplines but a transgression of the traditional borders of the participating disciplines and thereby their transformation into something new with its own identity insofar as it disposes of its own terminology overarching 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 and the gap between applied research and basic research. It is the result of a process that departs from mono- or multidisciplinarity and transcends interdisciplinarity.

b) Potential Societal Function

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 ICTs-and-Society research to contribute to shaping ICTs so as to help bring about a Global Sustainable Information Society (GSIS). A GSIS can be defined in a normative way and 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.

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.

As I have discussed elsewhere [29], the Logic of Transdisciplinary, as expressed in Logic in Reality, supports this transdisciplinary view in general. 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 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 [30] 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.

1.6 The Philosophy of Information. Informational Thinking

1.6.1 The Reconstruction of Phenomenology

Support for this picture of information, in which what is ultimately the logic of Lupasco plays a central role comes from recently published work in the area of the philosophy of information by Wu Kun [31] 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 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 [32]. Basically, 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, the Logic of Transdisciplinarity, 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, Husserl's bracketing is thus fundamentally flawed as a hermeneutic process.

In place of standard phenomenology, Wu proposes an informational ontol-

ogy 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 [33], *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 [34] 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 the "informosome".

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.

LIR provides a 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 [35]. 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.

1.6.2 Wu's Metaphilosophy of Information and Transdisciplinarity

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 begin to talk about a new, functional metaphilosophy of (a theory of) information. One of the consequences, however, is that 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 lack of separability between the informational and transdisciplinary approaches and their complementarity deserves much further work. For now, I will just say that to me the spirit of both forms of thought is similar, without being or having to be identical.

Let us assume, for clarity in the discussion, that there are higher levels of human thought, in the Heideggerian "clearing". Then theoretical transdisciplinarity, in the view of Nicolescu which I endorse, and which includes his concepts of the transdisciplinary Subject and Object opens out into these higher ontological levels of human thought and existence. I will continue the discussion in this paper, however, at the lower logical level of the evolution of complex real processes, essentially concentrating on their immanent aspects.

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, 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, the doctrine of Wu, unlike that of Husserl, does not have to be "naturalized", that is, brought into the domain of natural science[4]. 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

[4]As noted, the naturalization of Husserlian phenomenology was the subject of the major 1999 study [33]. Wu's approach eliminates the arduous task of finding natural equivalents for Husserl's transcendental intuitions.

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.

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.

1.6.3 Informational Thinking vs. Systems Thinking

Due to the inclusion in Informational Thinking of some of the principles, especially the logic, of transdisciplinarity that are comparable – (they do not have to be "identical") to those of transdisciplinarity – one can "go beyond" the limitations of a systems approach that lacks a comparable grounding. Further inferences, for example, about how best to bridge the gap between natural and social science can be made in informational terms, since inherent to it, *ab origine*, is a theory of ethical value present in informational entities at the lowest to highest levels. As a case study for inclusion in this Chapter, let us look at the advantages which the informational paradigm brings to a number of domains of research as compared with Systems Thinking as outlined above.

Wu Kun made an analysis of the relation between information and systems theory in 2006 [36] in which he called attention to the limitations of the latter, as well as of the related research programs of information science and complexity theory. His comparative study of Information Thinking (IT) vs. Systems Thinking (ST) is outlined below in part. The reader may wish, as an exercise, to judge from this comparison if IT has some of the "flavor" of transdisciplinarity.

- Ontology

  ST: Basically descriptive, a way of looking at the properties of things in an integrated fashion, based on established philosophical foundations.

  IT: Basically constructive, establishing new divisions of the extant domain as a dual-existent dimension of direct and indirect existence, bringing about the integrative and fundamental transformation of philosophy and other disciplines.

- Value

  ST: No internally defined conception of value (no "best" system).

  IT: A natural duality theory of the value of information and matter as nature and emerging from nature. It is similar to but more generally formulated than Floridi's Philosophy of Information [36], as higher cognitive levels are addressed

- Social Development Theory

  ST: Captures much of the complex structure of society.

  IT: Has an interpretive function that integrates informational developments with the essence of human society and its evolution, and from the dimension of information activities, establishing the essence of human society and criteria of its evolution.

- Economic Development Theory

  ST: Has the capability of describing informational activities as economic facts.

  IT: Can constructively relate all aspects of information production and human productivity to an underlying process of creating an informational world.

- Scientific Research. The Transformation of Science and Philosophy

  ST: As indicated, Systems Thinking is a valid way of focusing on and solving problems related to defined complex cognitive entities at biological, cognitive and social levels of reality.

  IT: Informational Thinking is a global approach to understanding the world in as a set of informational terms that extends from fundamental physics and metaphysical concepts (e.g., determinism and indeterminism) through to complex behavior patterns of individuals and groups. Unlike *ST, IT* provides a new informational paradigm for the overall fundamental transformation of both traditional and modern scientific ones. The informational paradigm generated leads to a new scientific system oriented by it, which Wu presented and foretold in 1995, when he described the tendency as an "informational rescientification (or naturalization) of science itself".

As implied above, 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, *ST* and *IT* 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 I 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 of 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. One should realize, only, that standard conceptions of logic, systems and information are *a priori* inadequate for this purpose.

1.6.4 The Informational Stance

Informational Thinking in fact further describes an attitude or 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 [38] is an attitude that requires attention to the informational aspects of complex processes as a methodological necessity that goes beyond the empirical epistemological formulation of van Fraassen [39].

Transdisciplinarity supports a humanistic worldview that is primary, similar to Wu's idea that "we should have a metaphysical picture of the world to discipline scientific methodology, and science and education policy". I note, as originally formulated by Wu, the non-separability of metaphysics, epistemology, value theory and social issues. 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 integrating position with alternating focus. The right integrative property enables 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".

1.6.5 The Consequences for Man and Society

The superiority of thinking centered on information in contrast to thinking centered on systems, Informational Thinking, (in which I include the informational attitude or stance), over Systems Thinking, can be brought out by reference to the development of a coherent ontological conception of one's place in the world[5]. The fundamental shift of philosophy toward a valuation of what one might call *immanent/transcendent realism* was also analyzed by Wu Kun in [31]. As he writes, "the revolutionary significance and value of information has gone beyond all previous theories of traditional philosophy". The term Information Society, where information has been understood primarily in a limited pragmatic sense, may be becoming devoid of meaning as a consequence. Rather, one should perhaps speak of an Information Era as a more historically comprehensive concept.

The justification for Systems Thinking, when well meant, is its orientation toward more effective and just management of a society based on new principles. When not well meant, the finality is limited to more effective operation of existing economic structures. The Philosophy of Information, like Logic in Reality, on the other hand, can contribute to the morally necessary objective of philosophically grounding of a more just society, in which invidious Manichean distinctions, supported by standard logics even in their modern forms, have no place.

It would be naÃŕve to suggest that the arrival of a new informational society with more democracy and individual freedom would mean that antisocial behavior would disappear overnight, even if reference to Informational Thinking and transdisciplinarity became widespread. What I stress here is only the desirability of independence in the new informational society, which means informational independence of human individuals from *institutions* but relative free will involving *interdependence* of human beings.

1.7 Transdisciplinarity, Ethics and the Common Good

The relationship between transdisciplinarity and the common good was very clearly laid out in a recent *ATLAS* paper by Christian Pohl [40]. 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

[5]This is, philosophically, an alternate to a Husserlian phenomenology based on transcendental subjectivity.

search for a unity of knowledge. Rapidly, the Nicolescu conception focuses on d) as well as on how to approach all of these areas.

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".

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 objectives of the research.

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" (see above, Section 2.1) 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. I believe, however, in the area of information, a functional role for the transdisciplinary attitude and transdisciplinary thinking is beginning to take shape.

1.7.1 What has happened to the common good?

There is general agreement that the objective of new science and technology is to promote advances in human civilization, civilized behavior and well-being. 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 by the artifacts of technologies. Unless logic and philosophy address this issue, they will have failed to address the reality of our world. François Flahault is a French philosopher without illusions about the current direction of society. In his

recent book [41], whose title is that of this Sub-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.

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. The role of information and its technology in this respect has been clearly outlined by Rafael Capurro [42]

1.8 Conclusion

In this Chapter, the theory of transdisciplinarity as defined by Nicolescu, consisting of its three ontological 'pillars' and the three axioms of its methodology, has been outlined. Three relevant and closely related logics, the original logic of the included third of Lupasco, the Nicolescu Logic of Transdisciplinarity and my Logic in Reality are compared. In particular, the principles of the Logic of Transdisciplinarity are shown to be essential to the understanding of problems in the areas of systems and information.

Transdisciplinarity is not a paradigm in the sense that a paradigm is a limiting concept. However, it can be related to recent developments, for example by Wu in the philosophy of information that have been shown to 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 informational paradigm. In particular, the concept of Informational Thinking has been shown to be more potentially valuable to the extent it incorporates a view of systems that fits Lupasco's dynamic logical conception of the origin of systems in the antagonistic dualities of physics and metaphysics. Informational Thinking, like transdisciplinarity in the acceptation of Nicolescu, defines a stance or 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. This informational paradigm is a transdisciplinary one in that it seeks, like transdisciplinarity in general, what lies in, between and beyond the different conceptions of information.

I share the conviction, expressed by Pohl and others, that the transdisciplinary approach, embodying the Logic of Transdisciplinarity, does not only have enhanced potential for problem-solving, but also direct implications for insuring that the "problem-solving" is done for the common good. 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. In summary, the inclusion of transdisciplinary and informational perspectives in scientific or philosophical work is not simply an intellectual exercise but a social and moral imperative.

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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 and Wu Kun who have encouraged the application of the Lupasco system 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 the convergence of these two lines of thought.

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Dr. Joseph E. Brenner was born in Paris in 1934. In 1958, he earned a Ph.D. in Organic Chemistry from the University of Wisconsin, After a career in the chemical industry (Du Pont de Nemours International) in R&D and corporate development, he began collaboration with the International Center for Transdisciplinary Research (CIRET) in Paris, working with its President-Founder, Basarab Nicolescu. His major objective has been to make the logical system of the Franco-Romanian thinker Stéphane Lupasco (Bucharest, 1900 – Paris, 1988), a co-founder of CIRET, accessible to English-language readers. Key publications are his 2008 book, Logic in Reality, Springer, Dordrecht, and recent papers on applications of this logic to information and the philosophy of information. He was involved in the 2010 inception of the International Society for Information Studies, Vienna, Austria, of which he is the Vice-President for Inter- and Transdisciplinarity. Also in 2010 he was named an Associate Director of the International Center for the Philosophy of Information in Xi'An, China. 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.

CHAPTER 2

Perceptive Levels in Plants: A Transdisciplinary Challenge in Living Organism's Plasticity

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Is a minimal 'cognitive' perception of the world by lower organisms possible? The aim of this Chapter is to evaluate the ability of plant kingdom to treat information without nervous system. On the basis of experimental results on plant bioelectrical potentials and on the analysis of extended cognitive levels defined in the emergent plant neurobiology paradigm, these organisms are considered: (1) as possessing dynamic integrated perceptive systems close to those of animals, (2) as self-organized entities with protoneural abilities and (3) as expressing primitive generic processes which have nonlinearly conducted to complex brain networks. This approach permits a new bottom-up investigation of plastic interfaces, particularly at the level of perceptive and knowledge accumulating systems. Providing the great value of early sensory processing in plants is accepted, the only way to progress would be to read the emergent behaviors of complex informational systems co-creating the world through a transdisciplinary framework.

Keywords*:* Plasticity, Protoneural networks, Sensory biology, Nonlinear dynamic systems, Transdisciplinarity, Information levels, Cognitive processes, Plastic interfaces, Plant behavior.

2.1 Introduction

The question of a common evolutionary tree before the divergence of plants and animals today arose, as shown by the discoveries of a lot of plants' functional receptors or enzymes with fully conserved amino acid sequences or transmem-

brane domains analogous to animal receptor proteins [1]. In the same manner, as recently clarified by Professor Balŭska, many data show that such neurotransmitters homolog, long-distance electrical signals, phenotypic plasticity, memory of developmental stages, coordinated hormonal transport through specialized tissues as well as rapid motility, insect-plant communication or social behaviors are preponderant in plants [2]. Our early work on Kalanchoë's extracellular potential variations (Debono & Bouteau, 1992) has shown that spontaneous electrical activities as well as responses to stimuli occur widely in plant tissues, being correlated with classical action potentials or resulting macroscopic currents sustained by plant receptor-channels and organic activities like those of root apical systems or Auxin transport [3]. Our hypothesis was that these network activities could, in analogy with animal whole organ bioelectrical activities, represent the by-product or the algebraic summation of derived activities of a great population of plant cell tissues. Several other kind of biopotentials are described in plants like Mac Kinnon's surface local electrostatic fields, electrosensory activities during thunderstorms (Goldworthy et al.) [4], endogenous fields and cellular dipoles during tip growth of root hairs or pollen tubes (Weisenseel et al. or Cooke & Racusen) [5], localized calcium influx mediated by electrophoretic or cytoskeletal mechanisms for Very [6], induction of stomatal closing by hormonal mediation described by Davies [7] or finally morphogenetic activities implying transcellular fields and biophysical or gravitational forces described by Nuticelli [8].

All these mechanisms of action could be directly or indirectly related to the microvolted spontaneous variations that we have recorded at the level of polarized groups of cells or tissues [3]. However, the precise functional role of these 'surface potentials' in the plant relation life remains to be found since they have not really been studied until today. Their physiological confirmation, correlated to other fine regulatory bioelectric mechanisms, would imply a minimal centralization and diffusion of the information without highly integrated structures like heart or brains. Historically, when I detected these field potentials in the 70s, I was totally isolated. Doing the bibliography on the subject, I discovered that two contemporaneous studies made in Russia (Paszeusky & al. 1961) and especially in the USA (Karlsson 1972, Pickard, 1973) independently found the same bioelectric potentials [9-11]. Then, the subject was progressively given up. It means: 1/ that they are still not directly linked to a clear physiological process; 2- that if signal transmission is well understood at the level of electrical or chemical coupling between cells by botanists, that of global behavior of plants - even finally becoming nowadays a preoccupation for a majority of scientists considering the great potential of plants in the ecosystem - is still either underestimated or not considered as a priority. Sensibility exists, plasticity exists, communication also clearly exists at plant level. So what? Plants are not animals, don't move quickly and don't communicate with us. We have then two solutions: to wait science advances or to treat the problem with a transdisciplinary point of view, which is one of the purposes of this paper.

Indeed, neglected during a long time, these hypotheses are now audible by biologists. It is the consequence of two main discoveries. Firstly, advanced works emerged from the XVI international botanical congress of St Louis MO (USA, 1999) showing five main trunks of complex "nucleated" organisms, from which four are classified as plants and the confirmation of the plants' synthesis and use of neuroactive chemicals typically known to mediate fast excitatory synaptic transmission in the central nervous system of vertebrates [1] were strong arguments in favor of the hypothesis that a primitive signaling mechanism existed before the divergence of plants and animals (Baum et al., 1996; Chiu et al., 1999) [12, 13]. Plant genomic complexity discovered during the same time was also intriguing.

Secondly, the new assertion of plant prototypic intelligence initiated by Trewavas in 2003, even controversial, had a lot of impact in the scientific world, and, interestingly, in distant disciplines from plant biology like behavioral, cognitive and social sciences, ecology, semiotics, autopoiesis or information theory [14]. Indeed, the semiotics of the term 'intelligence' (used to describe the sensitivity and the complexity of plant signal transduction as well as their ability to learn, memorize, communicate and compute responses at the whole plant level) was clearly redefined or resituated, and for the first time applied to the complexity of plant signaling and communication. It was the same for the term 'cognition' to there almost exclusively used for mental act processes implying knowledge processes, whereas decentralized or extended cognition take into account cellular computing, dynamic emergent properties from complex systems and more precisely "plant qua information-processing systems" as well as "plant-coupled-with-its-environment" levels (Garzon, 2007). This recent paper is in a instructive way titled "The quest for cognition in plant neurobiology" [15]. Another from Barlow describes the auropoietic and cognitive functions of plant roots [16].

All together, these discoveries and the recent recognition of the concept of network information in plants resulted in the development of a new paradigm called 'plant neurobiology' by Balŭska et al. (2006, 2007) clearly involving a transdisciplinary field of research in this area [2, 17]. These authors clearly say concerning this subject: "Neuronal informational systems allow the most rapid and efficient adaptive responses. Therefore, it should not be surprising that neuronal computation is not limited to animal brains but is used also by bacteria and plants". Balŭska and Mancuso conclude, one year after the publication of the plant neurobiology paradigm as an integrated view of plant signaling, that plants act, as any living and evolving system, as 'knowledge accumulating systems [18]. that plants act, as any living and evolving system, as 'knowledge accumulating systems'. Our aim is therefore here to show how the proximity of both plant and animal integrated biosystems: (1) conduct to common protoneural dynamic behaviors including complex sensory perception and communication (Debono, 2013), (2) is closely linked to information theory and the development of different adaptive and cognitive systems during evolution and (3) implies a transdisciplinary reading grid opening to nonlinear

dynamic analysis of biological and cognitive processes [19].

2.2 Common Sensory and Protoneural Dynamic Networks in Plants and Animals

2.2.1 Bioelectricity as Universal Signaling Pathway used by Biological Systems

At the beginning of the 20th century, Sir Jagadish Chandra Bose, that created the first scientific research Centre in Calcutta realized before Marconi pioneering works about electromagnetic waves. He also studied plant physiology, being interested in the growth of plants and their reactions to stimuli. He was the first to describe the neuroïd properties of *Mimosa pudica*, a plant endowed with a fast motricity visible to the naked eye, about which we know since the Riccas' work (1916) that it is closely linked to a circulating hormone [20], and more precisely to parenchymatous excitable cells propagating action potentials before cell deturgescence and the motor phenomenon itself (Stoëckel, 1976, Desbiez, 1985) [21].

During the 1970s, best selling authors C. Bird and P. Tompkins, a journalist, as well as an US military intelligence officer cast confusion with their pseudoscientific assertions of "telepathic recordings between plants and humans" obtained with the Cleve Backster's lie detector [22]. It caused considerable damage to this research area until now, stopping any serious research in the area of 'surface potentials' and more generally to the comparison of bioelectrical properties of both plant and animal cells. Happily, these times are over. All the biological data obtained since these period, concerning as well field potentials as endocellular events recorded by patch-clamp technics [23] clearly show that electrical activity is a general property of excitable cells, and is not restricted to nerve structures. Moreover, it is an evidence to assert that neurons used electricity long after plants. Wildon, Thain et al. (1992) have published data in *Nature* explicitly showing for the first time with molecular biology a direct link between the emission of propagated electrical signals produced by a tomato plant after a wounding (an insect playing naturally a natural role of mechanical stimulator) and the induction of a biochemical response (protein synthesis of a trypsin inhibitor) [24]. The authors conclude in another review (1996) and almost exactly two centuries after Burdon-Sandersons' discovery of electrical signaling in plants, that "*it is now clear that a wide range of plant species can generate action potentials in response to electrical or other stimuli, and that these action potentials can propagate through the plants' tissues*" [25].

As we stated in the introduction, many other mechanisms of action underlying tropisms, high sensitivity to any kind of stimuli, "self recognition or adaptive behaviors", fast motor reactivity or insect-plant very fine interactions are described more and more precisely every day, asking more acutely the question of a convergent evolution between plant and animal species not

contradictory with the divergence of the two reigns. In other words, if evolution has finalized electrical signaling in neural structures, conferring great advantages to animal and human brains in terms of speed and precision of the information flux, it seems likely that elementary cell properties as well as elaborated communicative strategies are common to both living systems. Indeed, electrophysiological data clearly show that the main difference between plant and animal cells is the time duration of events, plants being in the same range as cardiac cells (hundreds of milliseconds) of animals, compared to fast synaptic transmission of brain neurons during one millisecond (Figure 1). So, the first question that arises, related to complexity and evolution is how and why organisms lacking high integrative functions or specialized structures like brain cortex or central nuclei have developed such complex behavior? (Debono, 2004).

2.2.2 Complexity, Evolutionary Processes and Nonlinear Dynamics

As we stated in this Chapter considering the entire perceptive scale, the growth in complexity is not a single exponential [26]. We need to consider that each integrated living systems presents: 1/ a potential degree of reactivity, of communication and of informational level, and 2/ is aware of or as to be considered within its own limits. Cognitive and preconscious states in animals and man would have then to be seriously interrogated in this way. Preceding the classical definition of immediate or minimal consciousness in lower animals, protoneural systems could have started the complexity process by permitting the conditions of emergence of the access to experience. These states probably include and memorize the preceding ones. They may also correspond to independent evolutionary steps served by identical functions at plant and animal levels. Indeed, many examples suggest a common evolutionary tree before the divergence of plants and animals. For instance, markers like ubiquitous proteins or hormones have a common pathway before being expressed in many species including animals and plants. Roth et al. (1986) show that "the breakdown of the barriers for the hormonal molecules between the vertebrates and the rest of the metazoans, between metazoans and unicellular organisms, between the eukaryotes and prokaryotes, or the eubacteria and archebacteria is concordant with findings in multiple other systems" [27]. The case of hemoglobins present from bacteria to man, of photosynthetic proteins of plants having their homologues in bacteria, of many common receptor gene superfamily or of heat shock proteins of eukaryotes and prokaryotes are also extensively studied today.

A review made by Kohorn in 1999 addresses various signaling paradigms across kingdoms as constituting a new approach "in which characteristic proteins are used in a variety of ways and combinations to transduce a signal". Potential ligands activated by specific enzymes regulating cell division in the plant meristem are then described, concluding that this discovery "appears to

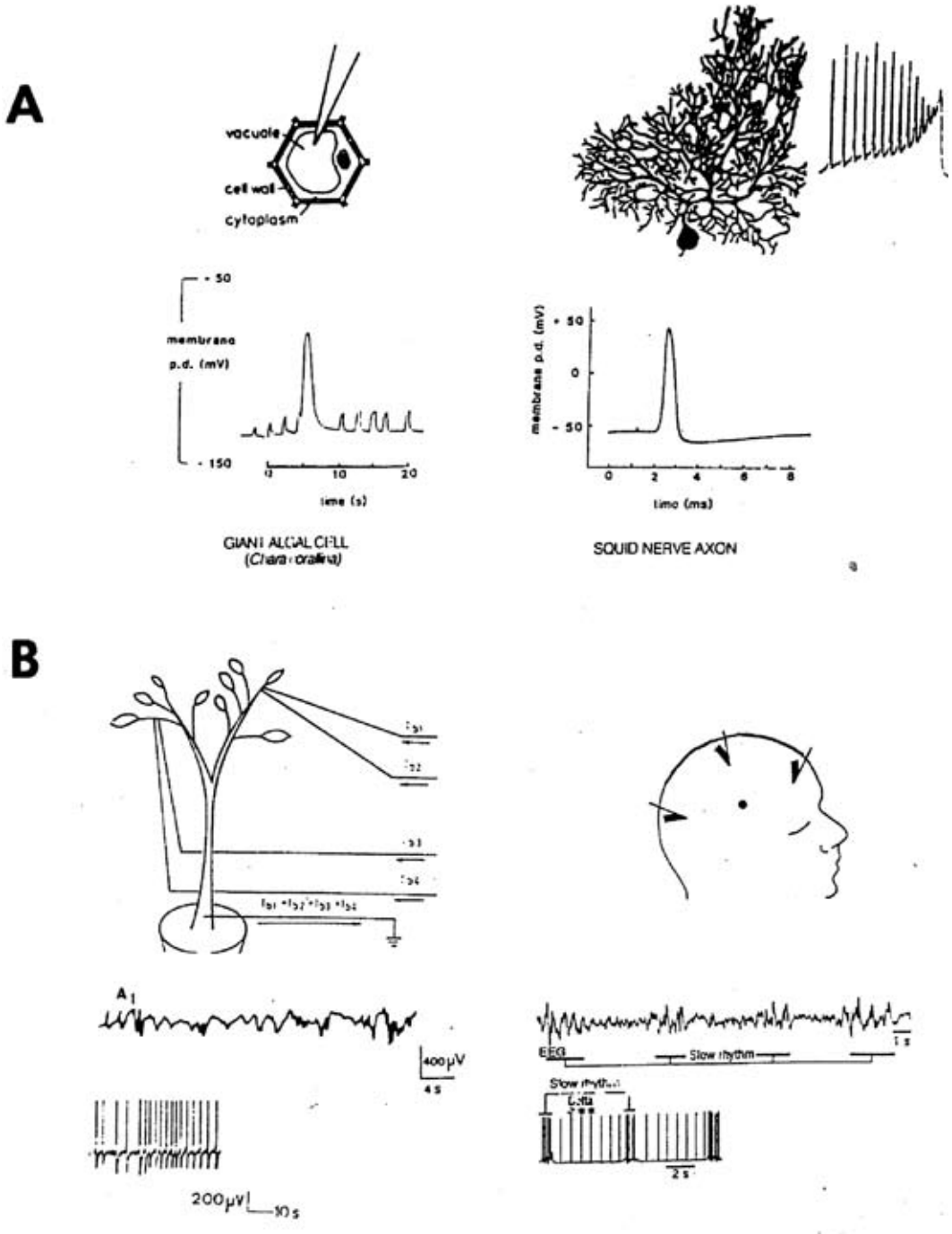

Figure 2.1: BIOELECTRICITY AT LIVING SYSTEMS. A: Endocellular recordings in a giant algal cell (left) and in a squid nerve axon (right). Note the delta observed on the timescale. B: Extracellular recordings (slow waves and spikes in response to chemical stimulation) at the whole plant level compared to brain EEG. This comparison is purely analogical and must be interpreted within our plastic reading grid (brain synchronized activities being related to highly specialized structures compared to plant sensitive organs). The new emerging transdisciplinary field called 'Plant Neurobiology' is now trying to discover whole integrated sensory, communicative and adaptive mechanisms underlying such activities.

shuffle" the paradigms used for cell communication in unicellular and complex organisms [28]. Signaling is also used like in animals for plant embryogenesis where positional information has a major role for sporofitic cycle and embryonic axis (Harada, 1999) [29] or for defense signaling pathways where apoptotic cells and conserved disease resistance genes may be related to functions in animals (Pifanelli et al., 1999) [30]. Finally, as previously evoked, recent discoveries of plants' use of calcium binding proteins and of glutamate receptor channels typically found in animals are a strong argument in favor of the hypothesis that a primitive signaling mechanism existed before the divergence of plants and animals (Lam et al., 1998). This discovery explains also probably why neuroactive drugs synthesized by plants are able to work at neuronal level, and may act as endogenous ligands regulating cell to cell signaling in higher plants [31].

Another important point concerns, as quoted in the introduction, recent phylogenic studies showing: 1/ that there are five main trunks of complex "nucleated " organisms, from which four are classified as plants and 2/ that animal and plant kingdom are categories no longer relevant. Thus, many authors dare say now: 1/ that plant cells could act like 'nerves' and 2/ that a common unicellular ancestor before the divergence of species is confirmed. These discoveries can be interpreted as a prerequisite for the emergence of complex differentiated systems. They strongly comfort our experimental data describing the common bioelectrical profiles of animals and plants. This major kingdom has thus for us a precise message for further species. This message can be translated as follows: our evolved treatment of the information is the result of a series of primitive generic processes which have progressively and non-linearly conducted to perception, immediate consciousness, and far away to the self-conscious mind.

2.2.3 How Plants Treat the Environmental Signals?

Among these primitive processes, biosensors like plants - lacking brain - could have progressively developed some level of integration or global states of receptivity without any representation or conscious activity. That would constitute a good reflect of the dynamic protoneural ability of the plant kingdom to react to the environment with adequacy, using sensing effectors to translate information into function. The original etymology of the term neuron indicates a biological matter of fibrous nature. It fits well with the emergent plant neurobiology paradigm taking as framework the whole integrated ability of plant signaling, including complex behaviors. Indeed, following the algorithmic information theory, there is a positive relation between complexity and the amount of information required to describe a system (Maze, 1999). This relation involves the emergence of new properties and of time-related irreversible changes. The direction of these changes is determined by the historical boundaries of the system which is considered as a whole rather than its parts [32].

As both parameters are related to emergence increase, there is a concomi-

tant flow of energy and information in plants. However, the biologic differentiation between animal and plant species does not always mean complexification, inasmuch several authors like Miller et al. (2001) described very sophisticated organic functions in plants or in co-evolving species [33]. Indeed, the complexity process is not an absolute criterion because the thresholds reached by both species are high but differentially expressed. As a classical example, plant cell compartmentalization (several membranes) shows a more complex profile than animal cells but their evolution or "behavior" is clearly different in terms of complexification (organs, brain development, etc.). For these reasons, plants have probably developed several strategies of communication without possessing nervous system. These Darwinian or biosystemic strategies are basically linked to high sensitivity and adequate responses to environmental or endogenous signals influencing growth, morphogenesis and behavior, but concern also memory or stock and recall of information. They could involve spontaneous and preponderant electric fields that were used in the fusion and orientation process of membrane cells and vesicles (Zimmerman, 1982) [34], and then by whole plants, far before fast neuronal transmission use them with a great efficacy (Turrigiano, 1999) [35]. These fields are clearly due, as in animal cells, to the electrochemical conduction of excitation through specialized tissues, including long-distance communication (via the plasmodesmata or due to electrical propagation between adjacent excitable cells) and responses to external stimuli.

Indeed, all these common features about the way from which plants and animals perceive and respond to the environment would explain why the rise in complexity is neither observed as an absolute criterion nor as a single exponential (Debono, 2004). At each bifurcating node, a big evolutionary step is made to reach a new plateau, but common pathways were taken to reach these new states or levels, being memorized in cells and reitered in each genomic species with respect to its descent. With this interpretation, the emergence of consciousness in animals could be a result of the progressive nonlinear integration of previous protoneural generic systems getting faster or more specialized, but above all differentiated. Then, the nature of complexity is probably not uniformly extended to living systems, and following the Morinian concept of 'complexus' (Morin, 2008), we can assume that plants exhibit more quantitative than qualitative complexity compared to animals [36].

So, plants have not only a large common genetic and biological background with animals, but also a large communicative repertory that contributes to biodiversity and adaptation. This panel is very useful to control their environment, their social interactions with neighboring plants or insect (as for instance in bee pollination) or still to prevent themselves from injury or climate changes. They are also able to develop phenotypic plasticity, evolved behaviors and cognitive abilities that were underestimated until a recent date. It is not a proof of intelligence *stricto sensu*, but a proof of high perceptive and informative level. This defines new plastic interfaces and new transdisciplinary pathways to understand cross-species evolution and to explore knowledge and

information theories (see chapters 4 and 5).

2.3 The Bio-dynamics of Plants as an Upstream Model for the Study of what precedes the emergence of Cognitive Systems

2.3.1 Do Primary Centers of Sensory Integration Could Exist at the Plant Level?

It is clear that plants do not have any nervous or conscious system corresponding to classical assertions or definitions of animal or human consciousness. However, as we had made the hypothesis in 1991, their protoneural organization allows them to develop high perceptive capacities. Recent advances in plant biology show many evidence implicating possible primary centers of integration located at foci of interaction of sensible and richly interconnected zones like specialized tissues as phloem or meristem where plasmodesmata ensure excellent intercellular communication (a symplasmic field), at roots and/or at sensorimotor structures [2, 16]. These recent data in plant molecular biology comfort our pioneering work, showing that these integrated states are mainly sustained by proteins, calcium channels or receptor gene superfamily similar to animal neuronal systems at cellular level, and polarized tissues or sensing effectors (like pulvini, traps, stomata or growth cone) translating information into function at the whole plant level (wound responses, reproducing, flowering, interspecies communication).

Several structures could thus be implicated instead of one "central nervous system". Our electrophysiological data particularly suggest that a primary integration of information, whose role is probably to coordinate basic activities, could possibly be reflected by spontaneous potential variations representing at tissue level the mathematical algebraic derivative or summation of intracellular activities sustained by classical receptor channels and/or electrogenic pumps. These field potentials (FP) are assumed to be a sign of "binding activity" or of global dynamic reception reflecting the ability of the plant kingdom to react to the environment with adequacy and sensitivity. FP have then to be studied as pseudo-'EMGs' or 'EEGs' i.e. like nonlinear dynamic systems able to detect transitional states during perception and responses of living organisms (Figure 1). In brain cortical structures, we can easily separate primary regions that treat unimodal signals like visual or auditory inputs and motor function linked to associative structures that treat more complex information like language or visual memory. In plants, neither attention mechanisms nor significance or representation is possible, but does it totally exclude a certain form of sensory integration (maybe present in several loci)? Does this integration is relevant of a basic adaptive or selective mechanism or of more sophisticated mechanisms implying interactive modes of communication?

Analogically, we know for instance that circadian rhythms observed as quiescent or dormancy states represent the slowing down of vital processes in plants. Does an extraterrestrial would qualify that of a simple oscillation, a sleeping state or a biological clock that progressively led to sophisticated aware-sleep cycles including paradoxical dreaming states in vertebrates? More seriously, these types of communication would more likely be interfaced with the environment from which we take part in a cognitive mode. A similar analysis of the auto-organization of living systems can be made about the development of electrical signals in plant and animal cells. It seems clear, on the basis of all the data presented in this Chapter that plants exhibit a well-structured bioelectricity, and that this ability was developed far before that of animals and man. Now, let us consider that in early brain development, gene expression was first controlled by biochemical messengers, and only later, by a selective addition of bioelectrical activity. This activity is considered 1/ to differentiate the brain from other organs and 2/ to be capable of influencing gene expression as posttranslational genomic modification (Turbes, 1993). Neurons then use selective action potentials to "enlarge the range and complexity of the "environment" available to self-organization process" says Turbes, concluding that electric signals which convey messages are used by the brain as information carriers for cyclical computational processes including reference, sensory feedback and inference systems [37]. We can then consider with this point of view that plants have exactly the same self-organization properties, but that they are limited to immediate access to experience and non-reflective activities.

Indeed, plants possess complex signaling paradigms and have a precursor role in the development of further elaborated systems. To enforce this consideration, we can briefly quote precise mechanisms of action at the transmembrane level, including protein-channels complexes and symplasmic fields associated with morphogenesis. Electrical, but also hormonal and hydraulic signals are known to modulate gene expression through transcription and translation via calcium-dependent cytoskeleton-protein-channels (Davies, 1993). Spatiotemporal and intercellular information are treated at specialized structures (Rinne & van der Shoot, 1998) [38]. Beyond voltage-dependent ionic currents from excitable cells (cytosolic calcium waves similar to those of animal cells), many examples of electrocoupling of transporters involving nonlinear oscillations of dynamic systems and providing long-term osmotic regulation are available like in the guard cells of the plasmalemma of certain plants (Gradman et al., 1993, 2001) [39, 40]. Finally, at the whole plant level, many sensitive systems are described from which *Brionnea* is an excellent example of strong and fast thigmoreactivity to touch. Although these citations are not exhaustive, they are intended for neurobiologists and readers misreading the high level of intra- and intercellular communication in plants.

2.3.2 Could Plant be Considered as Biosemantic & 'Embodied-Cognitive' Entities?

> *"The relations that define a system as a unity, and determine the dynamics of interaction and transformations which it may undergo as such a unity..."*
>
> **Maturana & Varela, 1980**

One answer to our question about the potential cognitive precognitive ability of plants is that plants do probably possess a rich receptive field or global dynamic perceptive states (GPS) without any central nervous system. That this field is not comparable to animal or human perceptions is evident, but it is probably a form of non-local integrative capacity conferring advantages during evolution. We have now to classify this perceptive capacity (an outer perceptive one) that could be attributed to this kingdom regarding its communicative mode of life. In animals, the central nervous system is the primary transductor between receptors and adapted responses, whereas in more primitive forms like plants, a protoneural network (i.e. having neuroïd properties without elaborated nervous system) is probably responsible for that, with a lower discriminatory window of reality. As propagated action potentials (APs) are able to modulate the intensity or the frequency of stimuli, showing an adaptive behavior in both kingdoms, we can argue that this common mode of treatment of information is compatible with the observation that decentralized or pure "embodied-cognitive entities" like plants challenge our conception of computation of the information and of non conscious vs. conscious processes. The distinction between autopoietic or operationally-closed systems as stated by Maturana and Varela (1979-1980) [41] and embodied-cognitive structures [42] in term of autonomy and level of information would be important questions to answer, particularly regarding information theory and new theoretical bottom-up scales of perceptive, aconscious and conscious systems.

Indeed, our discovery about spectral-coherent analysis in evaluation of plant functional activity as well as the emergent plant neurobiology paradigm confirms that the key role of electric fields was underestimated at plant level, probably because it was not considered in an epistemic vision of evolutionary processes (Debono, 2004). To my knowledge, it is the first time that plants are supposed, on the basis of bio-electrical data and heuristic arguments, to possess some elementary degree of integrative perception or cognition. But it is probably natural that this assertion is made (or is able to be heard) at the time where consciousness and perception in man are really questioned by science (Searle, 1998). Indeed, the coherent treatment of signs by plants reflect a complex bioelectrical patterns (action potentials, field potentials, etc.) would now be considered as a fundamental area of research to explore the multiple faces of *primitive and global dynamic outer perceptive states* that have probably been used during evolution to elaborate further divergent conscious and *a-conscious* constructions [43].

Soren Brier, editor of *Cybernetics & Human Knowing* and co-founder of

"*The International Association for Biosemiotic Studies*", gives as title to his post-doctorate thesis ≪*Cybersemiotics: why information is not sufficient by itself?*≫ (2006) clearly showing the fundamental rule of biosemantics in the analysis of all autopoÃŕetic and auto-organized systems. Following Pierce and Luhman, he reallocates the information sciences creating a new cybersemiotic field taking into account the auto-organization of closed systems to survive showed by Maturana & Varela, but also the Luhman's generalization of these states to human consciousness and socio-communication and the Pearce triadic semiotics (2012) [44]. Considering the biosemantics of plant life during evolution and their active rule in the ecosystem (cell complexity, protoneural activities, hormonal activities, social behavior, etc.) it would be urgent to reconsider the scale of perception and information of biological systems.

2.3.3 The Phenomenological Point of View: Blind Access to Experience vs. Structured Perceptive & Conscious Activities in Animals and Man

Following the exploration of closure and re-entry of signals in biological systems, the phenomenological experience, as defined by cognitive neuroscience research, is shown by Varela et al. not to be spatially and temporally homogenous, but discontinuous in the brain, showing synchrony in different brain regions whatever the activity of the neurons in these structures [42]. This discontinuity is described to explain global dynamic patterns of synchrony from which emerges consciousness and related to embodied cognition and enactive behavior. It implicates, as noticed by Kurthen et al. (1998) that "a phenomenally unified experience is not necessarily based on neurophysiological homogeneity" [45]. It is the same case for mental imagery where many experiments describe the same sites of activation in brain regions whatever the type of processes activated (perception of stimuli, memory and representation of images). So, why not speculate that GPS in simpler biological organisms lacking brains are still remaining in the desynchronized state, explaining polymorphic bioelectrical activities that we have recorded and several other bioelectrical events at different loci with physiological significance different from tropisms or survival, but not synchronized by evolved mechanisms such as centralized sensorimotor activities or at higher levels by attention giving the alpha rhythm of brain EEG?

GPS, including spontaneous activity and specific responses to stimuli or injury expressed by bursts of miniature APs correlated to classical intracellular APs rather than a centralized nervous activity, would typically reflect protoneural organizations highly sensitive to environmental changes, so literally having some access and experience of the world, but not able to integrate (and even less represent it) the semantics of these changes. This does not exclude intercommunication and some cellular memory (for instance recorded by proteins implicated in stress) or recall of information to be active in the whole organism, but they are limited to the contingency of the specie, never

becoming 'attentively or affectively' related to the world. The recognition of such dynamic 'perceptive states' (several organic structures could be implied) in simpler organisms would be a great advance for the comprehension of plant ecosystem and to apprehend cognition and the access to experience differently.

From Protoneural to Neural Activities: Brain-Mind Interactions

Even speculative, this assumption could help to answer a crucial question today squeezed by the "correlation paradigm" or the evidence of neural correlates of consciousness in man: why physiological processes are accompanied by experience and why experience is accompanied by consciousness? It is now clear that if considered as a protoneural one, the aconscious and silent world of plants could nonlinearly help to answer the interrogations of the neuroscience field about the nature of consciousness. We can then leave now without ambiguity this vegetal world to treat the phenomenon of consciousness as a by-product of brain activity. Recent discoveries in the field of cognitive sciences or neuropsychology show that there is a plurality of conscious and subconscious states. For instance, human visual consciousness may treat asynchronously motion and color attributes whereas a hypothetical binding system is able to link these two systems (Zeki & Bartels, 1998, 1999) [46]. Numerous plastic behaviors of neural circuits reflect a sensorial knowledge and have some biological substrates, but does that explain the feeling of Churchill's dog before his death? Self-reflective consciousness is also not easy to characterize: if awareness and self are often considered as the working definition of consciousness, the notion of self and qualia still remain unclear [47]. For Casler (1976), the concept of consciousness is not a problem from the point of view of behavioral scientists. It is not necessary and may be defined as "the very short-term memory of a just completed perceptual act" [48]. So, this author considers that the real question is not that of brain-mind interaction but that of "the relationships between brain and perception, memory and the mental processes that precede consciousness". We think that it is a right frame of analysis, and that our plant model may serve as an upstream demonstration of it (far before conscious activities). It would also be very useful for a better understanding of evolving systems to take into account protoneural and aconscious systems.

The hypothesis of Mitterauer (1998) suggesting multiple ontological self-organized loci in the brain, and qualia as a self-conscious qualitative experience may serve this view in that more simple organisms logically lack these integrated states [49]. Armstrong (1989) distinguishes three types of consciousness perceptual consciousness which is perceptual activity; minimal consciousness which is "the occurrence of any mental activity whether or not the subject is aware of this activity" and introspective consciousness as "perception-like awareness of the subjects' own current mental states and activities..." including "introspective consciousness of introspective consciousness itself". In this classification, where memory and the self appears only in introspective consciousness, it seems clear that plants would have some perceptual and local

memory abilities, but lack centralized nervous-like systems to integrate these perceptions. As a heavy consequence, the brain would not be a necessary condition to integrate perceptual processes, as currently admitted, but only for higher brain functions [50]?

In other words, brain activity accompanies our perceptions and permits us to make sense, creating a self, which is not the case for computers or for non-cognitive entities that have only access to a basic informational level. *But plants do have strong perceptual experiences without any representation.* Moreover, as shown by Llinas and Paré (1991) to demonstrate the role of thalamocortical loops in binding activities of the brain [51], our working hypothesis also challenges the Jamesian description of the brain where consciousness is considered to be "an exclusive by-product of sensory input", in that the intrinsic activity of cells (like oscillations for neuronal long-range correlations) have a central role to play. Indeed, our findings, together with a great amount of data in plant biology, show that the treatment of stimuli in organisms like plants lacking centralized structures clearly identified, is very sophisticated, and that bioelectrical measurements of macroactivities could highlight the presence of some integrative processes. At brain's level, Aurell (1979) more simply separate an *outer sensory-produced* and an inner conceptual consciousness [52]. As neural assemblies instantiate mental representations in evolved primates or man, why would a large amount of specialized plant tissues not be able to instantiate a perceptual event having sense in their biotope (critical environmental information for their survival)?

Theoretically, a form of perceptual or outer consciousness or perhaps of a restricted "core consciousness" as recently defined by Damasio (1998), i.e. "the transient process that is incessantly generated relative to any object with which an organism interacts", both related to brief short-term memory, have no reason to be excluded. Damasio associates this state "to transient core self and transient sense of knowing automatically generated" in man, and differentiates it from a more complex extended consciousness [53]. Plants are naturally not concerned by this aspect of core consciousness complexification, but it is not useless to recall that plants' "reactivity" existed far before man's self-conscious mind, and that it is too easy to classify this kingdom as blindly receptive or just showing tropistic abilities. We can hypothesize in this way that, as evolutionary steps of the emergence of primary perception and interoceptors were detectable at the brain level in higher organisms, a set of cognitive properties potentially present in lower organisms were not actualized. The same could apply to preconscious processing of sensory inputs existing in the waking and REM-states in man, possibly regulated by thalamocortical loops (Llinas and Ribary, 1993) [54].

However, from our point of view, it is more interesting to show that breaks of some residual brain microstates are able to produce or not conscious macrostates. It means that consciousness might perhaps have some survival value by itself, as proposed by the interactionistic theory of James and Popper, but also, that an intrinsic operational memory of living systems plays a key

role in evolution. A common tree, and probable bifurcations related not only to complexity, but to the specific dynamic content of life processes themselves might therefore be found to exist at this plastic interface.

2.4 Nonlinear Relationships between Perception and Integration: the Level of Information

Another important point, clearly linked to our analysis of evolutionary processes, concerns the central concept of the levels of information interrogated by GPS up to CCS (complex conscious systems). Conscious activity is assumed to create information, so the self-conscious mind is justified, but what about a-conscious entities? Do they create and/or integrate information without meaning and only to survive? Do they respond to stimuli and particularly to wounding without integration of the information of wound or stress? Is the adequacy of their responses, their adaptive morphogenesis, their sensitivity, their states of dormancy or motor activity, their immune, hormonal and social behavior totally blind?

2.4.1 Plants as Sensitive or 'Knowledge' Accumulating Systems

To try to answer to these questions, we can assume that if consciousness is essentially assimilated with experience, a lot of brain processes occur without consciousness. Moreover, if consciousness is synonym of knowledge, we have to define whether adaptive behavior, adequate response to stimuli and to environmental changes are or not a part of the knowledge (Balŭska, 2006)? Another point is that if phenomenal consciousness is different from physical consciousness as proposed by the Gestalt approach, an isomorphic running would be observable, not only for brain events, but also for any sensitive perceptual system. Now, if consciousness "is neither structure nor function" and has a subjective and irreducible content, as described by Chalmers (1996), sensitive and perceptive systems would have a clear justification [55]. Indeed, one can describe a positive feedback between complexity and the amount of information and/or energy required to describe the world of plants. In this way, classifying plants as, knowledge accumulating or outer a-conscious systems seems an adequate way to describe their world.

Let us now examine some other aspects of the information process. A first classical example is the interpretation of conscious states in terms of energy levels where classical quantum sources of information are fundamentally and qualitatively different from macrostructure experiences. We cannot develop these hypotheses further, but according to quantum physics, they are based on long-range coherent quantum phenomena (or quantum wave functions) occurring as non-local communication in a holographic brain, or with special conductivity of some biological structures such as electric dipole fields

or microtubules. However all pure physically descriptions of consciousness are limited to an explanation of why and how some structures might play a key role in a function, but this does not answer to the question of the genesis of the process leading to the elaboration of conscious systems.

Another information treatment process concerns the current comparisons of the brain to computers, which is clearly a reductionist point of view, but is instructive in that the brain is assimilated to a computing function able to display and monitor, for a great part automatically, through the different senses. This 'blind' ability cannot be exclusive of machines and might be quite the same for lower organisms like plants or bacteria, although they have absolutely no capacity to demultiplicate this mechanism using evolved feedback information, volition and awareness construction vectors of the self and the reality. However, plants can move and communicate each other or with insects. Except this inaugural capacity to move common to plants (in a lesser speed) and animals, the previous selection of items represent then a clear evolutionary step, but does not permit us to depreciate the quality of sensory inputs and of information processing by lower organisms. In this way, plants show efficient, harmonious and 'intelligent' relationships with the ecosystem.

2.4.2 Access to Experience without Representation: Sensory Streams of Information

More generally, meaning does not seem to be definable *per se*. What would be the concept of chair without the semantic and representational capacities of it? The chair is included in a creative loop where the man is the creator and the observer. Only, the functional association of an item with a symbolic function, like the creation of life or of a significant world is available. Baars (1993) quotes the global workspace theory suggesting "that conscious experience emerges from a nervous system in which multiple input processors compete for access to a broadcasting capability; the winning processor can disseminate its information globally throughout the brain" [56]. These global workspace architectures (parallel distributed processors) are unconscious but able to account for different levels of consciousness from perceptual to attentive behaviors. Biophysical experiments also show that the link between matter and conscious states is more complex and dynamic compared to the classical Cartesian cut (Rossler and Rossler, 1993) [57]. Artificial interfaces between a biological substrate (the neuronal fluid been assimilated to an internal observer) and the rest of the world produces non-local effects and possible microscopic changes in the perceived world. So, what is valid for nervous system could be also valid for protoneural systems. A crucial point is now to define perception and symbol acquisitions itself behind plant, insect and human filters.

Another more extended paradigm would be to consider the relationships between universal patterns of organizing principles. Indeed, one can suppose that when consciousness exists, it is possibly one face of a state of information

with the other face directly engrammed in the biological substrate, i.e. the somatic expression of a coherent subject. In this way, our concept of metaplasticity would be adequate to describe non conscious systems as different to unconscious and conscious processes involving different levels of knowledge (implicit, explicit and metaknowledge) as recently described in the literature (Feinberg et al., 1995) [58]. The different approaches of artificial intelligence are also very useful to understand the behavior of virtual and real thinking systems, if they do not have as objective to reduce virtuality to reality. Shannon's theory of information thus corroborate two majors ideas of this paper: 1/ the great value of early sensory processing and of global physiological perceptive processes (i.e. not only involving brain treatment of the information); 2/ the evidence of metaplastic levels involving vertical processes that re-express antecedent generic states (Debono, 2008) [59].

The first point recently developed by Buracas & Albright (1999) shows the high temporal precision of sensory streams of all systems possessing sensors and treating changes in the environment [60]. They produce a stream of information that is a product of the ecological niche of the organism. This stream is essentially described for individual neurons of different species, showing the progression of information high rates or abstraction in evolution. Indeed, if we accept that the perceptive capacities of living systems are not linearly related to their integrative ones, the potentiality of protoneural entities like plants to express what precedes consciousness is fundamental to be explored. This paper suggests that the fine comparison of macroscopic electrical fields at the crossroads of the plant and animal kingdoms would be a first mean to understand the common mechanism of perception of both species.

More globally, we must search all *primitive signs of perception at complex systems*. At the human level, we can take the example of the acquisition of the language. For Piaget (1950), the representation of events or objects is a prerequisite for the acquisition of the symbolic function linked to experience [61]. Generative semanticists suggest that the meaning of a word is based on invariant semantic features and that children acquisition of the language begins by perceptual and functional elements. Other theories consider "case prototypicality as a semantic primitive" to participate in the construction of "a non-procedural representation for word meaning" (Yang et al., 1999) [62]. Finally, neuropsychologists like Pinker (1999) suggesting reverse engineering of the mind, or Laplane (1997) observing aphasic patients, also consider that the language only participates to a partially pre-formed thought [63, 64]. A positive explanation for these observations would be that qualia and cognitive tasks admit a parallelism in the horizontal direction, but diverge in the vertical one, explaining thought without language or the cognitive abilities of children preceding their linguistic expression. At the level of living and non-living systems, it would mean that the gap of materiality would always be situated in the horizontal plane whereas the growing level of perceptivity is able to reach the vertical plane (Debono 2004, 2008). For plants, it would mean that experience without any meaning or representation is possible. A kind of raw

or *per se* experience conferring advantages for the specie, but also permitting a fast transmission of information at the organism level, but also for interspecies communication.

To resume this chapter, many different lines of evidence are consistent with our basic hypothesis which is to assimilate biological entities like plants to highly perceptive systems having an access to experience and to what precedes the emergence of cognition. Following this hypothesis, GPS could reflect the expression of primitive generic processes that progressively and nonlinearly led to the conscious systems of vertebrates. This classification is comforted by recent advances in plant biology showing a common evolutionary pathway of plant and animal species until their divergence, and that extracellular biopotentials intensively participate to morphogenesis, cell to cell coupling and transduction of stimuli. It suggests firstly the necessity of new bottom-up experiments on such simpler organisms able to express what precedes perceptive and conscious processes, and secondly, the consideration of a new concept of plasticity (Debono 2007) in which all different forms of perception and information processes are taken into account. We have shown that these plastic interfaces bind to form dynamic complexes respecting the level of expression of each binding state [65]. Several interfaces could be then defined following this paradigm, from matter-form to experience-consciousness. In the light of the present various conflicting hypotheses concerning the nature of perception and consciousness, it would be a means to broach the neuroscientist hard problem in a different and constructive way.

2.5 The Transdisciplinary Challenge: Defining a Core-TD Biosemantic Research Area

One must argue that to progress in this area, we must be humble because we do not know what exists before the emergence of consciousness. Is it a kind of perceptive experience *per se*, a kind of closed communication or a kind of identity? We must also keep in mind, as raised by philosophers like Chalmers (1996) or Searle (1998) that science is reductionist and cannot explain all. From tree to man we thus have to use the metaphoric mode as a philosophy and the informational mode as a scientific model (Debono, 1991). Finally, we must integrate the trans-objective as the trans-subjective state of natural systems (particularly in human relations) and practice transdisciplinary research, being careful to investigate the generic and/or ontological contents from the whole evolutionary processes, whatever their levels of expression.

Transdisciplinarity is unambiguously adequate to describe these different levels of knowledge and also a metaknowledge enlacing all subtypes or subcategories: here, specific and distinct dynamic perceptive systems of plants, animals and humans, and global states of perception as metafields including all steps from tropisms to emotions. Indeed, the important challenge that remains today is then to understand the common basis of perception at both

species. By combining theoretical analysis of networks expressing early sensory systems and primitive generic processes with it in vivo experiments at the dynamic 'cognitive' interface of plants, some of the puzzling questions about evolution and the emergence of complex systems could be uncovered.

An excellent initiative in this way was the reviewing of the fundamentals in bioelectricity and the questions recently put by the organizers of the first symposium on plant neurobiology held in Florence (Italy) in May 2005 and then the third international symposium on plant neurobiology (Slovakia, May 2007). The researchers centered the symposia on the concept of information in biology and the paradigm of 'Plant Neurobiology' treating without taboo of plant ionic channels, sensory signals (photoelectrical, mechano- or magneto-reception), rapid movements and neuronal-like behaviors of higher plants, memory (insect-plant interactions), processing and integration of information or intelligence (Trewavas, 2002-2005), but also fundamentals in molecular signaling, neurotransmitters or gene involved, cell membrane activities. We must go far away, considering plant biosemantics (Brier, 2012) in a world of human communication of which the ecosystem is strongly threatened.

2.5.1 Metaplasticity: Defining the Levels of Information of Knowledge Accumulating Systems at each Plastic Interfaces

As previously shown, we need to better understand the metadynamics from emergent behaviors of complex systems leading to the ontological human consciousness, some misleading "tunnel effects" as that of brain & mind being able to hide the real processes (Debono, 2008). As a matter of fact, on a plasticogenetic scale, plants possess dynamic perceptive systems and animal consciousness is obviously centered on survival whereas human creativity is expressed as a wide kaleidoscope oriented by emotions, self and feelings. In this way, we propose that instead of classifying conscious processes in order to determine gradual states of perception, we must examine their actualization into a living system as a measure of their level of *epistemic access to the world*. If we accept this model, a large metaplastic scale is now available and permits us to analyze a plurality of perceptive states containing or not consciousness, to establish a common perspective and going beyond artificial gaps

This paper clearly shows that only an approach integrating, going through and beyond the disciplines, taking into account a third term enclosing non-cognitive and cognitive entities - the intelligibility of life - will be able to permit such a discovery. This transdisciplinary paradigm as stated by Lupasco (1947, 1970, 1989) and Nicolescu (2002) [66, 67] will cover system theories, biological and genetic approaches, physics applied to the study of bioelectrical fields in plant and more generally in developing systems (like growth in plants), biosensors and energy transfer (like thermodynamics of short distance translocation (Tyree 1969, 2003) [68, 69], but also evolutionary sciences, informatics, bioengineering, information & cognitive sciences, ethological and

anthropomorphic fields and finally epistemology. We cannot treat all these cross-disciplinary links here. It involves clearly different levels of knowledge, of culture, of transverse approaches defining the core-TD research constituting our collective approach. A process that turns biosystemic data into information and then knowledge. So, we chose to treat here two levels: the phenotypic and epigenetic plasticity recently developed at the plant level and then the noetic plasticity as a global transdisciplinary approach of all plasticogenetic processes (Debono, 2012) [70].

2.5.2 Phenotypic & Epigenetic Plasticity in Plants

Let us consider now the first point. This research area could indeed conduce to seriously reconsider monolithic views upon the whole plant as a living entity having its sensibility and interacting with its congeners and upon the "rigidity" of the genetic code of all species, including humans. The first point regards the consequences of phenotypic plasticity for plant communities. Callaway et al. recently studied trait-mediated interactions (TMI) among plants regarding variation in the abiotic environment, in the presence or identity of neighbors and in herbivores [71]. They conclude as following "We consider how plastic responses to these factors might affect interactions among plants. Plastic responses to the abiotic environment have important consequences for conditionality in competitive effects, to the point of causing shifts from competitive to facilitative interactions."

Because plants show a high degree of plasticity in response to neighbors, and even to the specific identify of neighbors, phenotypic plasticity may allow species to adjust to the composition of their communities, promoting coexistence and community diversity. Likewise, plastic responses to consumers may have various and counterintuitive consequences: induction of plant resistance, compensatory growth, and increased resource uptake may affect interactions among plants in ways that cannot be predicted simply by considering biomass lost to consumers. What little we know about TMI among plants suggests that they should not be ignored in plant community theory. Although work to date on the community consequences of phenotypic plasticity has been hampered by experimental constraints, new approaches such as manipulating phenotypes by using signals instead of actual environmental conditions and the use of transgenic plants should allow us to rapidly expand our understanding of the community consequences of plant plasticity. This is a good example of the consideration of the whole plant organism and its interaction with other plants and the environment.

A second approach regards a very recent discovery from the Salt Institute of biological studies publishing a paper in Science about transgenerational epigenetic (TE) instabilities in plants (Schmitz et al., 2011) [72]. The researchers of the Ecker's laboratory show after a mapping of the epigenome of Arabidopsis thaliana upon 30 generations, that successive TE methylations were able to generate new allelic transition states altering transcription with-

out genetic mutations in this characteristic plant specie. As *Science Daily* titles, it is the first time that a "hidden" code in DNA (an epigenetic active and flexible code) evolving more rapidly that the genetic code is discovered. Moreover, functional and morphological modifications were observed in some generations, indicating a high plasticity in a short period. That could strongly and quickly influence biological traits and be highly predictable not only for plants, but for any organisms, including humans and their children. It could also be the case for human twins exhibiting different biological traits with the same DNA sequences. Other demonstrations about epimutations are clearly needed. They can turn off or turn on some genes, so be reversible. Some contemporaneous genetic studies are controversial, arguing that these effects are probably limited on long-term evolution (Becker et al., 2011) [73]. However, new epimutations, even transitory, could give better advantages than selection and sometimes win.

2.5.3 The Plastic Code of Life: an Epistemic Access to the World

Together, these discoveries reflect common mechanisms at living cells and a great phenotypic plasticity. They may lead to a new lecture of the frame separating lower from higher organisms and to a consideration of the nature of the plastic processes involved at every level of knowledge acquisition. We propose this sequence: 1- consider living organisms as plastic entities evolving in the same way - interact intelligibly with the environment; 2- consider plasticity not only as a systemic property but as a logical principle registered in reality (Brenner, 2008) [74] and the "complex of plasticity" (Debono, 2010) [75] as the natural binding between matter and form, subject and object or brain and mind, i.e. an universal co-inherent or co-signification principle (CIP or CSP) ontologically linked to the Lupasco's ternary logic and the Nicolescu's levels of reality, 3- consider inseparable plastic interfaces (PI) and plasticogenesis as a dynamic process acting at each informational node or knowledge accumulating system (Table 1).

Each plastic interface - from the unformed-formed to the subject-object, from experience to consciousness - corresponds to a level of reality, as described by Nicolescu (2011) and is ontologically linked to the other [76]. The plasticogenetic grid that we purpose will permit to more easily articulate these levels in a unique plastic scale. Four PI are concerned so far: the percept-concept one, the reality-consciousness one, the matter-psyche one, the brain-mind one and finally the noetic interface regarding a global 'noosphere' (Debono, 2012). The issue could be the *informed* or a series of co-creating worlds. It depends of our onto-epistemologies, of the plasticity of our memories and particularly of the archetypal ones (Debono, 2009) [77] and finally of our trans-objective & trans-subjective interactions with the created forms, with a-thinking (perceptive) or thinking (noetic) worlds or universes.

More globally, we must consider that plasticogenesis is a generic process

Table 1: Plasticogenetic Processes & Transversal Emergence of Noetic Systems.

Generic Principle	**Articulation**	**Semiotics**	**Translation**
Fundamental property of the matter	**Active binding** dynamic link (CP)	Informational levels	Noetic epicentre included middle
Plastic Interfaces	*'The Plastic Code of Life'*	**Ontological Crossroads**	**Tierceity** Imaginaries, memories Metalanguages Individuation
(Unformed-Formed, Matter-Form, Percept-Concept, Subject-Object, Brain-Mind…)	Irreversible processes inseparability	**Co-signification processes** Co-inherency, Co-implication Co-evolution (CIP-CSP)	**Metadynamics** transversality transdisciplinarity transculturality
Plasticity	**Complex of Plasticity**	**Metaplasticity**	**Plasticity of Mind**

in which we are inscribed as human beings like any living organisms. The basic sequence is linked to an observation: plasticity is a fundamental property of the matter that could be turn into form and vice & versa, this indicating an "evident" but crucial first plastic interface binding at the level of all morphogenetic processes (a plastic code of life) Debono (1999) [78]. Contrarily to elasticity, this binding is irreversible and dynamic, permitting co-evolution of matter-form aggregates or complexes being able, for the most evolved systems, to induce co-signified processes (Debono, 2010). These metaplastic steps necessarily create information, even at the lower scale, that can be translated into ontological, epistemic or phenomenological events by biosystems. The plasticogenesis describes all these states from minimal acquisition of information in plants to imaginary or metalanguages defining individuation processes and human consciousness (Table 1).

2.5.4 The Plasticity of Mind

The different grades of information were recently stated by Wu (2012): information in-itself, for-itself and regenerated information constituted by the first two, these basic forms establishing the essence of information further developed in social communication [79]. Moreover, as Brenner (2011) said it concerning the Wu's metaphilosophy of information constituted by these different grades, it constitutes an informational stance in which "the positioning of information as encompassing a critical component of disciplines, beyond the scientific content specific to them" is preponderant [80]. This attitude, also named *informational thinking* by Wu, allows a new glance on the rule of information in complex systems and defines an emerging field between science and philosophy of information fitting well with the concept of plasticity (Debono, 2007).

We have recently redefined "The plasticity of mind", in opposition to the classic philosophy or theory of mind, as a generic term designing the whole process of plastic dynamic acquisition of knowledge or consciousness (Debono, 2010, 2012). The plasticity of mind acts at three main levels: the plasticity of the process (from generic form to the plastic code of life), the plasticity of the subject included in the world and the plasticity of the mind in its extended noetic dimension. The plasticity of mind has as objective to transform the informed fields that surround us, to extensively use the unique articulation that animals and humans possess at different levels between experience and consciousness, and also to emancipate the self, particularly through Jung's archetypes (Debono, 2009). The expected result could be a better apprehension of the collective unconsciousness of humanity and the birth of new metalanguages or transcultures.

2.6 Conclusion

To conclude, we need to find a frame of transdisciplinary research to more acutely study the different plastic interfaces described so far, and particularly the informational or knowledge accumulating states reached by the so called simple biosystems like plants. The point of attack of the problem could be not to take into account only the biophysical properties of living organisms, but also to consider the epistemological links between matter and form, between perception and action, between transduction and information theories, and finally to rediscover the plasticity of life. The minimal 'cognitive' abilities of plants and lower organisms showing evolved behavioral and communicative abilities without brain is a good example to open and comfort new transdisciplinary fields combining at least biophysics, cybernetics, ecology, plant neuroplasticity, behavior, cognitive sciences and information theory. We could perhaps have then new insights about the life process itself.

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CHAPTER 3

The Essential Tension: Rational and Reasonable in Science and Philosophy

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This paper discusses some aspects of knowledge adopted in European history, politics and philosophy, in contrast with its own past and with other cultural areas. Some conclusions from various subjects of research in social sciences are commented upon with a view to assessing the relevance of a transdisciplinary perspective.

Keywords*:* comparative philosophy, cosmopolitanism, dialogism, epistemology, global governance, language, logic, modernity, rationality, reasonableness, relational, transcultural, transhistorical, truth.

3.1 Introduction

Most cultures in the world were by tradition keen to stick to some form of truth, whether derived from experience, from intuitive knowledge or from beliefs in sacred figures. The history of science and philosophy has fluctuated between a formalized explanation based on reason and aiming at ideal truth, and the more uncertain quest for a more comprehensive understanding of human motives and drives (greed, fear, courage, or spirit), drawing on various disciplines into a coherent whole. The quest for an ideal-type balance is constantly challenged by the effective imbalance created by conflicting views between individual and collective interests, reason and emotion, but also between diverging rational views and opposite drives. Understanding, if not explaining those interacting forces, consequently calls for approaches that interweave disciplines, but also cultures and epochs.

Truth has always taken many different aspects, whose legitimacy is enshrined in natural phenomena, supernatural symbols or sacred characters. With time, such realities have suffered continuous and significant changes due to interactions among neighboring or distant cultures, the advent of new teachers or leaders, or the rejection of past traditions and practices. In the

European philosophical and scientific contexts, these developments resulted into two crucial breaks.

First, the pre-Socratic era was associated with an idea of knowledge and philosophy which did not survive in later centuries, as Pierre Hadot has eloquently shown. As it existed and, more importantly, was practiced amongst the Ancient Greeks, philosophy was then inseparable from active efforts to determine what comprised a *bios*, a way of life, a method of being, rather than a field of study in which remembering its doctrine was the theoretical goal. So understood as *sophia*, wisdom, ancient philosophy was complementary with virtue and alien to what increasingly became the passive state of acquiring and possessing knowledge, soon to become scientific knowledge, for its own sake. As an active pursuit of the Good, it was inseparable from the very means employed to attain that goal. Socrates's declarations to his interlocutors of knowing nothing, in the writings of Plato, were the opposite of a body of work to subsequently be studied, commented upon, and taken up as a determined corpus of knowledge, but "merely a preparatory exercise for wisdom" which "tend[s] toward wisdom without ever achieving it" [2], a means of exercising freedom through the discursive method between the Master of the Academy and his disciples and auditors.

This "parting of the ways" is convincingly illustrated by François Jullien, who first applied comparative studies to Chinese philosophy on the one hand and European philosophy exemplified by Greece on the other hand, then to the historical split that occurred in ancient Greek philosophy between the archaic and the classical periods, when *sophia* and thought gradually crystallized into the philosophical search for truth, where *logos* lost its rhetorical function to be set up as the rigorous discourse of truth. In his successive books, Jullien shows that from that crossroads, the quest for truth has been adopted as an absolute method by science, to be finally standardized and universalized through globalization [3]. This method was based on the preeminence of reason in opposition first to the ambiguity of mythical accounts, later to the uncertainty of faith, sentiment and emotion. Locked up into its historical and epistemological context, reason initially distanced itself from myth to later fall back to it. The intellectual evolution of Europe took a rationalist orientation which culminated in the XVIIth century, nurturing a vision of *Cosmopolis* seen as a society rationally ordered similar to the Newtonian view of nature. While fueling extraordinary advances in all fields of human endeavor distributed in disciplines sealed off from one another, among which philosophy, this vision perpetuated what Stephen Toulmin called the "hidden agenda of modernity", referring to the delusion that human nature and society could be fitted into precise and manageable rational categories distributed into separate disciplines [4]. His analyses show how different the last three centuries would have been if Montaigne, rather than Descartes, had been taken as a starting point, showing that the Cartesian quest for certainty as intrinsic to the nature of science or philosophy is an illusion, exposing the rhetorical character of even the scientific discourse.

A second break in the history of ideas, albeit less significant in the history of science, can be detected in the development of another "parting of the ways" in physical theories, in the late 19th century, between the development of abstract relational sets or structures on the one side, and the concept of stable objects taken as an external world, which actually exists and is characterized by "true" theories, but cannot be directly observed. The two orientations are complementary, in that priority is given to representations by abstract sets or networks observed by active observers, or real entities posited by passive subjects. In the first case, what is observed is not predefined or predetermined, and is limited to relative identities determined by relational sets [5].

Another break, of an ethical nature this time, was the realization that the advancement of modern science could not be equated with human progress, despite its unquestionable achievements, did not put an end to its ambitions and did not halt its many developments. To take another example from history, the expansion of Europe that was made possible by the technological and geographical discoveries beginning in the 16th century had destructive effects since its very beginning, with the ecological damage inflicted by the transfer of germs, plants, and animals to the New World. According to historians' assumptions, the most drastic effect of European colonialism in the New World was not in the realm of social and political change but in the natural world. More specifically, the transfer of people, plants, animals, and germs from Europe, and vice versa, had a transformative and hugely disruptive effect on the local cultures and their economic viability in the Americas [6]. Rather than give credence to claims of innate European superiority and the like, Alfred Crosby explains the relative ease with which Europeans conquered the Neo-Europes as being a product of biological and ecological processes. According to them, one of the major contributors to European domination was disease, which is a natural byproduct of human interaction with animals.

To return to the status of knowledge, the quest for the an ultimate foundation, whether in natural or human sciences, has continued well into the contemporary period and still fuels debates about the respective merits of stark truth and tolerant cognitive pluralism, and the idea of a final explanation of the Universe by hard science. However, the decline of this assumption does not eliminate the implied question about the assumed "universality" of knowledge, science and philosophy, even if science has undoubtedly become a global concern of human history. This also raises the question whether the cultural context was relevant to the origin of science and, at the other end of the spectrum, the significance of knowledge and the social and political impact of human action eventually derived from science and technologies, an indirect consequence of the former question. For some time now, serious concerns have been expressed about such implications, particularly through civil society initiatives such as the *Bulletin of the Atomic Scientists, Medicine, conflict and Survival* or the association of *Concerned Scientists*. Parallelly, the first two points are being revisited, as both science and philosophy have taken more precautionary approaches about anything concerned with such concepts as

"truth" or "foundation", implying that the autonomy of science and scientists and the objective reality supposed to justify research and technological innovation are also questionable. The threat of a nuclear war and the actual use of bombs dropped on Hiroshima and Nagasaki first made physicists conscious of their social and political responsibility, and the pervading effects of scientific knowledge, technological applications and human impacts on the ecosystem have reduced to very little the myth of free science and neutral technologies. A different picture has emerged from the interactions between social, political and natural regularities, bringing new relevance to the strong linkages between *cosmos* and *polis* as part of a global and complex *cosmopolis*.

3.2 Incommunication

Further to the autonomy/heteronomy of science, the expression and understanding of scientific theories should be considered, whether in natural or human sciences, as well as its perception and dissemination in ordinary communication and lay opinion. Among those which are worth mentioning to illustrate the gap between scientific theories and their translation into ordinary language, the experiments carried out at CERN (European Organization for Nuclear Research) near Geneva, the world's largest ever physics experiments, offers a striking example. It is interesting to note here that the (provisional, as is usually the case in labs) conclusions have generated misunderstandings, such as the confusion between physical time and the human perception of time, the misinterpretation of a rereading of Einstein's relativity and the reformulation of the speed of light, or the elusory interpretation of a physical explanation of the big bang as the discovery of the origin of the Universe. One physicist working with the organization, Etienne Klein, explains that time meant nothing more than its mathematical representation, i.e. just a letter t. which differs from time as we imagine and experience it through ordinary discourse. Considering such ambiguities, physicists are reluctant to translate their findings or hypotheses in ordinary language: when experiments in a physics lab showed subatomic neutrino particles breaking what Einstein considered the ultimate speed barrier by traveling a fraction faster than light, did this lead to falsifying, or just reformulating Einstein's theory to account for the limit of light speed within a broader theoretical framework? Etienne Klein does not shrink from talking about "selling metaphysics" considering communication and its common assumptions as rhetoric, if not sophistry, in any case as meaningless discourse [7].

The same could be said about the chain of metaphors supposed to build up a "natural logic" like that of Schrödinger's cat to account for two simultaneous phenomena in quantum physics, or the contradiction in terms that appears in "Heisenberg's principle of uncertainty" to actually express what is more accurately described as the concept of indeterminacy (the relative indeterminacy of quantum particles' positions to the precision with which their momenta can be measured). Another example is the origin of the Universe

(point 0 in general relativity), in so far as the big bang as a scientific concept cannot be translated in ordinary language, because the latter is not the "zero hour" or the origin of the Universe, but a given moment corresponding to a initial state with maximum density. As a matter of fact, the idea of origin implies some previous nothingness, an unthinkable concept that destroys itself. Any potential explanation would presuppose a preceding vacuum state from which it would have emerged, something equally unthinkable. This is why the point zero of time and space as used in mathematics has no significance in physics, where it does not appear in equations because it just describes the first moments *after* the Big Bang.

3.3 Science and Culture

To return to the interplay between scientific knowledge and its cultural or historical context, the Chinese history of science is not without relevance to an adequate perception of its European counterpart. Although the Chinese admit that it originated in the West, they frequently ask the question: why was it not born in China? The common view is that in Antiquity scientific knowledge was of equivalent advancement, if not status. It was not until Western Renaissance when science began its rapid expansion, at a time when China was still stagnating because of its propensity to study the human mind or heart (*Xin*) and innate nature (*Xing*). Ever since, the gap widened further until the recent policies set up by successive authoritarian governments. Joseph Needham would not disagree with this assumption, showing that Chinese science was steadily developing in ancient China, whereas Western science was proceeding by leaps and bounds, unlike the stable and continuous course followed in China [8]. Incidentally, this may have been one of the reasons for the Western ascendency over the Middle Kingdom. Furthermore, the assumption that science was born in a given cultural and social context should not exclude some features associated with them, which is the particular concern of this paper. One remark in this respect was made by Isabelle Stengers and Ilya Prigogine who, even though the scientific journey is undoubtedly international and transcultural and is based on rational criteria belonging to all, remind us that its European impulse cannot be dissociated from such serious issues as the intricate interactions between scientific knowledge, industrial development and democratic choices [9]. The scientific enterprise as such consequently includes specifics of culture and history, in this case instability, conflict and philosophical dissent. As these two philosophers of science say, "... without the extraordinary faith in the powers of human reason which undermined the legitimacy of institutions and traditions, and ultimately resulted in the revival of the European idea of democracy, how would a few thinkers with no personal power have succeeded in setting the Earth in motion despite the triple authority of our senses which make us feel it as motionless, of the Scriptures and of philosophy, and in having recognized the autonomy of a research method accountable to no other authority than the scientists who took part in it?"[10]

The interacting components of rationality are differently exemplified in the Indian cultural area, in so far as perceptions of rationality cannot be limited to epistemological aspects but should also include interactions with social and political dimensions. To take just one example from the wide array of philosophical and logical schools, the Jaina logic developed by the 2nd century philosopher Kundakunda included the following ingredients: an ultimate distinction between "living substance" or "soul" (*jiva*) and "nonliving substance" (*ajiva*); the doctrine of anekantavada, or nonabsolutism (things have infinite aspects which no determination can exhaust); the doctrine of naya (there are many partial perspectives from which reality can be determined, none of which is, taken by itself, wholly true but each of which is partially so); and the doctrine of karma, in Jainism a substance, rather than a process, that links all phenomena in a chain of cause and effect. As a consequence of their philosophical openness, the Jaina logicians developed a unique theory of seven-valued logic, according to which the three primary truth values are "true," "false," and "indefinite" and the other four values are "true and false," "true and indefinite," "false and indefinite," and "true, false, and indefinite." Every statement is regarded as having these seven values, considered from different standpoints. It should also be noted that the intercultural dimension is not absent from scientific and epistemological developments in India, as their peculiarity did not prevent Arab thinkers like Alberuni from having a large number of Hindu collaborators with whose help he mastered Sanskrit and studied contemporary Indian treatises on mathematics, philosophy, astronomy, sculpture, and religion. His work had great influence in continuing the Arabic studies (well established by the eighth century) of Indian science and mathematics, which reached Europe through the Arabs [11].

As a whole, what can be concluded from comparative studies is the peculiar orientation taken by European science as focusing on ideal values and models. François Jullien illustrates this from a Chinese viewpoint, where "ideal" appears to be a European word, whether in English, German, French, Spanish, Italian, and also in Russian or Polish. Referring to Xunzi among other thinkers, Jullien notes that speculation is usually rejected as a way to understand nature, time or the Universe. In contrast with the Western method imposing a mental model, a plan, on the chaos of life, and striving to the utmost to make the chaos fit the plan, the Chinese approach tends to build a unitary notion different from Platonic idealism immune to the emotional dimension, the "idea" to be discovered as the ultimate truth [12]. The former method, favored by the Chinese, seeks a relation between conditions and consequences, whereas the latter establishes the relation of means to ends with which the West is more familiar. Among the illustrations of these contrasting logics, Jullien refers to Chinese strategists, who consider that a situation evolves in such a way that, if one allows oneself to be carried along by it, the effect results naturally from the accumulated potential of the situation. Such a strategy no longer needs to choose between means or to struggle in order to attain an "end." He opposes the logic of model-making founded on the construction of

an ideal end commonly practiced in a Western approach to the dynamic logic of a process. In the former the process is closed, and its result implicit in its evolution, while in the latter the causal system is open and complex, and an infinite number of combinations are possible. The efficacy of the two logics can be assessed through the ways in which success is perceived: as inevitable on the one side, as hypothetical on the other [13]. As Xunzi said: "If I know my opponent and I know myself, in a hundred battles I have nothing to fear", meaning that if I know enough about the relationship of forces between my opponent and myself, I can insist on not joining battle until such time as I am certain that the potential of the situation operates completely in my favor [14].

3.4 The Fluctuations of Scientific Knowledge

If we take the varying approaches mentioned above in a coherent whole, we can adopt new definitions and methods reflecting fundamental changes in the ways scientific is being produced in social, political and cultural fields. The resulting traits will be complexity, hybridity, non-linearity, reflexivity, plasticity, heterogeneity, and transdisciplinarity, as rightly observed by Michel Maffesoli [15]. As to the components and objects of knowledge, a first effect is that the interplay between disciplinary competences is the inclusion in research methods of a mixture of reason and emotion, hate and love, certainty and uncertainty, predictable and unpredictable data. Of course, the initial landmark of social sciences as autonomous disciplines was first the recognition of reason as a prominent criterion to establish its scientific status.

To take political science and more specifically the discipline of international relations as another case in point, I will cite the classical Treaty of Wesphalia in 1648, which put an end to the Thirty Years' War, one of Europe's most devastating, longest series of wars involving most European countries, and was deemed to provide a rational structure to the anarchic world of European polities. It was also history's first great international (the word did not exist yet) congress, held to settle what had been a deluge of emotions that engulfed European societies to the point of exhaustion. What should be retained from this is that three centuries later, students of international politics are still learning that states and governments are applying rational rules to keep irrational emotions at bay. In so doing, "scientific" realism as a political theory is still following the path opened in the 1850s by other social and human sciences, such as sociology with Max Weber (1864-1920), who rejected the historicist and descriptive methods and argued that social research proceeded by abstraction and generalization in the same way as natural sciences, or Ferdinand de Saussure (1857-1913) in linguistics, applying the same method to establish language as a scientifically defined object of study, the fixed "langue" as opposed to a flowing "parole". As Richard Ned Lebow remarked, "this method could apply not only to external behaviours, but also to the underlying motivations. Whereas the researcher's attitude was value-bound, the method of

social research was value-neutral," [16].

The same applies to morality is based on an 'ontological' conception of the world: phenomena, situations, identities that are intangible and sure of themselves. By contrast, plural ethics are essentially changing and provisional. Still, rather than deploring this mobile, uncertain, non-institutional side of the phenomena in question, can we not see in it the expression of an authentic, full humanism, a conception of the human that is dynamic, including both its constructive and destructive aspects. To take an instance of this debate in political science, the conflicting views about what is posited as rational and what is described as reasonable or irrational may generate competing theories of international relations, granting priority to rational sovereign states as sole actors, or opting for pluralist constructivism with a plurality of actors where non-state agents and subjective factors play a significant role. The model of Cosmopolis advocated in the 17th century as a natural outcome of both the origins and the prospects of the modern world evoked phenomena concerned with "being", and were driven by the quest for a rational, specific substance: God, the State, the Institution, man, rights. Its distant origin can be traced back to Plato's claim that the world exists independently of our mental categories and that man's only possibility is to find out "truths" our there waiting to be discovered. This conception still thrives in contemporary political theories, specifically in the discipline of International Relations. Although conventional realists, following Hans Morgenthau, Kenneth Waltz, Raymond Aron and others who acknowledge that there are many actors other than states, and that states engage in all sorts of economic and social interactions which have nothing directly to do with creating a balance of power, their basic argument remains determined by two essential principles. First, these interferences in non-state fields of activity do not undermine the basic assumption that in the absence of effective world government the international system is anarchical. Second, even if Waltz denies that he makes any kind of assumption about the rationality of states, most of his successors do assume that because states want to survive they will act rationally to increase their security, despite the paradoxical assumption since Hobbes that the security of individual sovereign states implies the absence of security, or anarchy, in international relations [17].

Opposed to these theories, the sociology of international relations has turned to the plurality of actors with different motivations, whether rational or not [18]. Far from sticking to the monologic of states posited as rational actors, theorists of the field have proposed operational definition of non-state actors in different veins, as referring to renewed conceptions of Cosmopolis, to social life organized according to inter/transnational civil society with its own logic, especially the logic of association, to supply its own economic, cultural and political dynamics, or a mixture of all those. Despite the four-century oblivion to which it was consigned by the Cartesian program of modern scientific disciplines, rationalist theories have consequently be questioned by new or updated ideas reappearing in the recent attempts at founding a cosmopolitan

law, actually a counter-trend in international law developments. Today, the resurrection of the Janus-faced concept of humanity and human being is at the center of the international law of human rights, which culminated with such regulatory instruments as the International Criminal Court founded in 2002. These legal instruments cannot be get rid of if we want to channel the shaping of a transnational society diversely defined in terms of cyberspace, scientific and technological rationality, international democracy or global civil society. A distant echo of the Stoic views, the adoption and implementation of a universal jurisdiction by "like-minded" states conceived of as standardized identities highlights the continuing relevance of basic transdisciplinary concepts such as human being and humanity. Considered from such perspectives, the current inter/transnational landscape sends social and human sciences back to the intellectual inquiries with which Montaigne was familiar, before René Descartes separated nature from humanity, reason from emotion, and distributed knowledge into autonomous disciplines. Descartes' rationalist system establishes philosophy and the sciences upon a secure metaphysical foundation, exemplifying an attitude characteristic of the Enlightenment, whose basic tenets are that the investigator ought to doubt all propositions that can be doubted – short of the existence of God, whose cosmic plan was to be explained thanks to the new philosophical method – with no other authority than the researcher's own conviction, subjected to rigorous skeptical questioning. As strongly expressed by Stephen Toulmin, "The culture and society of 17th century Europe were transformed by changes that set aside the tolerance of late Renaissance humanism for more rigorous theories and demanding practices: these changes culminated in the new cosmopolis built around the formal structure of mathematical physics," [19].

By contrast, Montaigne's perspective would be better illustrated today by a "geopolitics of emotions" [20] including some specific affects rather than reason only. Peter Sloterdijk, to take one of the leading contemporary thinkers, refers to the suggestive alliteration of Zorn (anger) and Zeit (understood here as historical time), displacing Heidegger's magnum opus from 1927, *Sein und Zeit*. Firstly, Sloterdijk connects anger, and not being, with time, displacing the terrain of the investigation regarding the essence of time from ontology to something like a philosophical psychology, focused on a very specific affect. Secondly, whilst Sloterdijk presents anger as what Heidegger would have called a "fundamental attunement" (*Grundstimmung*), or an affect that reveals a fundamental situation, whether existential or historical, Heidegger himself never identified anger as one such mood. Thirdly, the title itself seems to suggest that in order to understand time, our time as well as our conception of time, and both are at issue in Sloterdijk's book as we need to turn to anger not as one mood or affect amongst others, but as the most adequate and defining affect, here considered as a way into the implicit dynamic of European history [21].

True, in ancient times hegemony came before balance in so far as hegemony, in the guise of empire, meant order, culture and civilization. The outside world,

for both Europeans and Chinese, was peopled with barbarians, equated with chaos and instability. However, if empires have generally been static, they have also protected a degree of plurality in their ethnic and cultural composition from the start. This is due to many factors, among which the very extension and variety of occupied or controlled territories, which made it impossible to standardize or homogenize cultures, languages and political power. This fragmentation, or more positively the encounter between so many peoples, may have contributed to the cosmopolitan idea, i.e. the idea of human beings as citizens of the world understood not as an idealized building block in a European representation of the Universe, but as a complex, asymmetrical pattern calling for a wider perspective capturing the interactions between the variety of actors and factors involved. The underlying vectors of tensions associated with such an imbalance can be related to both the quest for an emerging world order and the chaos resulting from competing models of world order. The set of actors and factors so constituted may refer to state interests and community values, local and global views, moral and legal norms, charitable and economic aims simultaneously, calling for an inevitable cross-disciplinary outlook.

3.5 From Pre-Modern to Modern to Post-Modern

It should be noted here that, far from this notion of a potential, complex and plural world order, the United Nations is an illustration of the traditional system of "modern" states, following Machiavellian principles and a realist behavior of strict sovereignty and raison d'état, in an attempt to establish law and order according to the principles enshrined in the UN Charter. However, this also means that its aims to maintain order by force is strictly limited, the veto power ensuring that the UN system does not infringe on great powers' interests and privileges, destroying by the same token its original aim of considering all states equal. Although the UN was conceived to stabilize the order of states, it did not create a fundamentally new order, notwithstanding some developments since its inception. In a way, the collective-security element of the UN Charter represented an attempt to throw the weight of the international system behind the *status quo*, so that the international community as a whole would become the balancing actor in the balance-of-power system. Nevertheless, in the absence of any obvious alternative the interstate system has survived, and what emerged in 1945 was not so much a new system as the culmination of the old one, with the old multilateral balance-of-power in Europe becoming a bilateral balance of terror through deterrence.

In contrast with the modern system epitomized by the UN, the European model is the most developed example of a new rationality, variously called postmodern, postmodern or transmodern. Based on interdependence, the EU is more a transnational than a supra-national system, a voluntary association of states rather than the subordination of states to a central power. Abandoning the ideal of a "European state" or "European empire", it rests on the assumption that nation states are fundamentally unsafe and that the only way

to tame the anarchy of nations is to impose hegemony on them. However, if the EU considers the sovereign nation-state as a problem, the super-state is not necessarily a solution. The postmodern system does not rely either on balance, as it does not emphasize sovereignty or the separation of domestic and foreign affairs. On the contrary, the EU has become a highly developed system for mutual interference in each other's domestic affairs. In the field of defense, under the CFE Treaty parties have to notify the location of their heavy weapons and allow inspections. The shared interest of European countries mirrors the paradox of the nuclear age where to defend itself a state had to be prepared to destroy itself, overcoming the strategic logic of distrust and concealment. Instead, it recognizes such characteristics and practices as mutual vulnerability, mutual transparency, the breaking down of the distinction between domestic and foreign affairs [22], mutual interference in (traditional) domestic affairs and mutual surveillance, the rejection of force for resolving disputes and the consequent codification of self-enforced rules of behavior, which naturally translates into the growing irrelevance of borders [23].

In other words, the creation of this post-modern, post-national system is the recognition that Europe is not an empire in the conventional sense, but both a supra-national and transnational organization which brings order but rests on the voluntary principle confirmed in the Lisbon Treaty stating that any member state can leave the EU, as a consistent alternative to the fact that "there has never been a European empire" [24]. Thus conceived, a plausible explanation for this novel fact of international life is the hypothesis of the non-empire, an oligopolar trans-polity and quasi-polity, if the comparative method is to ascribe some significance to European history. Again, the feature appears more clearly when situated in a comparative historical perspective: the political fragmentation and cultural pluralism that characterize Europe can be contrasted with China, where competition and conflict between several of the great kingdoms during the fourth and third centuries BC gradually made way for a rational theory of State power aimed at strengthening the military and the economy by concentrating all power in the hands of the prince. As Jacques Gernet notes, this centralization was accomplished by eliminating the power of the old hereditary aristocracy, setting up instead an independent administration run by objective rules and regulations, hierarchically ordered and whose tasks were rationally distributed among various specialized services subjected to regular control and exercising in turn direct control over all the territories [25].

Obviously, the idea of empire still survives in Europe in the image of peace and order through a single hegemonic power. The former dreams of the restoration of Christendom has given rise to proposals for world government which would emerge from the United Nations, and calls for a United States of Europe. But the UN was never intended to be a cosmopolis of this kind, as it strictly preserves state sovereignty and has no democratic constitution, and the EU project is not comparable to the United States of America. The Federalists at the end of the eighteenth century in Philadelphia were engaged in *inventing*

a new political regime without historical precedent, whereas more than two hundred years later, the EU is both to *conserve* the democratic achievements of the nation-state and design, beyond its own limits, what Jacques Delors called a "non-identified political object" heir to a long-established practice of constitution-making, for which the future of Europe is more the province of economists, sociologists and political scientists, rather than the domain of constitutional lawyers and political philosophers [26].

For its part, even if the state is assumed to be the sole rational actor, we should admit that it no longer fulfills Weber's criterion of having the legal, let alone legitimate, monopoly on the use of force, in so far as it has in the past abused that monopoly. In other circumstances, it may be a fragile structure whose authority is not only restricted by commitments under the UN Charter to refrain from the threat or use of force against the territorial integrity or political independence of any other state, but also undermined by complex urban and industrial societies organized in private networks, whether nonprofit (civil society organizations) or for-profit (corporate players). The so-called failed states may even be completely overwhelmed by drug trafficking, criminal networks or terrorist syndicates using non-state (that is, pre-modern) legal instruments to weaken states and interstate organizations. As a result we have, for the first time since the nineteenth century, a *terra nullius* between anarchic globalization, demised or powerless states and unofficial syndicates operating without hindrance.

3.6 Pragmatist Alternatives

In other sectors of social sciences, the quest of rationality and scientific truth has been equally undermined by Thomas Kuhn's thesis that successive scientific paradigms develop in history on the condition that they can reach consensus and are not opposed by some ideological or institutional obstacle. Paradigms, a term and a concept Kuhn apparently borrowed from Gaston Bachelard [27], were justified by the need to protect scientific knowledge from opinion so as to guarantee the transference of a community's paradigm, a move radicalized by Kuhn who considers that a paradigm is so much attached to a given community that it becomes internalized and invisible. Logically, a crisis occurs in a discipline when the paradigm becomes self-reflexive and a subject of debate and the community is no longer in a position to remain immune to criticism and controversy [28]. The scientific truth principle was further weakened by Karl Popper's thesis that no scientific theory is definitely valid as it is always and necessarily open to falsification. The principle of contradiction can thus play an empirically active role to that end, as a rational motivation to revise theories, which will be eliminated as soon as a new and more adequate theory has been chosen [29].

In the field of social sciences, pragmatism appeals primarily to those researchers who understand the many limitations of positivism but are nevertheless committed to a scientific approach to the social world. Often accused

of a "physics envy" associated with objective truths as allegated by Lebow against political scientists [30], many contemporary social scientists turned to what I would call a "polis envy" to respond to such attacks, but also as a consequence of the increasing complexity of data collected in all subject matters, from anthropology and linguistics to sociology, psychology and cognitive sciences. Confronted with variable and unstable contexts, pragmatist theories reject scientific objectivism associated with abstract objects and binary logic, in an attempt to reconcile social, cultural or global data with the more homogeneous or universal knowledge associated with biological or genetic processes. In so doing, they also try to preserve the unity of science and the autonomy of individual disciplines, at the same time as hard science itself, and notably physics, are retreating to a more modest position freed from the search for an absolute truth. Remembering that Kant had already stated that knowledge of synthetic *a priori* truths about space and time is only explicable if they are formal elements of sense-experience rather than properties of things themselves, we should not be surprised to hear that quantum mechanics has established, with Bohr, Pauli, or Heisenberg, that isolated, ideal objects as understood in conventional metaphysics do not exist as such in quantum physics in so far as the observer and the object are never separated but are interacting within a relational, coherent set of events [31].

3.7 Language as a Relational Set

Considering these new epistemological openings, it may be surprising to find that the older method based on ideal, metaphysical knowledge continues to flourish in contemporary social science. The best known case is probably the genetic determinism extended to language. Once the most celebrated advance in social sciences, Noam Chomsky's linguistics formalized a theory grounded in biology, describing universal grammar as a "hypothetical component of genetic inheritance applicable to any language" [32]. The relation between the assumed innate language organ, or device, and the languages we acquire is seen here as no more than the adjustment of parameters. Even though Chomsky says he never uses the term "inneist hypothesis", which is said to be used only by his critics like Hilary Putnam, it would not be surprising since his epistemology is literally "natural" [33] . The ideological function of the language device is reduced to turning its neural substratum into absolute determination in a first stage, which makes the study of language a monodisciplinary subject first reduced to psychology, and second to biology [34], including the more recent functionalist and cognitive theories. In formal terms, this translates into the axiomatization of an autonomous syntax, the transformational generative grammar (TGG), entrusted with providing models for other processes of cognitive psychology such as visual perception and other models relating to the processing of external stimuli, based on the fundamental properties of learned cognitive systems and mechanisms used for acquiring and applying such systems [35].

In a second stage, the conception of a "mental organ" central to cognitive structures will confirm the demise of language as the subject of an autonomous linguistics, causing this science to be dependent, beyond psychology, on biology or neurosciences. Finally, both operations will lead to mentalism as a further step to the annexation of psychology and linguistics by physical sciences [36]. Language as a central of philosophical enquiry is then identified with the mental content of an ideal speaker-hearer in a completely homogeneous speech-community studied by a new fashion philosophy of spirit, later to be translated into the homogeneous *mind-brain* research topic as the TGG was evolving into a scientific theory of the substantialist family. In philosophical terms, this meant that the intellectual climate had entirely changed since the 1960s, empiricism was now submerged by rationalistic assumptions, linguistic or social systems were no longer understood in internal terms to make comparison possible, and particular aspects or traits of a system could be definitely isolated to outline a universal structure for language and cognition. It marked the return to Max Müller' claim in the 1860s that linguistics was a science whose methods were comparable to those of geology, botany or astronomy: "The science of language, one of the physical sciences" [37].

These epistemological tenets suggest, rather than an epistemological revolution, what amounts to a step backwards can be traced back to an older scientific and philosophical Western tradition: arguing the necessity for postulating innate ideas to explain the possibility of language, generativists, in the same way as immanent language for structuralists, convey Platonic conceptions that man is inhabited with true opinions about realities he does not know or he has not learnt yet. To the extent that some followers of this school, invoking Frege's Platonic doctrine initially conceived as an antidote to psychologism [38], engaged in a declaration of loyalty to Platonism. Jerrold J. Katz, one of the staunchest defenders of Chomsky's school, first supported psychologism or conceptualism in linguistics [39], according to which linguistic theory is identified with the theory of knowledge of language, and later mentalism [40], then rejected in favor of (Platonic) realism, according to which languages are abstract objects considered for themselves independently of our knowledge of them [41]. He described this change as follows: "I had been wondering about how well Frege's realism about senses, to which I was committed, squared with Chomsky's psychologism about language, to which I was also committed. I reached the conclusion that ... a theory of abstract senses could not be fitted into a theory of concrete syntactic structures in the human mind. My solution was to adopt a realist view of grammar as a whole, a move that seemed the right choice in light of the fact that the words and sentences that grammars are theories of are plausibly regarded as types and hence as abstract objects," [42].

On the formal side, Chomsky's method is one of the most systematic endeavors to transfer logical principles into linguistic theory, provided logic is restricted to classical logic, as he rejects all non-classical or paraconsistent logics commonly used today to represent language and cognition processes in

pragmatic contexts [43]. His method is radical if compared with Pos's position, a logician who inspired his work but restricted the link between logic and language to an analogy, whereas Chomsky bases both systems on a structural identity, making therefrom the concept of grammar "correctness" a derivative of the principle of logical generation which defines true and false [44]. We can recognize here the bivalence that characterizes Chomskyan linguistics as based on the classical binary logic since, as Chomsky clearly says, the logic of language "is" classical logic (with variables, i.e. the predicate calculus), and not some intentional logic (with no variables). However, some critics have noted that presenting the TGG as an instrument to "explain" the speaker's competence in the same way as theories in physics explain physical phenomena is a serious logical mistake. Indeed, theoretical physics as a predictive tool is analogous to Chomskyan performance (actual speech), whereas compe-tence (assimilated with physical theory) has never been presented as a theory of performance [45].

Again, as propositions are independent from empirical verification because they are based on concepts of necessary and universal concepts, Chomsky's logic is far from engaging in any "revolutionary" epistemology but rather goes back to the idealistic tradition of Western philosophy faithful to classical, binary logic at a time when most of his colleagues in linguistic pragmatics have long lost their interest in this logic and opted for "adaptive" logics and the forms that better explicate dynamic reasoning, a central concern today for philosophy of science and epistemology. Although Chomsky refers to the empirical adequacy of a formal universal grammar to actual languages, with a view to opposing the empiricist thinking that dominated the 1950s [46] exemplified by Leonard Bloomfield behaviorist psychology and linguistics, but also Edward Sapir's and Benjamin Lee Whorf's anthropological and comparative linguistics. His reference to Saussure is more ambiguous and will be used, in a first stage, as an ideological weapon against American structuralist behavioralism, then departed from it to enhance his own original approach defined as generative and subjectivist. Part of the explanation for such a return to reifications constructed on models recalling Platonic Ideas or the Aristotelian forms is a response to language theories drawing on the social or cultural environment, including later pragmatic approaches based on Austin's speech acts, Sperber and Wilson's Relevance Theory, theories of discourse arguing that interaction with other speakers is the critical dimension in learning language, or Vygotsky's psychology, which argues that all cognitive processes, including those involved in language, arise from social interaction. Chomsky also opposed the kind of constructivism elaborated in Jean Piaget's psychology, as illustrated in the famous Royaumont debate in 1975 between Piaget's and Chomsky's followers. The initial tenet inspired by rationalism ascribes no intrinsic structure to the environment, because any law of order belongs to the subject. In Piagetian terms, this means that of the two terms of equilibration – accommodation and assimilation – only the former would be maintained, but it would be entirely and absolutely controlled by the subject. Additionally, in

Piaget's theory there is no need whatsoever for an innate language device, due to the fact that neural structures and psychological processes are entirely sufficient to account for cognition and language [47]. In a way, the language device refers to a hypothetical mechanism, possibly genetic but which would then describe no more than a sub-linguistic mechanism and could equally underlie non-linguistic processes. This view is supported today by comparative research on neural substrata of language and music, showing that similar (as well as distinct) processes are active in understanding language and in perceiving music. Concerning language, an interesting finding is also that cognitive operations associated with meaning are specific to semantic treatment, i.e. distinct from syntactic processes, which clearly appears not to cover the whole of language neural mechanisms. Although the latter differ from those used to treat melodic and harmonic structures, it is equally relevant to note that the treatment of some syntactic dimensions of language is associated with electrophysiological processes similar to those implied in the treatment of certain harmonic aspects of music. This means that syntactic functions of language and harmonic functions of music may be governed by common mechanisms which analyze the structural features of a sequence of organized events, whether they are part of a sentence in speech or accords of a melody. Similar conclusions have been made when comparing aspects of prosody in language and rhythm in music, all of them supporting Piaget's view that language cannot be reduced to a specific language device, but that common, deep mechanisms underlie different cognitive functions [48].

3.8 Return to Reason

True, contemporary researchers have brought more experimental data to support the theory of inborn competences, like the famous FOXP2 gene supposed to be the core of language structure [49]. The strong impact of the rationalist model still prevalent in social sciences in the 19th century culminated in the demonstration by Berlin Kay of the language-independent saliency of "basic colors", which was taken as a decisive anti-relativist finding, and effectively terminated investigations into the Sapir-Whorf hypothesis conceived from historical roots. Although some recent studies based on non-industrialized societies still contest the existence of cross-linguistic universals in color naming, suggesting that color categories may not be universal, comprehensive objective tests have been conducted to resolve this issue, concluding from data from languages of both industrialized and non-industrialized that strong universal tendencies in color naming do exist across both sorts of language. However, the power of the genetic explanation declined as research was refining its findings: Evelyn Fox Keller argues that the very success of genetics has radically undermined its main thrust, the very gene concept. Originally presented as the driving force in the faithful replica of genetic traits from generation to generation, the stability of genes was actually hiding a great number of enzymes contributing to metabolic networks. Crick's central dogma in 1957 that

"DNA makes proteins, and proteins make us" has gradually been questioned as the gene was reformulated in dynamic terms to account for the chromosome structure on which it depends and on its developmental and cytoplasm environment [50].

Universal language standards can also be officially imposed, in contrast to ordinary language in which form and content make up a unit usually created unconsciously, establishing an artificial "universality". In the field of natural sciences and technology, the aim of terminology is to oppose any free play of language and for scientific communities to agree on unified (standardized) concepts and terms endorsed by an authority such as a national or preferably international standardization institute. So conceived, the analytic concept theory in terminology science is another instance of an infinite regression to Aristotelian philosophical ideas, consisting in defining concepts as the result of the necessary predications of referents and being represented in a term or name or conventionalized in a sentence stating the characteristics in their relationships. This conception ascribes to concepts a universal role in recognizing and constructing the world and is objects, categorizing and classifying them, while at the same time considering concepts as "units of communication" in the semiotic sense, summarized in definitions based on the classical logical equation *definiendum* - *definiens* [51]. The basis provided for dealing with the concepts formed and used in science and technology is a form of objectivism, which posits the existence of independent objects, regards our consciousness as a passive recorder of data. Its language of observation should, then, designate aspects of observable physical relations and events taken as valid for all possible referents belonging to a given class, consequently rejecting any contextualization for the purpose of elucidating the meaning of concepts. In line with the physicalist programme of the Vienna Circle, this view implies that the unity of science is reductionist in the sense that the observation of objective realities in makes it possible to build a uniform language of description (based on logical empiricism) that can be applied to the human sciences as well [52].

Obviously, this position has long been questioned by epistemologists not only in the field of the human sciences, but also in natural sciences, one assumption being that some events are intrinsically paradoxical [53]. Critical theorists in both fields have also argued against the validity of an independent, context-free facticity that provides the basis of assertions that are true by virtue of correspondence. The Frankfurt school and other philosophers influenced by the interpretive tradition of inquiry argue on the contrary, that human experience is apprehended on the basis of categories that have meaning in the cultural context of the analyst/observer. Experience is thus always contingent on the normative standards that are presupposed in the possible selection and constitution of "facts" [54]. Resorting to "open-textured" terms and concepts in relation to empirical theories [55], or to non-standardized terminologies in the social sciences, are two attempts among many others to deal with conflicting views of conceptual analysis. The aim is to integrate opposite assumptions usually believed to be mutually exclusive, if not empirically, at

least logically. One such attempt is the creation of the so-called socioterminology by François Gaudin [56], to deal with the sociological aspects of terminologies. In a pluralist approach, terminologies address concepts as they are disseminated in human societies and perceived by speakers to conform to the relative dependence of conceptual systems on contexts within which concepts are developed, interpreted and named. The explicit view of this approach is to account for ambiguity, homonymy, synonymy, extensional vagueness, opacity and contradiction, otherwise eliminated from conventional terminology. Ironically, scientific organizations, standardization institutes or terminological banks as autonomous transnational institutions pursue these goals in the full awareness of the underlying cultural values, namely that "technology and its dissemination is a product of culture, because its development depends less on technical capabilities than on its social and cultural desirability and acceptability" [57].

These claims legitimize the analogy between the aims and structures of these organizations and the language network intracultural model proposed by Milroy [58]. The rather radical view expressed by the Milroy's [59] about similar processes in an intracultural context can easily be referred to an intercultural level: only in written language standardization can true standard be achieved, and the "ideology" is all that gets transferred from the written to the spoken channel. To this we could add that, as commented by J.E. Joseph, what is transferred to the standard language is something much more significant: an entire way of thinking about language, as a medium composed of discrete units, able to be isolated in time, that is a meta-awareness of language; the means for those who have this power to consciously determine language functions to spread their views within the linguistic community; a form of graphicentrism which strengthen language's political force (what is material can be possessed), etc. [60]. In other words standard languages, which are acquired primarily through educational assimilation, acculturation and other prescriptive actions, reflect a cultural intervention against the way in which one's native language is normally acquired. The very notion of a standard language thus implies much more than a mere semantic convention, since it appears to be the product of a unified culture which, in addition to prescriptivism and culturocentrism, implies value judgments associated with the role of standardized concepts considered as the "true" representation of objective entities.

Reductionist epistemologies should not be rejected, but they obviously do not explain wider aspects of language development which always remain dependent on interpersonal relations and social context. Syntactic parameter may be inborn, but they will never explain or minimally make understand that language learning, formation and use is dynamic, self-organizing, and epigenetic. Universal grammar or, deeper cognitive mechanism which make the linguistic device hypothesis useless, may constrain the collective evolution and individual learning of language, but they will never explain discourse, dialogic, rhetoric games or literary creativity. Conversely, the anthropologi-

cal framework suggested by Geertz and many other anthropologists describe conventional understandings of humanity rested on reified images of man as a model, of gods as archetypes, of Platonic ideas or of Aristotelian forms, all of them dead identities disconnected from the intimacies of a lively environment and substantive human universals [61]. Instead of a modular or "stratigraphic" view of culture as a layer superimposed over biological, psychological, and sociological phenomena, he points out the interdependencies and coevolution of biology and meaning as interacting within experience. The anthropological picture thus firmly situates culture and biology as a unitary phenomenon, as otherwise suggested by human evolution: the neocortex grew up in great part in interaction with culture, a feature called "co-evolution" in an intermediate thesis between the nativist and culturalist theories. Referring to the explosion of symbolic artifacts in homo sapiens after a very slow acquisition of communication skills, this view proposes an integrational, "cognitive" theory compatible with pragmatics against the innatist, modular paradigm of language research. Drawing on neurobiology, evolutionary theory, linguistics, and semiotics, Terence Deacon and other teams of anthropologists suggest that language (inseparable from social life) and the brain (whose development in man is inseparable is equally inseparable from social communication) evolved in continuous interaction, generating a loop between the environment and genes, biological competences and the evolution of human culture [62].

3.9 Conclusion

The arguments above support the idea of an extensive, cross-disciplinary apprehension of most, if not all phenomena observed and studied in the many subjects of human and social sciences. In contrast with the "physics envy" mentioned at the start of this paper, they evoke openness to a "polis envy". The former could actually be addressed to many, if not all disciplines in social and human sciences, which one time or another have been committed to an ideal-type, or "common principals" imported from natural sciences. Taken as prescriptive criteria, these are somewhat analogous to a compass to establish the boundaries of the set of fields or subjects that can be considered as scientific, and consequently as a reliable source of knowledge. As to the "polis envy", it can readily be associated to the coexistence of plural subjects, whether citizens in this case or subjects or agents in other contexts, with no immediate or permanent definition of what could be taken as common, general or even universal. In this sense, the dream of scientific realism that underlies Western ideals of "progress"and "development", whose damaging sociological and ecological consequences are now widely recognized, together with the logical rationality shared by philosophy and science from Plato to Descartes and Popper, would give way to "humanist" and "reasonable" views, as expressed by Paul Feyerabend: "The appeal to reason is empty, and must be replaced by a notion of science that subordinates it to the needs of citizens and communities," [63]

Arguably, Feyerabend's remark radicalizes the view that of the quest for scientific truth is not only truth, but the motivation implied by its quest. Does this exclude reason? Not necessarily, if we remember Akbar the Great's point that "even to dispute reason one has to give a reason for that disputation" [64]. The object is then invariably underlain by the subject's choice, which requires a relational epistemology. Motivations and drives have been theorized by political scientists and philosophers, referring to such notions as honor, fear, spirit, courage or other emotions [65], showing that underlying social "facts" are interpretations of concepts used to name them. As Lebow says, in the physical world objects exist independently of our behavior or knowledge of them: "Molecules were features of the world before they were ever imaged by humans and the earth continued to revolve around the sun despite the insistence of the Catholic Church for many centuries that the reverse was true. This cannot be said for the balance of power, the state or even society," [66].

As can be seen, the two polarities of thought mentioned in the introduction, which can be called *logos* and *tao* and coexisted in Archaic Greece and in China in the same period of history, can no longer be clearly identified with Western culture on the one side and Chinese culture on the other side, as both modes of thinking existed on both sides and have intermingled in history. What is visible today is rather that the prominence of logos in Western thinking and science is being increasingly questioned by plural rationalities as the systems studied in social sciences are becoming more and more complex. The consecutive demise of the sole predominance of formal explanations aiming at "truth" has been compounded by the new uncertainty about progress conventionally associated with rational thinking and governance, as scientific knowledge, or at least its applications, is increasingly accused of undermining the sustainability of the ecosystem, to the point of exposing the senseless vainglory of a "Strong Anthropic Principle" belief that "the Universe must have those properties which allow life to develop within it at some stage in its history," [67].

True, genetics has made great strides in terms of increasing the potential value of the core assets we wish to rely upon, but human communication remains obscure as long as it is reduced to the syntactic treatment of its written constituents or the basic mechanisms of sentences isolated from the complex input of discourse, rhetoric and semiotics in producing and understanding human interaction in all its varieties. Formally, we are sent back to a logic of "both" and the plausibility of contradiction, the pre-platonic rhetoric of "double speech" of speakers/hearers playing with dissonance, far later expressed by Diderot when he sensed the exhaustion of Cartesian modernity, showing how human practice was generating a society made of individuals with multiple loyalties instead of sovereign, isolated subjects. "... we have not many mouths", he said, "But in the mind there is not the successive development we observe in speech; if it had twenty mouths, and each mouth able to say a word, all the above ideas would be expressed at once," [68]. This idea has been theorized in many disciplines familiar with cultural diversity, the rhetoric of discourse

and plural voices. "Polyphony" was theorized in the 1920s by literary analyst Michael Bakhtin from Dostoevsky's 'dialogical principle' to counter monologism, for which truth as a referential object is constructed abstractly from the dominant perspective and denies the subject any autonomous meaning in a closed discourse, in favor of dialogism, which recognizes the multiplicity of perspectives and voices in evolving interaction, each of which engaging with and informed by other voices. It draws on the history of past use and meanings associated with each word, phrase or genre, as well as on the anticipation of future statements [69].

On their side, social sciences can be expected to adhere to the same standards of evidence and theory-building as the natural sciences in so far as they remember that they are far more falsifiable than their supposed model, that rules are not laws, that reason is the ability to set up stable theories but also to make decisions, making reasonableness a more adequate concept than one-dimensional rationality. Concepts may migrate from one subject to another, but in so doing they are rebuilt with different components and contradict the fixed meanings they had at the start, a sufficient demonstration that disciplines are doomed to interact, losing some of their sovereignty in the same way as subjects and collectivities cannot stick indefinitely to their identities.

If dialogism is typical of everyday language use and literary writing, it is also deployed in social and political contexts where players are skeptical to identities, in an emerging transnational system of plural actors and complex factors interacting in an ordering which did not exist to that extent before the turn of the twentieth century. Not only do the few examples before suggest that there is no way out of the transdisciplinary approach, but they also imply that "transhistorical" elements derived from comparative history are inescapable, examining arguments in favor of the multi-perspectivism that thrived not only in Greece before the reduction of Sophia to episteme, of wisdom to science and one-dimensional reason, but also in non-Western cultural areas. Expressing and communicating knowledge in science can avoid a number of inconsistencies and misinterpretations providing they adopt a theory of transformative dualities, where symbols and theories are not static, ontological objects, but restore their pragmatic dimension in fluid circumstances.

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CHAPTER 4

Transdisciplinarity and Biomimicry

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Capitalizing on the emergent movement towards integrating transdisciplinarity with biomimicry, this Chapter provides an overview of the biomimicry approach, including discussion of its three basic dimensions: (a) nine principles of life; (b) nature as model, measure and mentor; and, (c) the Design Spiral methodology. If the intent of transdisciplinarity is to understand the world in all its complexities, and the world includes humans, non-humans and nature, then it makes sense to gain insights from non-humans (other species) and nature, the intent of biomimicry.
Keywords*:* transdisciplinarity, biomimicry, design spiral, complexity.

4.1 Introduction

Studying nature to get ideas to solve transdisciplinary problems has recently received new attention from the field of biomimicry [1]. An intriguing discussion has emerged in the literature during the last five years about transdisciplinarity and biomimicry. Those engaged in this intellectual discourse argue that humanity is encountering powerful new insights from the foundations of transdisciplinarity: quantum physics, chaos theory, complexity theory and living systems/ecosystems theory. They further suggest that those engaged in transdisciplinary work can benefit from employing the principles of biomimicry (and vice versa). They maintain that sustainable products, processes, services and institutions are needed as catalysts to the transition towards a sustainable human civilization. They believe that solutions to the world's problems require the transdisciplinary integration of multiple perspectives and knowledge bases, augmented with insights from biomimicry [2, 3, 4, 5].

I find this idea intriguing. If the intent of transdisciplinarity is to understand the world in all its complexities [6, 7], and the world includes humans, non-humans and nature, then it makes sense to gain insights from non-humans

Figure 4.1: Nine Life Principles from Nature.

(other species) and nature, the intent of biomimicry [8]. Madni [9], when discussing Daimler Chrysler's transdisciplinary application of biomimicry principles to design a Concept Car, observed that "humans have much to learn from Mother Nature"[9:7]. Transdisciplinarity arose from the increasing demand for relevance and applicability of academic research and non-academic knowledge to societal challenges [10]. Biomimicry arose from the increasing demand for deeper innovations and inspirations [8]. It has witnessed explosive growth as a new concept [11]. This paper provides an overview of biomimicry, anticipating insights for future conversations about the synergy between transdisciplinarity as a methodology [12, 13, 14] and biomimicry as an approach to solving problems [8].

Biomimicry claims that the laws of nature can be applied to modeling social systems, that we can adopt natural laws and logics to human needs [15]. Jucevicius [15] observes that analogical thinking (transferring ideas from one context to another) is at the heart of creative solutions to complex human prob-

lems. Successful biomimicry thinkers are inherently transdisciplinary thinkers [16]. The time seems ripe for further discussions around the idea of solving transdisciplinary problems of the world using insights from biomimicry, especially since "[m]any of the currently envisaged solutions to the global challenges facing humanity are in paramount contradiction to the 'approach' of nature" [16: 9].

4.2 Biomimicry Explained

The term biomimicry is from Greek bios, life and mimesis, imitation. It represents the new focus on mimicking natural processes to find innovative solutions to complex problems; instead of focusing on what can be extracted from nature, biomimics pay attention to what they can learn from nature. Those inspired by biomimicry study nature and then imitate or take inspiration from the designs and processes inherent in nature to solve human problems. Biomimicry occurs at the juncture where ecology meets agriculture, medicine, manufacturing materials science, energy, computing and commerce [8]. It uses an *ecological standard* to judge the rightness of human actions and innovations. The overall approach is grounded in three dimensions, discussed below: (a) nine principles of life; (b) nature as model, measure and mentor; and, (c) the Design Spiral methodology that informs biomimicry-inspired practice [8].

As a caveat, Jane Benyus [8], the founder and genesis of the idea of biomimicry, has deeply and critically engaged with each of these nine principles as a preamble to including them in her biomimicry approach. There is no question that they really work. Indeed, many others are applying this approach to their own work. Also, I purposefully chose to cite her book [8] and the work of the institute she founded, the Biomimicry Institute, as the primary sources for ideas about "what is biomimicry" as a concept and as an approach to design, development, science and research.

4.2.1 Nine Principles of Life from Nature

Benyus [8] encourages people to engage in behavior that is in harmony with earth processes. To that end, she offers a primer into nature's secrets. Indeed, many who have analyzed her work conclude that these secrets are hiding in plain sight and have been so hard for us to see because they are so familiar, so obvious [17, 18]. Benyus holds that nature has nine basic operating principles that can be used as a beneficial model for human behavior. She [8] further posits these laws, strategies and principles have been found to be consistent over generations, and over cultures. More importantly, they can be observed by anyone who is interested in perpetuating a high standard of living in harmony with nature. These life principles reflect the inherent characteristics of ecosystems (see Figure 1). In effect, nature:

- **rewards cooperation** and integration and makes symbiotic relationships work because nature is all about connections between relationships. Nature knows that we do not always have to go it alone. In fact, sometimes we cannot do it alone. Moreover, nature allows predation and competition to exist *through* cooperation. Natural ecosystems operate on a symbiotic, complex network of mutually beneficial relationships. Working together is rewarding and necessary.

- **always fits form to function**, efficiently and elegantly - nature builds something that works because it was built within the confines of available resources. Also, the shape that something takes depends upon what it is intended to do. Furthermore, nature's designs are organic and only as big as they need to be to fit their function, rather than being linear (squares and blocks) and oversized, with a focus on form. Nature optimizes rather than maximizes. Organisms in nature co-evolve, adapting to the changes of others (i.e., they fit form to function).

- **depends on and develops diversity** of possibilities to find the best solution(s) (rather than a one-size-fits-all, homogeneous approach). Nature also depends upon randomness, more so than reason, because randomness creates anomalies that open opportunities for diversity. The randomness of entropy (the breakdown of order) allows for flexibility. A wide variety of plants and animals creates the bank of diversity. The entire habitat is used, not just bits and parts of the system. Also, a system must be as diverse as its environment in order to remain viable. Systems respect regional, cultural and material uniqueness of a place. Systems are flexible, allowing for changes in the needs of people and communities - allowing for emergent diversity.

- **recycles and finds uses for everything**. Everything becomes recyclable; everything has a use. Waste should be a good thing because it will be reused again for another purpose. Nature *wants* waste; it *needs* it to sustain itself (waste equals food or sustenance). Nature does not generate waste, per se; it does not foul its own nest because it has to live in it. In closed systems, each co-existing element consumes the waste of another as its lifeline! From this perspective, the word waste goes away because *waste* means to fail to take advantage of something.

- **requires local expertise and resources**. Just as nature requires a rich bio-diversity to adapt to change and to grow, local ecosystems require a rich range of interlocking resources and the involvement of many local species to create a vibrant natural community. Locals are familiar with the boundaries within which they are living and are familiar with other species who share this space and who have developed their own adaptive expertise. Nature does not need to import from outside. If it is not there, it cannot be used. Natural ecosystems are tied to the

local land; hence, sustainability requires reliance on local expertise and indigenous knowledge.

- **avoids internal excesses** and "overbuilding" by curbing excesses from within. Nature has no ego to drive it. It remains in balance with the biosphere, that part of the earth and its atmosphere in which living organisms exist, that is capable of supporting life.

- **taps into the power of limits** and manages not to exceed them. Species flourish within the boundaries that surround them. They do not seek elsewhere for resources, and they use existing materials sparingly. Nature depends upon its constant internal feedback mechanisms for information on how to maintain balance. Nature makes the most efficient use of its surrounding resources. Nature uses *limits as a source of power*, a focusing mechanism, always conscious of maintaining life-friendly temperatures, harvesting within the carrying capacity of the boundaries and maintaining an energy balance that does not borrow against the future. Otherwise, she would perish at her own hand. Learning to live with finite resources is a source of powerful creativity. Limits create power. This idea is the opposite of seeing limits as a dare to overcome the constraints due to scarcity and to continue our expansion. Nature teaches us to flourish within boundaries.

- **runs on the natural sunlight** and other "natural sources" of energy, such as wind. All energy is sunlight. Nature knows how to gather energy efficiently. Leaves follow the sun and photosynthesis is 95% efficient (plants use the sun to turn light into sugar, the natural food that the plant lives on - and then humans eat the plant). The photosynthetic process also uses water and releases the oxygen that everything absolutely must have to stay alive. But, nature does this by using contemporary sunlight rather than heirlooms of sunlight (fossil fuels).

- **uses only the energy and resources that it needs**. Nature draws on the *interest* rather than the entire natural *capital* at its disposal. It does not draw-down resources, meaning it does not deplete resources by consuming them unnecessarily. In order to make optimal and maximum use of the limited habitat, each organism finds a niche, using only what it needs to survive and evolve.

4.2.2 Nature as Model, Measure and Mentor

Biomimicry is a new way to view and value nature. Benyus [8] posits that if people want to consciously emulate nature's genius, they need to look at nature differently. In biomimicry, people look at nature as model, measure, and mentor. Consulting life's genius brings nature's wisdom to bear [8] on today's pressing, messy, wicked problems (see Figure 2).

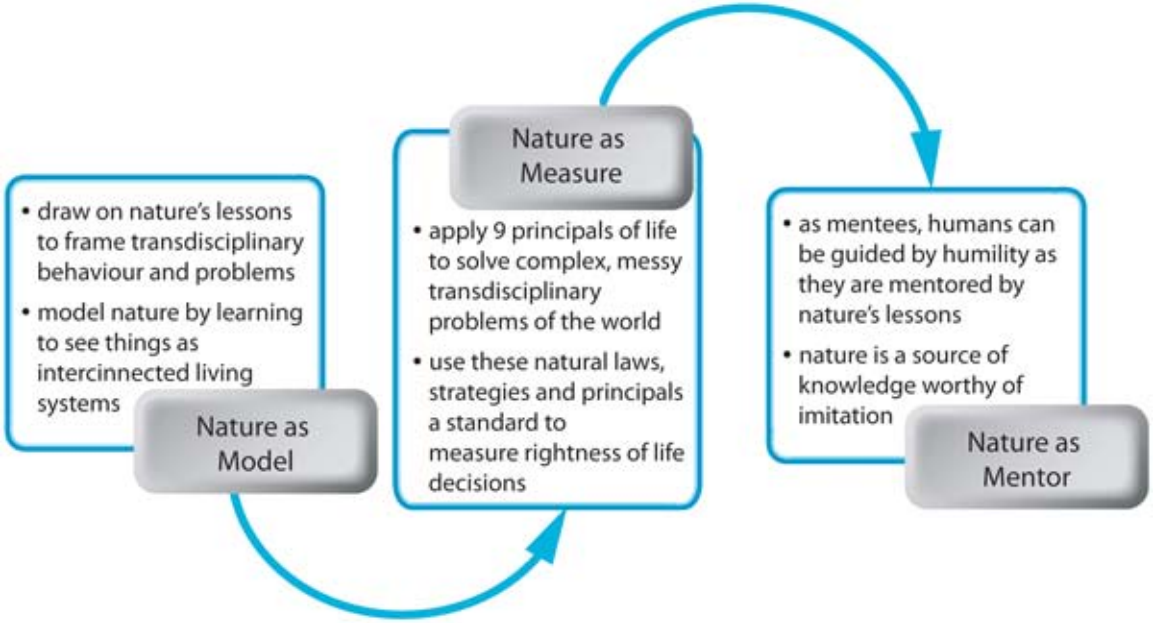

Figure 4.2: Nature as Model, Measure and Mentor.

Nature as model

People would draw on nature to model new forms of behavior. Nature can provide insights into the quest for new ways to frame day-to-day life. In nature, there is no waste, and there are no borders separating things. There are just nested systems wherein each part of the system supports the existence of the other parts. Modeling this interconnectedness and interrelatedness would respect the needs of the other species. As Benyus [8] affirms, humans are one vote in a parliament of 30 million other species. Human being's long standing arrogance (hubris) would no longer be the model for human behavior. Communities modeled on nature learn how to stay put without bankrupting their ecological capital. They learn how to optimize rather than maximize. The latter focuses on increasing measures such as revenue, profits, and margins while optimizing involves making a system or design as effective or functional as possible.

Nature as measure

People would turn to nature for guidance for standards to use to judge the "rightness" of their innovative behaviors and decisions. Are they life promoting? Does the resultant action fit with nature? Will the results or the impact last in a positive way? These questions are judged using an ecological stan-

dard, what Benyus [8] refers to as the Nine Laws of Nature, Life's Principles (discussed earlier). When a natural ecosystem reaches maturity, it is populated by *mature living organisms* that act in life affirming ways, grounded in the nine laws of nature. One measure of rightness is *ensemble living*. In nature, an ensemble is a group of complementary parts that contribute to a single effect. Ensemble living means organisms (humans and other species) learn to maintain a dynamic stability, like dancers, continually interacting without harming or compromising each other (stepping on each other's toes in the dance). The parts of the ensemble that manifest (raise up from the whole) are still enfolded in the whole.

Nature as mentor

People's relationship with nature would change from master to teacher and mentor. This new relationship would mean people have to steward nature if they want to continue to have something from which they can learn, a source of ideas, innovation and inspiration. Nature is a source of knowledge fit for imitation. Mentors are trusted friends, counselors or teachers, usually a more experienced person. Nature has had 4.2 billions of years to evolve and gain experience of living systems in evolving complex, efficient, resilient and adaptive systems. Humans would do well to watch and learn rather than exploit and destroy. The answers are there in nature if we take the time to discover and apply innovations. Nature has figured out what works, what is appropriate and what lasts. Nature has a spirit of cooperation, flexibility and diversity that has made her a reliable and long-term survivor. As mentees, humans would be guided by humility (rather than arrogance) as they begin to learn "from" nature so they can learn to fit in alongside the rest of nature.

4.2.3 Biomimicry Design Spiral

The Biomimicry Institute [19] (founded by Janine Benyus) created a Design Spiral methodology to help people learn and practice biomimicry. It comprises five or six iterative phases (see Figure 3, used with permission) based on the assumption that "after solving one challenge, then evaluating how well it meets life's principles, another challenge often arises, and the design process begins anew" [19: 1]. This section of the paper is shared using second person narrative,*you*, because each reader is presumed to be part of the transdisciplinary narrative.

The spiral process begins with you *identifying* a problem that has to be resolved. Rather than asking "What do I want to design, to come up with?", you would ask "What do I want people to do?" and continue to ask why you want them to do this (distill the problem) until you get to the bottom of the problem. You also have to be concerned with who is involved with the problem, who will be involved in the solution, its consequences, where is the problem and where will the solution be applied.

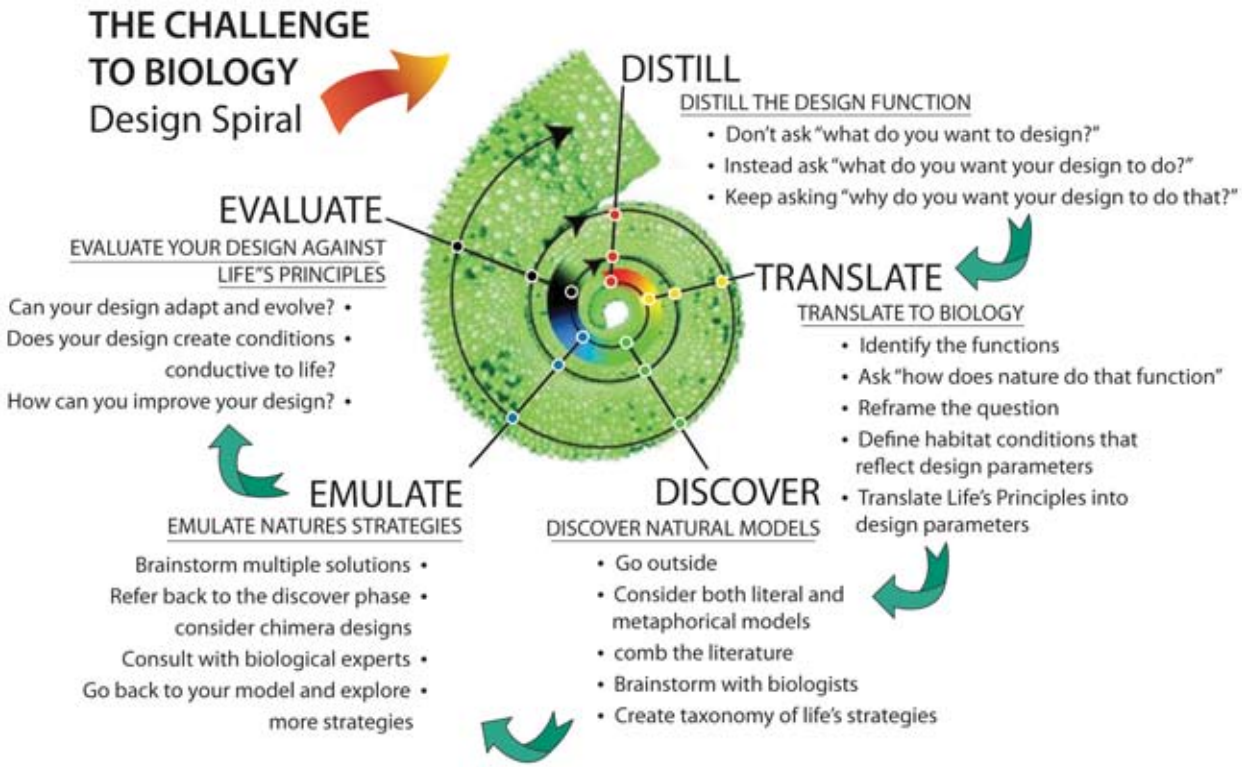

Figure 4.3: Design Spiral Methodology (used with Permission).

The second phase involves you *translating* the question so it can be approached from nature's perspective, "What would nature do here? What would nature not do here?" This reframing of the question will yield additional key words and will involve placing the issue in broader contexts and conditions so as to better translate life's principles into problem solving parameters. You need to know the climate, social, temporal and other conditions of the problem. The Biomimicry Institute [19] refers to this as *biologizing the question.*

Now you are ready to look for champions in nature, to observe what is available to answer or resolve the challenge you have identified, distilled and translated into nature's terms. In order to answer "What would nature do here?" you can consider literal examples from nature or you can use a metaphorical approach. The former entails literally going outside and looking at nature to find examples of organisms that offer insights. They are often those aspects of nature that appear unfazed by their milieu, despite its challenges (e.g., tree, stream, field, an ant's nest), and are often on the extremes of the habitat you

are observing. You can also open your discussions to other disciplines and specialists, turning the problem inside out and on its head, the true spirit of transdisciplinarity. Scour the literature and brainstorm solutions.

These third-phase strategies will move you into the fourth phase, wherein you discover and report repeating patterns and processes that nature has used to achieve success. Chronicle these discoveries and create a taxonomy of nature's genius, her life's strategies, selecting those most relevant to your problem or challenge.

The next step is to develop ideas and solutions based on nature's models and apply these solutions to your problem; that is, e͡mulate nature. Your solutions will apply the lessons you have learned from nature, your mentor and teacher (see Figure 2). You may decide to mimic a *form* from nature, one of nature's *functions* or a natural *process* (e.g., an ecosystem). Whatever strategy you settle upon, endeavor to apply the lesson(s) as deeply as possible. Ensuring this depth will likely entail resorting back to the discovery phase so you can find more patterns and processes that repeat in nature, indicating they have worked in the past to ensure survival and evolution. You will also want to consider the merit of chimera designs, those created as a result of purposively integrating two or more things together [19].

In the final phase, you *evaluate* how well your ideas and solutions (i.e., what you designed to address the challenge or problem) reflect the successful principles of nature. Ask yourself, "Does my solution(s) create conditions conducive to life? Are my solutions flexible, and able to adapt and evolve? If not, how must I change my solution(s) so that I can best emulate nature - apply life's principles to solve the problem?" This approach entailed using life's principles to develop these questions that you can now use to question your proposed solutions. As you pose these questions, the design spiral begins to unfold again and the iterative, inclusive process continues. New questions to explore emerge, and these questions tend to refine the concept you initially set out to explore in such a way that life's principles are respected and emulated.

4.3 The Fit Between Biomimicry and Transdisciplinarity

In summary, transdisciplinary problem solving from a biomimicry perspective means recognizing organic patterns and natural connections, understanding the causes and effects of competing and interrelated components, and then making appropriate modifications. People intuitively problem solve with deep respect for flexibility, adaptability and universality. They plan space for growth, restructuring and contraction. From a biomimicry perspective, people inherently adapt, deconstruct and recreate as needed, a process that mirrors the actions of living organisms [20].

The nature of problem solving from a biomimicry perspective reflects the very essence of the transdisciplinary methodology used for creating new knowl-

edge. First, transdisciplinary knowledge is complex and emergent, meaning the knowledge is continually changing as it is created, an idea which parallels with biomimicry's assumption that people have to adapt, deconstruct and recreate as needed. Transdisciplinary knowledge is alive because the problems being addressed are alive, emerging from the life world [12, 13, 14]. In the case of biomimicry, the solutions emerge from nature (which is alive as well), as discovered and interpreted by humans.

Second, the creation of transdisciplinary knowledge entails the Logic of the Included Middle wherein as many perspectives as possible are integrated. In the case of biomimicry, there is a special focus on insights gained from nature. Transdisciplinary problem solving happens in the fertile space between things, in this case between people and nature. Finding new knowledge in the fertile middle ground is possible when everyone's ideas are heard. Regarding biomimicry, the agenda is to discover and listen to ideas from nature as well, ideas that present as life principles from which complex human problems can be posed and solved. The fertile middle ground is ripe with possibilities, as is nature. People have permission to wonder, experience awe [13] and seek nature-inspired, far-reaching solutions to the world's pressing problems.

Third, transdisciplinarity assumes that many levels of reality are central to knowledge creation, including the internal mind of humans (their consciousness) and their external world (including nature) (information flows). Just like transdisciplinarity, biomimicry-inspired problem solving, with a deep emphasis on how humans from all walks of life can learn from nature, focuses on the processes and energy flows inherent in deep, complex interactions among people's internal world and their external world, mediated by such factors as culture, art, religion and spirituality. Transdisciplinarians refer to the latter as The Hidden Third, the place full of potential where people's experiences, interpretations, descriptions, representations, images, and formulas meet and new insights, perspectives and indeed, new knowledge, can emerge [12, 13, 14].

The fit between biomimicry and transdisciplinarity is elegant, ripe with hope and potentialities. Within its iterative solution-creation process, biomimicry aims to produce both new knowledge and technical artifacts (innovations) [3]. In concert, transdisciplinarity strives to produce new knowledge that can be used to create innovative solutions to pressing world problems, innovations in thinking as well as in actual artifacts to solve the problems [11]. Transdisciplinarity aims "to make *knowledge products* more pertinent to non-academic actors" [21: 170]. The synergy between these two approaches is encouraging, warranting further reflection and deliberation. Both strive to create new knowledge to inform innovative solutions to human problems.

If transdisciplinary solutions to world problems necessitate a holistic coupling of the human and the natural, as well as the inclusion of many voices and perspectives [12, 22], it makes sense that transdisciplinarity gain inspiration from biomimicry, with its focus on nature. Transdisciplinarity based on the principles of nature (biomimicry) is promising. It supports visionary approaches to solving complex messy problems that require people to "rethink

and reorient human's relationship with the planetary environment, leading to *society being able to work together with nature*" [23: 484, emphasis added]. Society *working with and through* nature, in order to solve wicked problems affecting the human condition, is a provocative concept, invoking synergistic, emergent, integral thinking, the hallmark of transdisciplinarity. Readers are encouraged to follow through with any thinking inspired by this paper, especially thoughts about what key research questions can be asked, what problems can be posed, what research designs and methods can be employed, what results can be anticipated, even which disciplines and civil society members could participate in biomimicry-informed, transdisciplinary work.

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CHAPTER 5

Transdisciplinary Pragmatism?

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In this Chapter we will carry out an ongoing exploration of a phenomenon we chose to name Transdisciplinary Pragmatism/TD–P. This phenomenon will be addressed by recognizing our intellective capacity as a continuous unveiling, an opening, a movement towards a reality that is by nature muti-dimensional and multi-referential. In our investigation, we revisited the writings of Charles Sanders Peirce (1839–1914), Martin Heidegger (1889–1976), the epistemological, methodological and ontological pillars of Transdisciplinarity, as well as three archetypal roots that invoke and evoke core principles of the proposed pragmatism: Tao Te Ching, Prometheus and Percival. We view TD–P as an event of appropriation: a creative and free act, original, present since forever, open to possibilities, but yet to be unconcealed. TD–P demands the articulation of the phenomenal method and the "trans" dimension inscribed in the transdisciplinary system of thought. We will also touch some aspects of the structural situation that make such pragmatism possible.

Keywords*:* attunement, ereignis[1] , language, logos, ontology, phenomenon, pragmatism, rift, thought, transdisciplinarity.

5.1 Introduction

Two routes of philosophic traditions. Some thoughts about the iconic landmarks of a contemporary philosophic tradition would be an initial possible approximation to understand what Transdisciplinary Pragmatism/TD–P may come to be. This because it manifests the existence of two routes of different natures and temperaments, characterized by the method they use and by their

[1]German word for event, event of appropriation, appropriation that takes place, "enowning".

démarches: "logical method which associates the analysis of concepts and mental experiments in the Anglo-American tradition; historic method which allies formulation of problems and history of philosophy in the continental philosophic tradition" [1]. Continental philosophy is here understood to mean European, and specifically, the one cultivated in France and in Germany.

Each of these directions of philosophic tradition are expressed by two currents: the analytical current and the experimental one, marked by the English utilitarianism and by American pragmatism; the current of historicity and that of reflection, the philosophic thought of the French and German schools, with a historic method and systematic spirit.

Both philosophic traditions mentioned herein contain limitations within their core. Ivan Domingues states that the limitation of the logical method is its logicism and attachment to the universal, leading the philosopher to distance him/herself from the space–temporal context, of the real historicity of systems, of the author's personal marks. The limitation of the historic method, due to its contextualism, is attached to what is particular-specific and factual, impeding "philosophy from attaining higher peaks, overcoming the limits of time and space and providing a universal discourse" [2].

Based on contradiction **A** – **no A** eminent in these two currents of philosophic traditions mentioned herein, what becomes patent is the need for a new path or route to emerge, a third way, one able to encompass a transdisciplinary perspective to come closer to reality. This way would be an emerging **T** term able to go beyond the limitations of the logical and historic methods: be it from the logical method translated by its attachment to the universal, regardless of the temporal context, be it by the historic method, with its contextualism and attachment to the particular and factual.

As part of this proposal, the logical method, a tool of philosophy, and the historic method, a tool of biology, history and philosophy, are deemed as tools and propedeutic, in the sense of instruments and of preparation put underway for the exploration of truth, and not as an end in itself, but as a process for unveiling reality. In this sense, we would be entering the field of meta-philosophy, and would be led to come ever closer to epistemic patterns or standards, of a new philosophic approach that would make possible the emergence of a new pragmatism we would call TD–P.

Our investigation led us to revisiting the body of philosophy created by Charles Sanders Peirce (1839–1914), by Martin Heidegger (1889–1976) and some archetypal roots that invoke core principles for the emergence of a TD–P. Undeniably, we come closer to these possibilities for having been inspired and founded, during decades, on the research of eminent transdisciplinary thinkers from the XX and XXI Centuries, such as Barasab Nicolescu (1942), Francisco Varela (1946–2001), Hélène Trocmé-Fabre (1931), Michel Camus (1929–2003), Michel Random (1933–2008), Patrick Paul (1948), Raimon Pannikar (1918–2010), René Barbier (1949), Stéphane Lupasco (1900–1988), among others, and also on our experience with everyday living.

5.2 Pragmatism

Since 2010, the research and actions we have carried out at the Center for Transdisciplinary Education (Centro de Educação Transdisciplinar) – CETRANS, founded in São Paulo, Brazil, in 1998 has challenged us to articulate a vision, a mindset and transdisciplinary practice. Based on our "hands on" experiences, it became evident we needed to better understand what the transdisciplinary work was all about. This concern led us to the following questions: What is Pragmatism? And what would a TD–P be?

Pragmatism is a philosophy which came about in the United States in the middle of the XIX Century, in the post civil war period, a stage of development and consolidation of industrial capitalism, when the cultural and historic horizon allowed for the emergence and subsequent development of this new thought, which responded to the desires of an intellectual American elite, and, up to a certain point, those of society. Three of their main representatives are: Peirce, William James (1842 - 1910) and John Dewey (1859 - 1952). As part of the scope of this article, we will dwell on Pierce's pragmatic vision, despite acknowledging the work of other philosophers who, in the XX and XXI Centuries, contributed to the reflection and deepening of Pragmatism.

Peirce, upon coining the name Pragmatism in 1878 defined it as the maximum rule to clarify the content of a hypothesis and its *practical consequences*. In the same way, he introduced fallabilism in his epistemological view, an anti-Cartesian stance, as an essential standard for the exercise of investigation. Twenty years went by, at a conference imparted in Berkeley, James brought Peirce's innovative thesis and his name to the attention of a seasoned and enshrined circle of philosophers, at a lecture that he called: *Philosophical Conceptions and Practical Results*. Since that time, James gave a personal interpretation to pragmatism, distancing himself from the original conception given by its creator.

Peirce states he coined the name Pragmatism for the theory according to which a given conception, what it means, the rational meaning of a word or of a given expression, consists solely and uniquely in its conceivable reach in leading life. Peircian pragmatism implies experimentation and, refers to thought, that is to say, to a reflection of how people think, how to make ideas clear and how to set forth beliefs. The principles of this pragmatism lie, in essence, upon the need to obtain clarity in our thoughts, and for that, it is necessary to consider the conceivable practical effects that objects may have, as well as the sensations we can expect from them, and also, which reactions we can anticipate. For him, the final test of what a given proposal means, in its truth, is the behavior it dictates and inspires.

Peirce's pragmatism is a sound reference to think about a TD–P, as this pragmatism articulates sensible reason – feeling and imagination; reason arising from experience – experiences and memories; formal reason – theories, concepts, rules and generalizations. To each reason, its logic, its inferences and its methodologies. According to Denoyel [3], the processes of inference

interwoven or overlapped with the three reasons, do not place impenetrable borders between then and communicate with the pragmatism of the three peircian categories: firstness, secondness and thirdness as pointed by him as shown in Table 1.

Our reflections led us to consider that even the term pragmatism be expanded, its original make up, defined by Peirce upon creating, should be preserved. For Peirce his pragmatism is interwoven into a philosophical system and aims to make that philosophy a science. Understanding the meaning of the three categories, which permeate our entire existence, allows for a fertile dialogue with the levels of reality, one of the pillars of the transdisciplinary methodology.

5.3 TD–P Inspired by Peirce's Thought

In the article *The Fixation of Belief* Peirce points out that the object of reasoning is based on what we know, to find what we still do not know. He states that whenever hope is not verified by experience, it can lead to extravagant results, that because we are inclined to fulfilling our pleasurable visions regardless of their true value, that is why he deems the strength of *foundation thought* as a decisive factor for the world's evolution.

Peirce warns that whenever conceptions are the product of logical reflections or are mixed with our common thoughts, there is great confusion and this result is never the object of observation. Exemplifying: he says a thing may be blue or green, but the quality of being blue or green are not things we see, they are the product of our logical reflections. Thus, common thought that emerges outside of what is practical, has a poor logical quality and is called metaphysical, because of this his criticism of metaphysics.

For Peirce our beliefs guide our desires and configure our actions and, because of that, they should be understood. Our beliefs determine our habits. Doubt is a state we want to get rid of so as to go on to a state of belief. All in all, doubt never changes our beliefs, but enables us to revisit them. Doubt impels us into action, until it is dissipated, it struggles until a new state of belief is attained. We resort to investigation to leave this state of irritation caused by doubt. In that sense, we perceive that because life has that old pragmatism under doubt and questioned, there is the chance for a new pragmatism to emerge.

In the second article, *How to Make our Ideas Clear*, Peirce refers to the differentiation that exists in the treaties on logic between the conception of *clear* and *obscure* and between the conception of *distinct* and *confused*. Says he: "A clear idea is defined as one which is so apprehended that it will be recognized wherever it is met with, and so that no other will be mistaken for it. If it fails of this clearness, it is said to be obscure" [4]. Moreover, the issue of the feeling of subjectivity can distort this clearness or clarity. Due to that, the idea of clarity should be supplemented with the idea of distinctiveness.

Table 1: Pragmatism of the Three Reasons.

Sensible Reason	**Experiential Reason**	**Formal Reason**
firstness (possibility) «mental mediation"»	secondness (concrete existence) «mediation – process»	thirdness (law, habit) «continuous mediation»[*]
re-presentation (strategy of the senses)	sense (strategy of the sense)	meaning (strategy of the meaning)
immediate Interpretant	dynamical interpretant	final interpretant
primacy transduction	primacy abduction / induction	primacy deduction

* Gérard Deledalle distinguishes three types of mediation as it relates to the interpretant's trichotomy in Peirce (Deledalle, 1979, p.64).

Peirce writes: "A distinct idea is defined as one which contains nothing which is not clear" [5].

Peirce points out that the limitation of these two visions is that they are given in abstract terms. According to him, this intellectual activity of logics, for centuries left aside the engineering of modern thought, and because of that, it would be necessary to set forth the method to obtain greater clarity of thoughts. Another idea on the notion of clarity and of distinctiveness involves and understanding that "Nothing new can ever be learned by analyzing definitions" [6].

Said in another way, Peirce want to move forward regarding three proposals set forth previously: 1) that of Descartes, which discards the method of authority as the apogee of the source of truth and goes on to an a priori method which it professes to find in human mind, in whatever is agreeable to reason, as a source of truth; 2) that of Kant, founded on a priori and, 3) that of Leibniz, on abstraction. Thus Peirce states that the highest level of clearness of any idea merges and will be found in its highest expression, considering that "what effects, that might be conceivably have practical bearings, we conceive the object of our conception to have" [7]. Furthermore, beliefs and order are the essential elements for intellectual economy, so much so as the other elements approached. He therefore points to the need of going beyond the notion of clearness and distinction proposed by the logic of Descartes, Kant and Leibniz.

The issue that is set forth here is the importance of knowing what we think, of becoming the masters of our own senses, so as to create a sound basis for what we think. Another relevant issue for Peirce is that the mind can merely transform knowledge, but never originate it, unless it is nurtured by the facts of observation.

In his understanding, the moment has come to set forth a method able to clarify thought, as is already being announced in some of the thinkers which are his contemporaries. This method for the clarity of ideas should have a higher level and go beyond the idea of distinction proposed by the logics up to that point. For Peirce, differently from sensations, "Thought is a thread of melody running through the succession of our sensations" [8].

The philosopher says that the action of thought is excited, motivated by the irritation of doubt and ceases only when belief is attained. For him, the only role of thought is the production of belief. Irritation, doubt, belief, fallibilism – that through which we believe that all existential truths, theoretically, if revisited by experience, offer the possibility of having something novel or better appear –, are sine-qua-non aspects for his pragmatism. Quoting Peirce:

> And what is, then, belief? âĂę first, it is something that we are aware of; second, it appeases the irritation of doubt; and third, it involves the establishment in our nature of a rule of action, or, say for short, a habit [9].

Belief herein is understood as a rule for action and, as such, as an applica-

tion which instigates new doubts and new thoughts. Belief inherently contains a contradiction: it is at the same time a place to stop and a starting point; a thought at rest and in action, despite the fact that thoughts or thinking is always essentially an action that consists in relation, as a consequence of the action. This being the case, the function of thinking is to produce habits for action. Each distinction in thought has a tangible and practical result, said in another way, each tangible and practical result has its roots in thought.

For Peirce whatever is added to thought, if disconnected from its purpose, cannot be deemed as part of it. In the same fashion, if there is a unit in our sensations that cannot be used as a reference on how to act at a given moment, we cannot call that thought. It is the identity for the habits which guide us on how to act. Thus, what is created is a causal enchainment where "... our action has exclusive reference to what affects the senses, our habit has the same bearing as our action, our belief the same as our habit, our conception the same as our belief" [10]. Thus, thought has no independent meaning from its sole function. For Peirce, the third rule on the clarity of ideas is knowing that we can only speak about which is the object of our conceptions when we consider the possible effects that its practical purposes may potentially have.

The operationalist maxims as a theory of meaning and the pragmatic maxims proposed by Peirce are valuable for the emergence and comprehension of TD–P. For him, any hypothesis has meaning in so far as it specifies what needs to be done, so that effects pre–configured by the hypothesis itself can be observed, the effects it has on other people and in the changes it processes in the environment. Even considering that the formulation of the structural situation of the TD–P is at the beginning, a deep reflection on the issues of the nature of logics and ethics formulated by Peirce are fundamental to think about the dynamic of such pragmatism. Peirce writes:

> "We have hitherto, not crossed the threshold of scientific logic. It is certainly important to know how to make our ideas clear, but they may be ever so clear without being true. How to make them so, we have next to study. How to give birth to those vital and procreative ideas which multiply into a thousand forms and diffuse themselves everywhere, advancing civilization and make the dignity of man as an art not yet reduced to rules, but of the secret of which the history of science affords some hints" [11].

A paradigmatic rupture implicit in Transdisciplinarity and the advances of science at the beginning of the XX Century announced changes posited by Peirce, the birth of what he calls vital and procreative ideas. TD–P is born from this rupture. Although the priority of such pragmatism cannot be deemed proof of its truth, simply through its exercise, constant analysis and renewal, we can, in a stepwise manner, come closer, remembering that here truth is understood as that which is closest to reality, to the origin, to singularity. To develop, understand and carry out TD–P is a choice. But, as Peirce writes, what we choose depends on if we are prepared to admire

and this is the gesture which takes us to an aesthetic, differently from what we approached previously, that falls within the realm of logics and ethics. Without logic and ethics, TD–P cannot be set up, and it is worthwhile recalling that for Peirce ethics arises from contradiction, from the tension between a pair of opposites: logic-aesthetics.

5.4 TD–P Inspired by Heidegger's Thought

> To know means to have seen, in the widest sense of seeing, which means to apprehend what is presents, as such. For Greek thought the essence of knowing consists in aletheia, that is, in the revealing of beings. It supports and guides all comportment towards beings [12].

Can the phenomemic approach by Heidegger contribute to understanding the phenomenon TD–P? Upon remarking on the concept of phenomenon, the philosopher explores the Greek roots of this word. They refer to *showing oneself* - and also to that *which shows itself*, to *that which reveals itself. To bring to the light of day* for him is what should be maintained as the meaning of the expression phenomenon, that is, that shows itself. Heidegger points out that manifesting oneself is a non–showing oneself. The self-showing that makes possible the manifestation is not the manifestation *per se*. Thus, the concept self-showing is not delimited, but an assumption, an assumption that remains concealed or unveiled. To manifest oneself is understood as announcing oneself through something that is shown. There is ambiguity and a contradiction in the word to manifest oneself, as it is at the same time what is announced and what is shown, as what is announced is not shown, it merely indicates something which is not shown. These ideas inspire and nurture the understanding and formulation of the pragmatism proposed herein.

Phenomena are never manifestations, and all manifestations are remitted to a phenomenon. It is necessary to understand the concept of manifestation to understand what the phenomenon is. All in all, there is another meaning for – manifestation, manifest oneself –, that is, something that *emerges*, that *radiates*, in that which is being announced and manifests itself, as that which can never reveals itself. Heidegger says: "Every disclosure of being as the *transcendens* is transcendental knowledge. *Phenonenological truth (disclosedness of being)* is *veritas transcendentalis*" [13].

The phenomenology of Heidegger shows two meanings: 1) method to exhibit the fundamental structures; 2) theoretical framework to be able to respond to the crisis in contemporary science. These two meanings are elucidated through the understanding of the term he created *DASEIN*, impossible to be translated in a definition, as it is about a structural situation that lies upon subtle nuances of interpretation: **DA**sein and da**SEIN**, be it in the sense of **THEREbeing** or of **BeingTHERE** as an unconcealing of being.

Dasein can further be understood as the individual non-existence, with presence, meaning, the set of all possibilities, that which is taken from the masses, the subject as maximum and ulterior authenticity, truth as unconcealed, as absolute silence, as pure moving, pure mutant, a continuous quest for that which is *more one's own*. *Dasein* also refers to the cure as care – as expressed in the meaning of curator of a museum – that has the role of bringing together, harmonizing, preserving. *Dasein* is not a rational animal, it is not the intentionality of consciousness, it is not monad, it is not idea, has no gender, nor species, nor categories, it is not *logos*, it is not *res cogitans*, it is not will and representation, it is not the will for power, it is not collective, it is not developing roles, functions. *Dasein* is imbalance par excellence, as it is a constant movement in the search for what is *more authentic to one's own*. The world is the coming into effect of *Dasein*.

Investigation and thought are two phenomenological horizons for Heidegger, even when it is about a work of art. Heidegger is not concerned with the work of art from the viewpoint of the object, nor about the creator, nor about the spectator. For him, a work of art is not an aesthetic, nor the subjective fruition as posited by Baumgarten, Kant and Schiller, nor a creating event as wanted Nietzsche, but a structural position which transcends. Art is a displacement which makes possible to unconceal that which is most authentic at a given instant, in the wink of an eye.

The substance of the work of art, its qualities – extension, form, color, weight - do not reveal it. Albeit color is a semantic filter, even so it does not reveal the initial or the rightly an origin. A work of art goes much beyond that, as we can never determine what it is fully. Heidegger states that we can use a work of art as a utensil – be it as social or orgiastic representation, profits or gains – however, a work of art as a utensil, in the sense of serving for something that will not lead us to Being. The foundation of art is to lead mankind in the direction of Being, contrary to technique which hampers and distances the unconcealing of Being. A work of art is not subjective, it is the product of the potentialized collective, that helps respond to the question about Being, about the genesis of ontology, not positioned in the realm of beings[*seiend*]. A work of art is deemed by him as being a possibility of going in the direction of the essence, of the origin, of the idea of opening to Being[*Sein*].

The focus of a work of art for Heidegger is not existence, but truth. Despite beginning not as a phenomenon, but as a product, it should lead us to the original phenomenon. Being is not a substance, nor a utensil. But within the utensil is the proof of how it is in itself, as well as how it is in the original horizon, what it was before being positioned by the artist or the spectator.

Which is the network of references that is set up when faced with a work of art? Is it ontic or ontological? How far can it lead us? The work of art itself encapsulates a given network of references. The work of art point towards itself and to its original phenomenal field. In the work of art, through the network of references, truth of the beings is *setting–into–a–work*. The function of a work of art for Heidegger is: "*Setting–into–a–work–of truth*". He writes:

> Truth is the unconcealment of beings as beings. Truth is the truth of Being. Beauty does not occur apart from this truth. When truth sets itself into the work, it [Beauty]appears [14].

The work of art waves to the abyssal dimension. Truth is that experience, the experience of Being. This revealing of oneself always conceals something. In this sense, the work of art is a event, not a substance. The event demands a complete dis-appropriation of oneself to receive one's own *Dasein*. Art for Heidegger is the place of truth – the historic power and the horizon where the one's interior, the oneself is founded.

If the transdisciplinary method is phenomenological, be it at the ontic existential level [*existenziellen*] or at the ontologic existential level [*existenzialen*], Heidegger's phenomenal approach is a great contribution to configuring the phenomenal field of TD–P. Such pragmatism addresses events with a high degree of complexity and of complexity of a high degree. It recognizes reality in its ontic dimension, that which refers to loved ones and the being of loved ones and, in its ontological dimension, that of Being. Thus, in it, *in vivo*, different levels of reality are articulated: macro-physical – emotional, psychic, mental – mythical, symbolic and of the soul – and the level of nonresistance, that is, the realm of what is sacred, of the indescribable, intangible, ineffable, where concepts do not exist, nor substance, nor loved ones. It is in this continuous being that transdisciplinary evolution is thought of in TD–P.

5.5 TD–P: Three Archetypal Roots

Our thinking led us to exploring the archetypal roots of thinking, as it is our understanding that the origin of our way of thinking, understanding and acting in the world dates back to teachings that arise from the traditions of wisdom of the East and the West. The history of thought is a constant summing up of instances that were set up in time and formed a complex structure that came up to us, after a long trajectory. In this line of thought, to elucidate the TD–P, we have chosen three archetypal currents: the first, from eastern origin, Chinese – the Tao Te Ching; a second and a third, of Western origin, European – with the myth of Prometheus, and the saga of Percival respectively.

What led us to choosing the Tao Te Ching? We chose this text for its attunement with the thinking of philosophers that we chose to work with, and because of its affinity to the guiding principles of TD–P. What does the Tao mean? The Tao can at the same time be a path in the direction of some place, a trajectory, trail and also a way in which we do things or lead our lives. Tao can further mean a discussion, a text or a way of thinking and speaking. It may refer to the fundamental nature of reality, that which things really are, the way in which the universe exists. Human life is centered on thought and language, in making distinctions, discriminations, Tao also means thought and language.

Tao is first of all the Tao of life, a way of life, a way of living in harmony with the universe. Tao is the fundamental nature of all things, that is to say, the right way for life to happen. Thus, Tao is the way we should think about the nature of the universe, and how to live according to the nature of the universe, and how to live according to those movements. These are necessary principles for the emergence of TD–P.

Some other highly relevant points in the Taoist tradition also dialogue and have that direct link with TD–P. Among them we highlight:

- Life demands constant pruning, a clipping, reaming, that requires cutting and throwing out, lapidating, getting rid of additions in its form to make it possible to return to the natural state, therefore, it's a return to the origin and valuing the primeval. Culture is always an addition which inhibits our natural state. For Taoism, we become better the more we denude ourselves of culture and regain our primordial state.
- In this path, the emphasis is placed on the *background* on the concealed plane, the backdrop, the forerunner, in the depths and not on the *foreground*. It is not about building a spontaneity, but instead recovering an effortless spontaneity we carry within us since our birth.
- In Taoism the recommendation is to return to the primordial state of thinking, which is prior to and more fundamental than that which surrounds logical thought. It is shown to us clearly that *a basis of non-discursive primordial experience* is necessary, one that considers not only the signs and thought, but also simple language as instruments for a common life.
- Tao Te Ching, shows exhaustively that the world is open for what is across and beyond, for a sort of coming into awareness, a state of permanent presence where everything that takes place has to be taken into account. It prioritizes calmness and openness to receive what comes, as what happens ends up like all good or bad things end up [15].

Tao Te Ching [16] further presents the idea of mutual relativity of all things, the mutual dependence of opposites which makes us, many times, characterize something through them. But above all, it points to our preference for choosing one of the two pairs of opposites, in detriment of the other when, in truth, there is not privileged pole that defines objects, situations, things. This trend shows us that we are constantly comparing, judging the appearance that we project on things and forgetting there intrinsic quality. It is our concerns that make objects what they are, reality is not previously sculpted for us in beings. Tao Te Ching in chapter two says the following:

> Under heaven all can see beauty as beauty only because there are ugliness,
> All can know good as good only because there is evil.

> Therefore having and not having arise together;
> Difficult and easy complement each other;
> Long and short contrast each other;
> Voice and sound harmonize each other;
> Front and back follow each other.
>
> Therefore the wise go about doing nothing, teaching no-talking. The ten thousand rise and fall without cease, Creating, yet not possessing, Working, yet not taking credit. Work is done, then forgotten. Therefore it last forever.
>
> Therefore the wise go about doing nothing, teaching no-talking.
> The ten thousand rise and fall without cease,
> Creating, yet not possessing,
> Working, yet not taking credit.
> Work is done, then forgotte
> Therefore it last forever.

For Taoism, a man who knows how to live recognizes that actions do not iniciate with him, it is up to him merely to begin them. Everything is part of a vast set of processes. He does not claim for himself what he fulfills or achieves, as fulfillments or achievements are a consequence of the confluence of a vast network of events, and that causal network is built by many people through many, many years. The life of each person is a particular fact, it is merely the extraction of a moment taken from the background, from a greater plane and it would not be different for the emergence of TD–P.

What led us to choosing the myth of Prometheus? There are several versions of the myth of Prometheus in Greek mythology [26-28], and one of them says he is a late descendant of the titans. His name, in Greek, means "the one who sees before, foresees". As a titan, he is a figure that is born from the earth and the fire of the sun, his nature is dry and a source of fire, and because of that, far from aging and deterioration. A great friend of Zeus, Prometheus helped the supreme god to dribble the fury of his father Chronos, who was dethroned by him. In exchange, Zeus granted him his friendship. However, Prometheus enjoyed the company of men, which left the god indignant and full of rage.

Prometheus fools Zeus twice: firstly, when he, wishing to mislead him and benefit the men, sacrifices an ox and offers Zeus the largest and worst part, setting aside for the men the smaller and better part. Nonetheless, the supreme god, upon perceiving what has happened, is infuriated and takes away from the men the control of fire, and symbolically deprives them of nous, of intelligence. For the second time, when Prometheus, wanting to benefit the men, steals the fire through lightning, which is an attribute of Zeus, cunningly placing it in a hollow of narthex. This plant has a combustible nature and there men once again have fire at their disposal, no longer depending on Zeus's lightning to be granted fire. Prometheus, upon stealing the sacred fire to give to the men, granted them the power to think and reason. Hesiod [17] writes:

> ...from then on, never forgetting the trick, he would not give the strength of untiring fire to ash-trees for mortal men, who live on the land. But the great son of Iapetus deceived him and stole the far-seen light of untiring fire in a hollow narthex; this bit deep in the spirit
>
> of high-thundering Zeus and his heart was angry when he saw the far-seen light of fire among men.

Zeus' anger mounts even more when he discovers that his purported friend has betrayed him and decides to punish him, decreeing that his son Hephaestus, the blacksmith god, imprison him with chains at the top of Mount Caucasus, during 30 thousand years, during which he would daily be pecked by the beak of an eagle, that would destroy his liver. The tragedy Prometheus Bounded narrates:

> ...for he stole and gave to mortals thy honor, the brilliance of fire [that aids] all arts. Hence for such a trespass he must needs give retribution to the gods, that he may be taught to submit to the sovereign of Jupiter [Zeus], and to cease from his philanthropic disposition [18].

As Prometheus was immortal, his organ regenerated constantly, and the cycle of destruction would begin anew every day. He simply frees himself from this destiny when Chiron exchanges his own mortality for his release. Zeus allowed Chiron to rid himself of the suffering caused by the poison arrow of Hydra who wounded him, thus Chiron became mortal and died serenely.

We can comprehend this myth in several ways and approach it different ways and, as a myth, its meaning will never be depleted, beginning with the name Prometheus that gives it a fundamental characteristic: that of *metis* – keen and wily intelligence, provident and practical –, *metis* warped. In this story there is an evident imbalance: Zeus is the father of the men and of the gods and is sovereign, as, he has not only *metis* but also *nous*, reflexive intelligence, the spirit. Prometheus is a titan, and his *metis* has a different nature, he is impulsive and skillful in the art of plotting. There is therefore an opposition between intellect and spirit.

Continuing to punish men and in response to the plots suffered, Zeus makes Hephaestus responsible for fabricating a woman to give to Prometheus' brother, Epimetheus, which means "what came after", the imprudent one. Thus, Pandora was created, the first woman and with this transforms the *anthropoi* (primordial man) dividing them in *andres* (men) and *gynaikes* (women). Pandora therefore brings separation. She carries a jug containing all evils and also *ElpÃηs* – expectation, pre–science, waiting, hope – and with Pandora the human conditions sets in. It inaugurates another era marked by separation, where sexuality is the form of creation that requires two opposites to give life to a third. Paradoxically, upon bringing separation she also brings the possibility of union, of reunion.

In the myth of Prometheus, the new creature, Pandora, was shaped from a mixture of earth and water and received two attributes: the first, *auden* (potential human language), the language of the *andres*, necessary for this new conditions, as that of the *anthropoi* no longer sufficed for an understanding with the gods; the second, strength, physical vigor of man. In her making, this woman should be similar in her face to the immortal gods and in her body, similar to a beautiful virgin. With Pandora therefore the process of imitation comes about, she is the imitation of what already exists, and at the same time, by not being completely novel, she is the first of her species. She is a product of *thecnē*, of the arts, whilst the primordial man belongs to the *physis*, he is, besides the gods, the original element. All of those who are born from her, are copies.

The TD–P mandatorily has to deal with this ancestral break, this reality designed archetypically in this myth. We are heirs of Prometheus when we were granted metis and the nous; we are also from Pandora and the technique that made it possible to create her, acquiring a meaning of fabrication and copy. The phenomenon of the technique becomes a part of our history as a constructive mechanism, without a return to the primacy of functionality, of total oblivion of the Being that transforms itself into something. To remember who we are we need to go back into our original experience and understand ourselves through that nature. As reported in the book *A Escola de Kyoto e o Perigo da Técnica*, São Paulo [The School of Kyoto and the Danger of the Technique]:

> Quem sabe disso é Heidegger, por ter visto que o esquecimento da experiência do primeiro começo pode e deve ser rememorado já em vista a apropriação (Er-eignis) do homem pelo desolcultamento que se oculta no e pelo outro começo do pensamento do Ser, que está por vir. [19]
>
> The one who knows about this is Heidegger, for having seen the oblivion of the experience of that initial beginning can and should be remembered in view of the appropriation (Er-eignis) of man through the unconcealing that is concealed in and for the other beginning of the thought of Being, that is about to come.

Heidegger speaks to that regard:

> But might there not perhaps be a more primally granted revealing that could bring the saving power into its first shining-forth in the midst of the danger that in the technological age rather conceals than shows itself? [20]

From the same poet Holderlin from whom we heard the word of salvation:[2]

[2]The word salvation in Heidegger's approach means to fetch something home into its essence, in order to bring the essence for the first time into its proper appearing.

"But where danger is, grows
The saving power also."

He further tells us:

"...poetically
man dwells on this earth" [21].

Inspired by the Prometheus' myth we realized that we are thrown into the world to connect future, past and present: future as a flight towards a becoming, which is a transgression of the established order, a boldness to innovate; past as destines that have been inaugurated long ago and in which we find ourselves immersed in; present as presence and our ability of being–in–the–world and being–with. This horizon of possibilities call out to be disclosed if TD–P is to be effective.

What led us to choosing Percival? This saga takes place in the ontic existential world, in which there is no unification of kingdom, but, in truth, it is about the quest for unification that takes places at the ontological existential world and, such search is an awakening process. This was the reason that led us to choosing it. Percival narrates the story of a young man who has no knowledge of his origins and who goes on the quest of the potential of becoming a knight in King Arthur's court, becoming engaged in the legendary search for the Holy Grail. We based ourselves on two versions of this text: the French by Chrétien de Troyes,*Perceval ou le Roman Du Graal* and the German by Wolfram von Eschenbach, *Perzival*, both written in the XII Century. Percival, whose name in itself is revealing, as it refers to crossing the valley or going through the veil, is about the construction and the destruction of the temple, the invisible castle, the cure of the wounded Fisher King. The version by Troyes falls into the Judeo-Christian tradition of the quest for the Grail and, that of Eschenbach, in the mythical Germanic tradition of the Grail from Munsalvaesche. In the version by Troyes, King Arthur begs Merlin, the court magician, for the unification of his kingdom, that will be consummated by the cure of the Fisher King. In the version by Eschenbach, the unification intended is in the kingdom of Amfortas, the wounded King, son of Frimutel, grandchild of Titurel, and uncle of Percival, creatively celebrated by Wagner in his opera Percival.

The line of narration of this saga is a field of successive experiences that map the road of initiation, a long journey. Finding the Grail means receiving the universal language, it is the re-appropriation of a much higher level of reality that brings the fragrance of what is Real. Percival lives many stories, each of them is a part of the whole. He does not know what he is living, he ignores his wisdom. He lives with complete detachment, presence in life. His experimenting will have the capacity of fixating something that is on the way and will culminate through the connection of his existential and spiritual body.

Percival reveres the Lady, an inspiring figure, the inspiration. This path shows the need to enhance and to set out a dynamic to revere Beauty, as the

opening to a spiritual dimension that implies being in attunement with what is Beautiful.

Countless passages of this experience are laden with meaning, with signs and signal to a destination. Among these, a strong scene where heads are cut and roll. Cutting the head means opening up to another dimension, it means establishing a new tie or link with life, it is birth into imagination, intuition, spontaneity, creativity. Heads are cut to lose human blood and open up to the emergence of royal blood.

Thus, Percival's experience is an energetic process, initiatic and not moral. He finds his own vital energy, experiences the world based on the spiritual path. He neither refuse, nor retreat when faced with confrontation. If there is no real confrontation, there is no path. Percival, listens in the first place, later sees, and does not shun, he is vigilant. His link is primarily with reality, and then with life, then with death and in a continuous purging, purifying the experience of living the path arises. Percival's experience is a passage, an opening to the field of Light.

Would the great experience of the TD–P lie in this archetypal root? Based on this saga, would it be possible to understand much more on the transdisciplinary attitude in the exercise of TD–P?

5.6 What else makes Pragmatism be Transdisciplinary?

TD–P is an *event of appropriation* in the heideggerian sense of that which is original, already present, but not yet thought of. It is based on this event that things begin to be thought of and are not remittable, as they are founding and cannot be founded, they originate. This moment is given, it is an open possibility, and it is up to each of us to accept it or not. This calling is silent, it gives us no explanation, no response, it is a calling that if we are dis–appropriated from the everyday occupation, we hear it or not. The difficulty which appears is that this calling presents itself to us as something peculiar, despite the fact its origin lies in the deepest part of ourselves, in truth: it is our interior self that calls us. It summons us to where we already belong and convenes us and provokes us to a creative act. To be faithful to this calling is an option, a choice. What calls us is the *most authentic to one's own.* It withdraws us from the everyday life and requests to be heard. It is based on this calling that we articulate new possibilities, *more authentic to our being.*

If we understand transdisciplinarity also as an epistemology, as an experience of incompleteness, as something that is at the same time *between – across – beyond* disciplines, things and people, as a transversal crossing of the borders of formal and tacit learning, academic and non-academic that aims at the emergence of the subject in his/her multidimensionality – how to foster a pragmatism that could cope with such complexity? Or what would render such pragmatism be called Transdisciplinary?

To imagine what a TD–P would be like, based on the transdisciplinary paradigmatic model, requires to understand what logics, art, cognitive references and heuristic instruments could lead the practice of the *trans* dimension to its excellence. This is a *sine qua non* condition for TD–P to emerge. However, this structural conjuncture cannot be confused with a recipe nor with a check list, as it has to be attuned, contextualized and articulated to the reality that has demanded it.

The logic of this pragmatism sets in within a fluid non-binary dynamic. It is inherent to it contradiction and paradox, transductive and abductive inferences, the dynamics of potentialization and actualization, with its intermediate stages of semi-potentialization and semi–actualization as posited by Stéphane Lupasco. This theory also posits a successive generation of third terms included that sets themselves on higher levels of reality. Each third term included is constituted by other laws and materialities that differ from those where it originated from. This logic has the role of clarifying our ideas and elucidating the consequences of our choices, forging and reformulating our conceptions, beliefs, habits and actions.

The art of this pragmatism is a *setting-into-a-work-of-truth*, that is, of Being and contemplation, in the sense of acting for the benefit of knowledge and of the pulsating wisdom in the trans dimension of Transdisciplinarity. This idea evokes the original, in the sense that Heidegger ascribed to this term: "The origin of something is the source of its essence" [22]. The cognitive frames of reference able to nurture the TD–P have as their dwelling place: the humanization of science, the multidimensionality of reality, imagination, Art as the expression of Being, the emergence of the subject, phenomenology in its ontologic existential level, the sacred and the ineffable.

Among the heuristic instruments of TD–P are: operational models; procedural pragmatism: experience–reflection–everyday living; triadic alternation: sensible, experiential and formal reasons; Art as opposed to technique.

The meaning as destiny, direction, orientation, signification, feeling and viability that fosters the TD–P emerges from the want of belonging and the search for plenitude. It is engendered by deaths as transformation, by the perception of emancipation through Beauty and what is Beautiful, and by the possibility of *coming–into–Being*. Conceived in this manner, TD–P operates in high complexity systems, that need to surpass themselves.

The *Surplus* is a type of device or activity of a cultural nature or of knowledge not directly related to a system. Whenever introduced into a system it forces the system to exceed itself. The surplus promotes the broadening of the spectrum and widens the margin of choice. This occurs due to the fact it makes available to the system resources that are vaster than those needed for its self–reproduction, of what it already has as unique in itself. In this sense, it increases the power of the system over itself, giving it greater autonomy. The *surplus* instigates curiosity, stimulates the imagination, enlarges the horizon of investigation and innovates the dynamic present in the system. The author writes that surplus is:

> ..cette partie de la ≪matière≫sociale que le système potencialise pour se reproduire comme système. Le surplus social c'est donc aussi cet individu ou ce groupe qui a ≪plus≫de culture qu'il n'en faut Ăă son rôle, une plus value pourtant indispensable à la tenue de ce rôle [23].
>
> ...a given part of the social "matter" that the system potencializes to reproduce itself as a system. The social "surplus" is therefore this individual or group that has a "plus" of culture, that it does not take into account for his role, a plus value however indispensable to sustain such role.

As regards the TD–P it is our understanding that the concept of surplus goes beyond the sociologic dimension, the social network, and can be applied to different levels of reality.

Transdisciplinary thought articulates the four paradigms – mythological, philosophic, theological and scientific – that have been known since long ago [24] which were slightly touched herein. However, we are continuously faced with the challenge of articulating thought and action based on a transdisciplinary vision. To think about TD–P is a gesture in that direction and a possible way to respond to the personal and collective flooding of suffering that continues to grow ever more and whose origin remains concealed. As Heidegger says:

> The closer we come to the danger, the more brightly do the ways into the saving power begin to shine and the more questioning we become. For questioning is the piety of thought [25].

The philosopher further adds:

> ... The lasting element in thinking is the way. And ways of thinking hold within them that mysterious quality that we can walk them forward and backward, and that indeed only the way back will lead us forward. [26]

5.7 Concluding Remarks

In this article, by revisiting the path already tread by many transdisplinary thinkers we reactivate and revere in our hearts and in our minds that invisible thread woven by our forerunners and thus, recognize its value for the emergence of what is novel. We trust we have somewhat moved forward in the reflection of what constitutes the TD–P. We also trust that the strength itself of this initial reflection will open up a rift and will create its own movement, in such a way that the status of this pragmatic utopia will be continuously enhanced, revised and updated.

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CHAPTER 6

On the Relationship of Metaphysics to Transdisciplinarity

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This essay shows the parallels between metaphysics and transdisciplinarity, both in terms of their aims and methods and in terms of their place or role in academic institutions. It attempts to define metaphysics, addresses criticisms of metaphysics, and indicates the necessary relationship of metaphysics to transdisciplinary endeavors.

Keywords*:* metaphysics, philosophy, method, transdisciplinarity, hermeneutics, deconstruction.

6.1 Introduction

In the Nicomachean Ethics, Aristotle recognizes that "each person judges rightly what he knows, and is a good judge about that; hence the good judge in a given area is the person educated in that area." No more succinct statement can be given as the basis for our traditional disciplinary way of thinking, researching, and educating. This insight is no more than common sense. But Aristotle follows this reasonable thought by claiming that "the unqualifiedly good judge is the person educated in every area,"[1]. If the requirement for being an "unqualifiedly good judge" is that one be "educated in every area," then the most reasonable conclusion to be drawn from this is that there are no unqualifiedly good judges. If this is so, then disciplinary thinking–its methods and procedures, its practices, authorizations, and certifications–are all we are reasonably entitled to. For who could possibly be "educated in every area"? It is no longer possible–if indeed it ever really were–to be a Renaissance person, engaged in the widest possible array of scientific, philosophical, and cultural pursuits. In our age of analysis and specialization, one who posed as such could be seen as no more than a dabbler. Perhaps only an Aristotle, who wrote on physics, logic, rhetoric, ethics, zoology, meteorology, poetics, politics, and so

on, could make such a claim, but it seems far too late in the scientific and cultural evolution of humanity for us to expect another Aristotle to arrive on the scene.

But just exactly what did Aristotle mean by this insight that Terrence Irwin translates as being "educated in every area"? Did Aristotle mean by this that one would need to have developed "expertise" in every area, that (in today's terms) one would have to major in every subject, earn PhD's in every field, in order to be the "unqualifiedly good judge"? And what does that latter phrase really signify? The word translated by "unqualifiedly" means "as such," a good judge *as such*, without regard to any particular field or fields of expertise. It would not intend one who is qualified (certified) as a competent judge in some specific field rather than another, but one who is competent to judge *per se*.

Let me note that if there were no such persons, the prospects for transdisciplinarity are dim. But could there be such persons? The key to answering this question lies in our interpretation of the requirement to be "educated in every area." The Greek words do not reference "areas" (or fields or disciplines). They say that one must be educated "about all" The *all* is not qualified, not referred to as the *all* insofar as it is considered as this rather than that. Is there a way of approaching the *all*, of grasping the *all* in this unqualified sense, of coming to the all as such? In other words, how can we know the *all* as the whole as such in addition to knowing the parts?

6.2 What is Transdisciplinarity?

Basarab Nicolescu has provided us with a brief and useful history of the application of the term "transdisciplinarity," [2]. He traces its earliest appearances in the work of Jean Piaget, Erich Jantsch, and André Lichnerowicz. In a critical synthesis of their various understanding of transdisciplinarity, Nicolescu summarizes the intent of transdisciplinarity by keeping close to the meanings of the Latin prefix, *trans-*: across, between, and beyond. The transdisciplinary way of understanding rests on the traditional and newly developing disciplines or regions of research and knowledge generation. It cannot mean simply to overcome or leave behind the power and productivity of disciplinary practices. Further, transdisciplinarity recognizes the fecund interplay between disciplines, which often-times leads to the conception and development of new disciplines with new research projects.

But transdisciplinarity envisions more. What is this "more"? What does "beyond" mean in terms of transdisciplinarity? Before attempting to answer this question, let us first note the motive for this desire for something "more." In an earlier essay, I wrote:

> The economic, moral, political, environmental, technical, intellectual, scientific, and even spiritual challenges we face demand approaches that are suitably rich in resources for tackling them. We

> need to learn how to take the full measure of our knowledge, to find out what it is we really know, now that we know so many disciplinarily distinct things. We need to find a way of recapturing a vision of the "forest" and not just the "trees." The negative consequences for failing to do so are obvious. Our disciplinary practices inevitably give rise to the fragmentation of knowledge. This fragmentation of knowledge leads to the fragmentation of the university, which has a significant impact on its mission to educate the next generation. The fragmented university leads–consciously or unconsciously–to training students (and faculty, too) to compartmentalize their thinking, their reality, and hence their lives. Our situation demands we respond to the "transdisciplinary imperative," an approach to research and teaching that would serve to mitigate the consequences of this fragmentation [3].

What I call the "transdisciplinary imperative" stems from our concrete reality, our present situation in which the traditional policing of knowledge and education hamstring us in our struggle to solve pressing real-world problems. We have found that a generalized fragmentation in ourselves, our communities, our institutional practices, and our world at large–a fragmentation resulting in a significant way from philosophical commitments–is no longer acceptable, that the gains we have made via our analytic prowess have come at a cost of debilitating fragmentation that needs to be addressed with alternative concepts and practices. Our sense of the root of the problems points to the fact that we will need "more" than our disciplinary practices and the institutions that support them if we are to have hope for a better future. We must not only continue our discipline-based research and not only look for fruitful cross-disciplinary initiatives; we must also look beyond disciplinary ways of encountering and appropriating reality, which may include moving beyond the institutional embodiments of disciplinary practices in order to cope with complex problems.

But Nicolescu is right, in distinguishing his views from those of, for instance, Michael Gibbons and Helga Nowotny, to say that transdisciplinarity and the "beyond" that it seeks are not solely about solving the problems that confront us–as important as those efforts are [4]. There is more to the "more" than that; the transdisciplinary imperative goes beyond that, important as that is.

It is in this that I would like to tie transdisciplinarity to metaphysics. I will not argue (in this essay, anyway) that those working in a transdisciplinary mode need be committed to any particular metaphysical position or system. Rather I want to argue against any attempt to avoid metaphysics or downplay its ultimate importance for getting to the *more*, for getting at the *all*. In short, I want to tie the transdisciplinary imperative to a metaphysical imperative (an imperative to metaphysics). Metaphysics pursues the "more" that transdisciplinarity demands, and it is in this that they are allied.

6.3 What is Metaphysics?

What is metaphysics? The answer depends on who is doing the defining. The term metaphysics has had many meanings over the course of the history of Western philosophy, and any two philosophers can run into all sorts of insoluble problems if they happen to start with two different notions of what metaphysics is. Blackwell's *A Companion to Metaphysics*, edited by the eminent philosophers Jaegwon Kim and Ernest Sosa, begins its entry on "metaphysics: definitions and divisions" (which you'd think would be pivotal) as follows: "There is no clear and generally accepted definition of metaphysics, no agreement on its tasks, scope or divisions" [5]. If that's right (and it is), then whatever I am about to say about metaphysics is likely to be arguable if not thoroughly controversial. I can do no more in this essay than to point to some of the key points or elements of metaphysics and must leave so much that would need to be said unsaid. Again, this essay is meant to suggest the broad outlines or at least the motives of what might be considered a research project at the service of a deeper understanding of transdisciplinarity.

It would pay us to recall the origin of the term "metaphysics." Aristotle, who gave us our start in so many disciplinary practices, inaugurated (from within a long-standing context, of course, dating to the Presocratics) the field of physics. The *Physics* launched a project that is still with us today, namely, to explain things in terms of their causes. In essence, that is what we still attempt to do today in physics. Aristotle discovered in the course of this pursuit that it seemed that one could not fully understand anything unless one traced the chain of causality back to the beginning (*arché, principio*), to what must be, to that which, though the cause of all else, has no cause itself. But to speak of such things required a new language, a new *method*. One cannot "explain things in terms of their causes" (physics) if they have no causes. Thus a book appeared in Aristotle's name that addressed such things as the *arché*, the beginnings, the first things, the necessary things, the unmoved mover and uncaused causer, etc. This book has come down to us through the ages bearing the title, *Metaphysics*. Aristotle did not, himself, name this book this way, nor does the book contain the term "metaphysics." Were Aristotle to describe what he was doing in that work, he would say that he was pursuing either "first philosophy" or "theology." It was "first" philosophy not in the sense that one needs to know about this particular subject matter prior to exploring, say, physics or biology (i.e., natural philosophy), but only that it was an exploration of the first things (*arché*) that were operative whether anyone recognized them or not. As John Stuart Mill (no metaphysician himself) would put it much later,

> The truths which are ultimately accepted as the first principles of a science, are really the last results of metaphysical analysis, practised on the elementary notions with which the science is conversant; and their relation to the science is not that of foundations to an edifice, but of roots to a tree, which may perform their office

> equally well though they be never dug down to and exposed to light [6].

Aristotle would also call his project "theological" not in any religious sense of the term but in the sense that in order to fully understand anything (and everything, *all*) one must make reference to a Prime Mover, an uncaused causer. Reason seems to demand it. Again, physics is not competent to address such questions according to its own method. Something *more* is needed.

But it was not until at least a century after Aristotle's death when an editor or librarian, Andronicus of Rhodes, tried to catalogue this work that the name *Metaphysics* was applied. The term simply signified the set of books that comes "after the *Physics* books"–*ta meta ta physika*. Something should be said about this word/prefix, *meta*. In time, as we shall see, thinkers came to confuse a cataloging position of the text with the subject matter of the work, coming to see the focus of metaphysics as that which is "beyond the physical." *Meta* can mean not only "after" but "beyond." However, the word meta can also signify, according to Liddell and Scott, "in the midst of" or "between", [7]. We can start to see, then, that the Greek prefix *meta-* bears a family resemblance to the Latin prefix *trans-*. Both terms convey *beyond, in the midst of, between, across, through*. The term "method" itself, to which we have referred, derives from the Greek *meta-* and *hodos*, meaning *in the midst of a certain way*. There is a relation (and tension) between metaphysics and method and between transdisciplinarity and method. Further, we should note that the disciplines derive from the nature (*physis*) of things themselves. The tension is felt in the fact that we cannot get beyond things to "things" beyond (unnatural natures?) nor can we simply leave disciplinary methods behind (as we attempt to go beyond disciplinarity?), and yet both metaphysics and transdisciplinarity demand *more*. We will return to the discussion of the interweaving of metaphysics and transdisciplinarity.

But first we must continue our discussion of metaphysics itself. Classically, metaphysics is defined as the study of being *qua* being, i.e., the exploration of being or existence just insofar as it is being/existence at all. We could think of this as the most "general" or "abstract" science (defined as any organized body of knowledge). It is not the study of this or that type of being–that's what we do in the natural and social sciences. For instance, we study living beings in biology; we study material beings in physics; we study vegetative beings in botany. But we study any kind of being–animal, vegetable, mineral, or even abstract beings–in metaphysics. This view sees metaphysics as abstracting from any given object only what pertains to its being at all, to the fact that it is. I might suggest that metaphysics is, in fact, the most concrete (if concrete is taken as the opposite of abstract) in the sense that nothing particular or idiosyncratic is abstracted from being to be focused upon. In other words, metaphysics does not abstract from being as a *whole* in order to focus on, say, the kind of thing a thing is (i.e., a thing's particular *form*). Being is what all beings have in common and does not distinguish between types of being. In any event, we could say that in any science, we're looking for patterns,

that which stays the "same" in all the various instances of any type of thing. So, for instance, in psychology, we study the pattern of human mental and emotional behavior. Any reference to particular persons and their particular behaviors are meant only to illustrate or give an example of some general pattern (say, aggression, shame, etc.). Metaphysics, in some way, tries to find the pattern of patterns. To put it in Platonic terms, it attempts to understand the "forminess" of forms. Classically, metaphysics asks: What does it take to be a thing of any kind at all? (Note here that there is a presumption in this definition that reality is a field of things but that this is, in fact, a questionable assumption.)

This basic understanding of the metaphysical endeavor would be shared, more or less, by Plato, Aristotle, and St. Thomas Aquinas. To get an in-depth understanding of what metaphysics is all about, we'd have to elaborate all the differences between these thinkers. We'd also have to trace the history of metaphysics into our present day. Were we to do that, we'd find that there are in fact various meanings for the term, metaphysics. Some thinkers discern a difference, for example, between "being" and "existence." Some equate "metaphysics" with "ontology," which term comes from the Greek words *ontos* (entity, "thing") and, of course, *logos* (meaning "study of...," but of course signifying much more than that). Some thinkers think metaphysics includes but is a wider term than ontology. Some see the job of ontology as to elaborate all the various types or kinds of things there are (this is the understanding of "ontology" that is used in computer science, database design, artificial intelligence, etc.). Philosophers who see it this way think that "metaphysics" (as its name might suggest) is supposed to be about "things" that are somehow *beyond* the physical (or at least beyond "thingness"). Opinion about whether there are such things is, of course, divided.

By *metaphysics* I mean an attempt to articulate the basic or fundamental structure of reality, the way, at base, things are. The classical definition of metaphysics is the study of being *qua* being, the study of things (*any* thing, broadly construed) in terms of the fact that it *is* at all and without regard to the type or kind of thing the thing is.

So is being, then, on this reading a univocal term or is it analogical? Is the being of any given being the "same" as the being of any other being? Or are there "manifold senses of being,"?[8].

The fact that we can formulate this as a question points to the fact that, historically, there has been confusion in the pursuit of metaphysics. One way to try to lessen this confusion is to distinguish and define a set of terms that sometimes are used interchangeably. Those terms are *being, existence*, and *reality*.

First of all, the word "being" can be thought of in a couple of different ways. We can "hear" it as a noun (a gerund). As in: "a cat is a being." In this sense, being = thing. But we can also "hear" it as a verb, a present participle, as a word signifying ongoing activity or action. As in: "the cat was being patient while waiting for his dinner." There are plenty of other examples of taking a

verb (action/activity) and making it into a noun (thing). For instance,

> "Joe is skating." (verb)
> "Skating is something Joe likes to do." (noun)

Martin Heidegger focused his attention, first of all, on the question of being, noting the ontological difference between beings and Being. A being (noun, an entity) ought not to be confused with its Being (verb). Or, better, Being ought not to be thought to be a being (or entity). This would amount to what Heidegger called "ontotheology," the confusion of a "what" with a "way." A being or entity is a thing or an object. Things are thought to have essences or that which makes them to be what they fundamentally are. St. Thomas Aquinas could be accused of "ontotheology" in his claim that God's essence is existence, which term here is meant to be synonymous with being.

But can we distinguish being from existence? Some philosophers have argued that while all real things *are* (i.e., "have" being) only some *exist*. On this view, exist means literally to "stand out." Stand out from what? Being. So a rock, for instance, "has" being and a human "has" being [to explain these "scarequotes," note that *being* is not a predicate (Kant) and is not something a thing could have or not have; if something is a thing it "has" being; there could not be a thing that then acquires being or which could lose being and remain a thing]. But only the human exists, stands out from and over against being–even its own being–and must take a stance towards being. As Heidegger would put it, human being (*Dasein*) is the being whose being it is to be a question to itself [9]. In fact, Heidegger prefers the term *Dasein* over "human" and takes a critical stance towards "humanism" just because even "human" is a question and a project, as can be seen in his quarrel with Sartre [10, 11].

Thus *Dasein* or "existence" in this conception is a sort of being, a particular kind of *what*. We might say that the particular kind of *what* is a *who*, in other words, *Dasein* or existence is or is the basis of personal being. But then not all being (verbal) is univocal in that the way of being of a rock is not the way of being of a human. Both ways entail that the different types of being in question here *are*, but they *are* not in the same way. Being (verbal) must be an analogical term rather than an univocal term.

In any event, the point here is to note that reality/being/existence is the focus of metaphysics, that reality/being/existence has a richness or essential diversity to it, and that thus there are what have been called "levels of reality" that must be recognized in any metaphysics. This insight militates against any reductionistic view or "levelling" of reality/being/existence. And if that which metaphysics pursues is that which serves as roots of the various sciences and their disciplinary practices, then there is *prima facie* evidence for seeking the "more" of transdisciplinarity.

But there have been objections to the very project and prospects of metaphysics.

6.4 Objections to Metaphysics

The fundamental questioning of the possibility and validity of metaphysics can be traced to the "epistemological turn" inaugurated by Descartes. From Thales until Descartes, philosophy was grounded in the metaphysical questions of what there is *really* and why. Philosophy, at bottom, was metaphysics. But with Descartes, the fundamental question changed from "What is there?" to "What can I know with certainty?" Philosophy became epistemology. At first, this was a matter of emphasis. Descartes applied his radical methodological doubt to the various *sources* of knowledge to see if anything could withstand withering skepticism. He found that the *I*, the ego, the thinking thing that he himself is, proved indubitable, and further that the nature of the experienceable "world" was such that it gave itself as extension, as extended things consisting of parts outside of parts. With a proof of a good God acting as a basic guarantee against radical skepticism (while still allowing for the errors of finite minds), Descartes could rebuild the edifice of knowledge based on these two substances: thought (*res cogitans*) and extension (*res extensa*).

The question arises, though, concerning the meaning of "substance" with which Descartes was operating. For it had changed. The ancient and medieval thinkers understood substance as that which was apt to exist *in* itself and not as an intrinsic part of another. On this view, there were many substances, many real things, each with its own *eidos*, its own form or idea, and its own *telos*, its own aim, goal, or purpose according to its kind. But for various philosophical reasons (and theological interests), the definition of substance changed. The definition with which Descartes was working held that substance is that which is apt to exist *by* itself, i.e., that which needs nothing other than itself in order to exist. Clearly, on this definition most (and perhaps all) of the substances (substantial beings) recognized by ancient and medieval philosophers would no longer qualify. Whereas previously both ships and sailors would count as substances (i.e., as *real* things), neither would count any longer. Ships need something other than themselves in order to exist (shipbuilders, trees, etc.), as do human beings (parents, air, water, food, etc.). These could no longer be considered the *real* constituents of reality.

But *res cogitans* and *res extensa*, as Descartes saw them, were genuine substances, the *real* things constitutive of reality. Thinking substance needs nothing other than itself in order to exist. The famous hypothesis of the "Evil Demon (or Genius)"–that legendary thought-experiment–demonstrated that even an all-powerful malevolent force is incapable of shaking the certainty of the existence of the *I* as a thinking thing. This is the conclusion of the famous argument: "I think; therefore, I am." But I am...what? *Only* a "thinking thing." The "Evil Demon" could be making me think I am an American citizen, philosophy professor, husband and father, but all of that might well be an illusion. The "Evil Demon" might even lead me to believe that I need a brain in order to think, but of this we have no absolute certainty. But I cannot be misled about my existence–no matter what the "Evil Demon" may try–so

long as I am doubting, which is a mode of thinking. So this thinking needs nothing other than itself in order to exist. And when I experience, say, this coffee cup, the "cause" of the experience may be that there is a coffee cup in front of me, or that I am remembering a coffee cup, or that I am imagining a coffee cup, or that I am hallucinating a coffee cup, or that the "Evil Demon" is making me have this experience of a coffee cup. But no matter what the cause (if any), I cannot be having an experience of this coffee cup unless it comes in the "way" of extension, of parts outside of parts, or to put it another way, if it were not to have "dimensionality." It is not possible to have any experience of a coffee cup without it having a top, bottom, left, and right, and for some duration. Otherwise, it is not experience of a coffee cup (or anything else) at all. Thus extension, extended substance (*res extensa*), needs nothing other than itself in order to exist.

This is Cartesian dualism, the idea that there are just two substances (plus God, of course): thought and extension. This leads to the intractable mind-body problem, viz., the question of how immaterial and thus un-limited mind can influence or operate on material, finite bodies. It views the human being as fundamentally *thought* (consciousness, mind, or soul) that *has* a body. It is a metaphysical schizophrenia, a condition brought on by an epistemological anxiety: the need for certainty (defined in a particular way based on particular assumptions). For Descartes had clearly not abandoned metaphysics–after all, his most important work is entitled, *Meditations on First Philosophy* (1641), "first philosophy" as we saw being Aristotle's designation for what he was after in the work known to us (but not to him) as the *Metaphysics*. Rather, metaphysics was transformed due to a change in a metaphysical point of view regarding substance coupled with a drive for a rigorous epistemology based on particular premises.

The aftermath of Cartesian dualism is well-known. Descartes' methodological skepticism is applied to his own project, the result being Humean skepticism and empiricism (a philosophical view that claims to eschew metaphysical speculation). Kant, in his horror at the implications for science, morals, and religion of this radical skepticism, developed his critical philosophy to try to have things both ways. A Kantian "critique" purports to show both *limits* and the *conditions of possibility* of its subject matter. For instance, the *Critique of Pure Reason* (1781, 1787) shows both the conditions of possibility of experience (which was meant to be the foundation of knowledge for the empiricists) and the limits of reason in terms of its drive to have metaphysical knowledge. Those limits are severe. According to traditional metaphysics, "cause," "soul," and "God," were thought to be realities about which we can have knowledge. Hume's empiricism rejected the possibility (How can one possibly experience a "cause" or a "soul" or "God"?). Kant accepted that "cause," "soul" and"God" (along with time and space) are not "out there" in the world waiting to be experienced; rather, he ingeniously placed them all in the structure of reason as constituting the conditions of possibility of experience anything at all (transcendental subjectivity). We cannot have knowledge of these–knowledge can

come only from experience, and these are impossible to experience. Rather, they make experience itself possible and so make possible what knowledge we might have. Metaphysical speculation, however, transgresses the limits of reason by positing as objects for experience that which is a formal and constitutive structure of transcendental subjectivity.

This Kantian critique has been at the base of all subsequent criticisms and rejections of metaphysics, through positivism, scientism, phenomenology, and deconstruction. The problems many philosophers see for metaphysics are as follows:

1. Metaphysics, as its name implies, attempts to investigate that which is "beyond physics." As there are no such things, metaphysics has no subject matter and is empty.

2. Metaphysics claims that there are things such as "causes" and "God," but such things cannot be experienced in any verifiable way.

3. The claims of metaphysics are such that one could both prove and disprove the same claim, leading to antinomies, confusions, nonsense.

4. There is no way to ultimately justify the principial (may I use this locution as the adverbial of principle?) or foundational claims of metaphysics; therefore, these principial claims are matters of choice, putting metaphysics on the same footing as aesthetics (which has diminished status in the aftermath of Cartesian dualism).

5. The natural (and social) sciences are perfectly able to carry on their business without reference to metaphysical claims. Therefore, the legitimacy and justification of our knowledge have "no need of such hypotheses" as metaphysics alleges to provide. Metaphysics, in this sense, is akin to religious claims.

6. Metaphysics attempts to define or delimit essences as if these were timeless and unchanging. Metaphysics privileges the timeless and unchanging over the temporal and changing as the perfect over the imperfect, as the truth over opinion. Metaphysics is about stasis. But all is flux. All things are the effects and the flow of evolutionary processes. There are no timeless essences. The pretensions of metaphysics are false.

7. But not only false. When it comes to delineating the metaphysics of human persons, metaphysics is also dangerous. It is behind the notion of set natures of things, leading to claims of natural law. A division is made between that which is natural (appropriate to a particular nature) and that which is unnatural. This thinking has been the basis of all racism, sexism, nationalism, speciesism, etc. Metaphysics is ethically and politically abhorrent.

6.5 A Response to the Charges Against Metaphysics

Quite a bill of particulars!

Again, philosophers agree that "metaphysics" is a tough word to define and yet everyone carries around some kind of working definition of it in their heads, including those who deny the possibility, plausibility, or desirability of metaphysics. So let's just start with some of those working definitions, indeed, let's just combine them. Metaphysics studies being/existence/reality as such; metaphysics studies that which must be; metaphysics studies that which does not change; metaphysics studies the first causes/principles of things. Being/existence/reality; that which must be; that which does not change; first causes/principles: Are these, themselves, *things*, things like other things? And are there such "things" (if they are, in fact, things)? And what are these like? If you address yourself to these question, you are engaged in metaphysics. The way to not be engaged in metaphysics is to not be engaged with these and allied questions. However, it seems plain to me that whatever philosophical questions you choose to engage with in lieu of these sorts questions will in fact lend themselves to raising these sorts of questions anyway. So that means we cannot fully and finally escape metaphysics. We can only shift from one more or less consciously held, more or less richly detailed metaphysical position to another. There is no "end of metaphysics," in the sense of "cessation," short of death. But what is the "end of metaphysics" in the sense of its *telos*, its aim, goal, or purpose? As already mentioned, the end of metaphysics is to explore being/existence/reality; the immutable; the necessary; and first causes/principles. But is there more to the aim of metaphysics? That is the question, more than any other, I think, that leads to opposition to metaphysics. In other words, the opposition is not to metaphysics *per se* (it is, in my view, un-opposable in that sense); rather, the opposition is to its purported aims, to what it wants to say or tries to do beyond the formal (let's call them) aims of metaphysics just mentioned. Another way to put this would be to point out that there can be no absolute opposition to metaphysics, but only opportunities to point out problems and make trouble for the metaphysical endeavor undertaken for this or that particular aim.

Does this imply, then, that there are some legitimate or acceptable or benign aims for metaphysics but also some illegitimate, unacceptable, or dangerous aims as well? And, if so, is it possible to determine whether a given aim falls into one category or the other?

I would want to answer in the affirmative. But to do so, I'd have to get back to something Spanish philosopher Miguel de Unamuno insisted upon: that philosophy (which is metaphysics) is "owned," so to speak, by the person of flesh and blood. It is that person who determines the character of metaphysics (not the formal aims, of course). Would this leave metaphysics in a position that is hopelessly subjective, perspectival, and relativistic? I would say, first, it depends on what you mean by "hopeless." And, second, I would point

out that "subjective" is, itself, a metaphysical determination, a determination that might, itself, prove unacceptable or even dangerous, as compared to other metaphysical determinations one might adopt.

Let us review the objections to metaphysics noted above. One, it seems to me, rests on an unexamined presupposition, that what there is are things, and that metaphysics deals with a particular class of things ("existence" as a supreme thing, necessary and immutable; forms-as-things; causes-as-things, etc.); and that, in fact, there are no such things, and so metaphysics is talking about nothing, i.e., it is nonsense. That is one criticism of metaphysics that starts with Kant and is continued by modern empiricism, positivism, scientism, phenomenology, and deconstruction. But, as I said, this all rests on the assumption that metaphysics addresses itself to certain kinds of things. Second, an objection to metaphysics rests on the claim that we cannot really ever know that about which we speak and write while engaged in metaphysics, that one could write up a marvelously sophisticated, intricate, ingenious metaphysical system that is based, at bottom, on the will and imagination of the philosopher himself. Such systems have no real connection to reality, or no more connection than competing systems. Hegelianism, Thomism, Begsonism, Whiteheadianism, etc., are all fine intellectual constructions that one could dabble with, but one system is as good as another because none touches reality in a real way (it is claimed). In short, there is no epistemological legitimation for metaphysics. This complaint, of course, rests on the unexamined assumption that epistemology is primary and, in its foundations at least, problem-free. This is highly debatable. This complaint stems from Cartesian thought which lost no time in transforming itself into radical skepticism. This complaint further assumes that it counts against metaphysics that there are many plausible (or should we say equally implausible, on the critics' terms?) metaphysical positions, as if the multiplicity itself militates against metaphysics, instead of, for instance, pointing to something arising archaically/principially, necessarily, and unchangeably from being/existence/reality. Now I think that in both these objections there is a problem the critics have with the non-formal ends of metaphysics. That is, I think the objectors think the metaphysician wants to have something she is not entitled to (in their minds). The metaphysician has an aim in mind, which is to know something true about the whole, which the critics say she ought to forswear. She ought not to want what she wants. But want it she does.

The other complaints against metaphysics follow from this last point. The critics seem to infer the *reason* the metaphysician wants what he wants, which is to know something true about the whole. They seem to think that this knowledge would give some sort of power and that the power is insidious and it would be used for nefarious purposes. This is not a wholly unfair complaint, by the way. Historically, there have been numerous cases that would count as evidence in the critics' favor. For instance, metaphysicians want to know something true about human beings as a whole, and when they believe they have discovered this universal truth about humans and then

articulate that truth, that truth hardens into a doctrine or an ideology that can be used politically to serve certain interests rather than others. So once you have discovered human being's timeless, unchanging nature, then any actual human being who does not fit neatly into that particular articulation of human nature becomes something other and therefore less than human (*other* seems to be always *less*). Racism, sexism, nationalism, speciesism, ableism, and on and on, all rest on what critics call a metaphysical assumption rather than a metaphysical fact, as it were. Metaphysicians claim to know what they cannot know, and as we learn from Diotima's warning about fools in the *Symposium*, believing you know what you (don't realize you) don't know is dangerous. But does this danger in itself de-legitimate metaphysics? There are, of course, lots of dangerous things that are worth doing despite any dangers that might be attendant upon their pursuit. The lesson of courage is neither to give into our fears nor to ignore them but to learn to cope with that about which we are rightly fearful. It is a lesson that teaches eternal vigilance, not defeat. Either there is something that human beings are (or "are like") or there is not. But both of the possible answers are potentially "metaphysical" in the sense that the critics mean it. Any answer is dangerous. Life is dangerous. But that is no argument against metaphysics and is actually evidence for acknowledging the ineluctability of metaphysics. Reality is fearsome, but that does not mean we ought to (or even can) recoil from it. Reality is also awesome, awe-inspiring, and to paraphrase Aristotle (without falsifying or disagreeing), philosophy, which is metaphysics, begins in awe.

In order to address two powerful would-be opponents to metaphysics, allow me to refer to Jean Grondin's biography [12] of Hans-Georg Gadamer (the hermeneuticist) as he describes the latter's debate, such as it was, with Jacques Derrida (the deconstructor). Grondin does a nice job in few words of characterizing the two thinkers' points of view. First, Derrida and deconstruction. Derrida's grammatology held that

> there is no meaning beyond the signifiers but only a ceaseless deferring of meaning, which is never accessible outside the signs projecting only the illusion of its presence. We are as it were 'imprisoned' within a pregiven sign system that we never entirely understand; only within it do we understand, find meaning, and experience truth. Truth and meaning are never given independent of a sign system. Thus the task is to deconstruct, where possible, the predeterminations of the linguistic framework, so as not to be misled by them. A respectable ethos of ideology critique, then, lies very much as the heart of deconstruction.... [13]

I want to note the end or aim of deconstruction, according to this view of deconstruction (which seems accurate to me): "The task is to deconstruct, where possible, the predeterminations of the linguistic framework, so as not to be misled by them." What could "misled" really mean here? It can only make sense to worry about whether one might be being misled if one could be *rightly*

led. What would it mean to be *rightly* led? To be *misled*, according to deconstruction, is to think that one's truths and the institutions that spring from them and in turn reinforce them have dropped from the heavens fully formed, that they reflect and reproduce and hence are the way things are and must be. To think that is to be misled. Truths and their corresponding institutions have a history, a genealogy, a contingency that is masked by "metaphysics' hypostatization." It is the false claim that these contingent constructions are necessary and unchanging (metaphysical things). That is what is false. Believing that is to be misled. But where ought we to be led? If this is the wrong path then what is the right path? If there is no right path, then there are no wrong paths. If there is no place you mean to go, then any map will do, because no route could be wrong. But deconstruction has "a respectable ethos of ideology critique" at its heart. So there is a motive. We do not wish to be misled. Who does? But now we must tread carefully. If there is no right road, then I might as well stick to the one I'm on if it should turn out that only Jacques Derrida happens to have a problem with it. As a flesh and blood man myself, I can have whatever problems I choose or that choose me, and they might not be identical with Derrida's. If my path works well enough for me, who is Derrida to warn me off of it? But what if Derrida does in fact think there is a right path (or a right-er path)? Then we need to know what it is. It can be framed negatively: there are no timeless, eternal things; as Heraclitus taught, "all is flux." But this is a claim about the *all*, which is metaphysics, which is about the way things are, now and forever, without change. All is contingent just means that contingency is a metaphysical character of reality, and as real beings ourselves, it is that with which we need to cope (and not cower in the face of). The enemy here is finality, the idea that metaphysics, in grasping for the timeless and unchanging, is hoping to put an end to something. But what about the idea of, shall we call it, *contingent necessity*? A paradox? An oxymoron? Or is it a metaphysical insight? If all is construction and all is susceptible to deconstruction, then deconstruction is not adequate to ideology critique in some sort of final way, either. Say we realize that some particular institution has a genealogy and serves some interests and not others and could be deconstructed. So what? Unless you have some idea of better or improvement, you have made a claim equivalent to "everything is made of matter." What does that even tell us, who are men and women of flesh and blood who have to live? There is in fact no praxis lying behind deconstruction, nor does it arise out of praxis. It just claims that things do not have a final set meaning. To put it in the terms of Richard Rorty (and in opposition to his view), no one can take up an ironic stance with regard to the whole of one's life. My life is contingent, perhaps, but given that it is my life it has a necessity about it that is inalienable.

And what about Gadamer's hermeneutics? Grondin explains that

> Gadamer had to show that the experience of meaning that he was talking about has nothing metaphysical about it. For hermeneutics too there is no such thing as a final, fixed (metaphysical) meaning,

> only a meaning borne along by unpredictable effective history in which we stand and which we can try to deconstruct. [...Gadamer said] 'It seems to me that aspects of Derrida's conceptual formations such as dissemination might be viewed as structurally similar to historically effected consciousness, or *différance* to fusions of horizons' [14].

Grondin continues:

> Derrida was suspicious of the hermeneutic concept of horizon, because it seemed too close to an all-encompasing *horizon* of meaning [i.e., it seemed "metaphysical" to Derrida]. In 1993, however, Gadamer tried to explain to Derrida that the horizon is rather something that is never reached. [...] Gadamer's universalist hermeneutics was never meant to imply that we can understand everything but at most that we are beings that try to understand and often enough fail. Indeed, it is precisely because we fail in principle that we are always in search of understanding and meaning. This failure is one manifestation of the human finitude that Derrida too wants to insist on. [...] Yet [Gadamer] must have felt challenged by Derrida's charge that the will to understand operates by way of (imperialistically) appropriating otherness to the understander. For, crudely put, do I understand *the other* when I understand him? Or is it precisely then that I miss understanding him. In fact, does not the gap in understanding, the jump beyond understanding, get us further along? [15]

Grondin explains that Gadamer's thoughts were honed by this engagement with Derrida and deconstruction such that in his later work he came to think that "it is not the case that understanding can always find words for what we are trying to comprehend. Rather, 'we can never say everything that we would like to say'–from now on, this is the 'highest principle of philosophical hermeneutics.' Because we are finite, language always leaves us in the lurch. In this situation, hermeneutic openness to the other–to the possibility that the other is right–succeeds in achieving a new dimension, indeed a dimension of world-historical importance." [16] Taking hermeneutics in its widest possible sense as strategies for understanding in terms of an horizon (perhaps ever-receding), then hermeneutics is metaphysically engaged. The deconstructively chastened Gadamer is still making claims to the way things are. "We can never say everything we'd like to say." That's just the way things are and they are not going to change. Things have a *necessary contingency*. A paradox? An oxymoron? Or is it a metaphysical insight?

Perhaps I am concluding that there is actually less squabble here than one who attends philosophy conferences might think. All these philosophers, careful as they may be, are engaged in metaphysics in the sense the term has always had. Problems arise not from its formal ends but from the contingent

ends of its practitioners and its would-be critics, all persons of flesh and blood. The objectionable end is the end of ending metaphysics, either by concluding it, as if your articulation of it is undeconstructable, or by attempting to avoid it all together. One side purports to finish it; the other side purports to finish it off. But it is, for us men and women of flesh and blood, never finished until we, ourselves, are finished. The end of metaphysics is death.

And now one more turn: The end of metaphysics is death in the sense of the finish line. But what about a claim that says the end in the sense of aim or purpose of metaphysics is death? On a cursory reading of that claim, I'd say stay away from metaphysics if you want to live! But our own end (finish line) is death. It is the way things are. Eventual not-being is the way things necessarily and unchangingly are. They say the only sure things in life are death and taxes, but if we were to elect an anarcho-capitalist libertarian government, not even taxes would be a sure thing. But death remains. Necessarily. We are all already as good as dead. Metaphysics might seem deadly (at least deadly boring) to some people because of their aim to bring things to an end when in fact all is flux. This would, as I have argued, not be an argument to avoid metaphysics (that can't be done) but to avoid this interpretation of metaphysics and to avoid adopting this end of metaphysics. Instead, we could adopt the vision of metaphysics as a way (*meth'hodos*) of living as men and women of flesh and blood. This vision would see metaphysics, as life-affirming, as contingency-affirming. It would see the necessary as contingent because of the necessity of contingency. It would not be seeking closure but living in the time before closure, at the beginning or principle of that closure called death. Metaphysics would be a kind of virtue, perhaps the highest virtue. Metaphysics, which is philosophy, would be about the love (which is open, not closed) of wisdom, which we are driven to seek, each in our own way of flesh and blood.

Thus metaphysics is ineluctable. As a practical matter, of course, one could always do something else beside metaphysical reflection. And should one take it up, one could always reject certain metaphysical systems or positions or resist certain aims that other thinkers might have for metaphysics. But if one wants to understand the *all*, the *whole*, even if just of one's own life, sooner or later one comes down to those questions that have constituted the core of metaphysics. If one is honest with oneself, as a person of flesh and blood– and who engages in any scientific, artistic, philosophical, or spiritual pursuit if not persons of flesh and blood?–one will find oneself in one's essential nature (*physis*) always in the midst of (*meta*) metaphysical questioning.

6.6 On the Parallels between Metaphysics and Transdisciplinarity

In his 11th Thesis on Feuerbach, Marx complained that philosophers had only been interpreting the world but that the point is to change it. Let us, for

simplicity's sake, take this complaint to be a sign of tension between theory and practice. Marx was saying that all along philosophy took itself to be attempting to see (*theoria*) how things are. By "are" is meant the way things not only are but have always been and will always be, that fundamentally how things are is eternal and unchanging, despite the flux of everyday experience. That was to be the mission of philosophy, to penetrate the flux of experience to discover the eternal, to pierce through the *changing* to the underlying *unchanging*. In other words, philosophy is metaphysics. The presupposition is that one could know the way things are without affecting the way things are. The presupposition is that things are, at bottom, *unchanging*, and so not changeable in principle. Thus human appropriation of reality leaves reality "untouched," so to speak. Things are *of necessity*.

And of this, Marx complained. The basis of his complaint can be traced to the "Copernican revolution" of Kant, to the turn to transcendental subjectivity, to the notion that reason does not "discover" a world ready made but in fact *makes* a world according to its own structure. I.e., reason forms a world for reason according to reason. Still, Kant did not view philosophy's mission as being to change the world. The structure or reason was *set* (eternal and unchanging), and so the world of reason's making was also set. This is the genius of Kantian thought: it is a bulwark against the skepticism that stems ineluctably from Humean empiricism. We can know things (and hope for things and know what we ought to do) because, though the world is always for us rational beings the phenomenal world, that phenomenal world is the way it *is* for us (and the way it would be without us or for that which is other than us is unknowable and absurd). Even for Hegel, who introduce history into philosophy, who, in effect, put the structure of reason into motion, still recognized that, as he put it, the Owl of Minerva only takes flight at dusk [17]. In other words, philosophy comes along after the fact to see that what has become must have been. Philosophy's mission is to understand, to simply stand under the sway of how things are and appropriate it.

But not for Marx. For Marx, the point of philosophy is to change the world, to see that the world is always a world we make and that we must be prospective rather than, as always had been the case, retrospective. It implies a non- or anti-metaphysical position, a sense that things do not have to be as they are and always have been and always will be. We need not be mere spectators but actors.

Old habits die hard, however, and it is at least arguable (and likely probable) that historical materialism still harbors *necessity* within it, even in its revolutionary pronouncements (the so-called "inevitability of communism," e.g.). But if Marxist-inspired thought were pushed to logical limits, then we'd have to admit that, if the world needs to be changed, there is not, in fact, the guiding star to lead us in the way of change. In other words, if the world is as plastic as this position would have to hold, then the malleability of the world would have to be truly infinite. In still other words, we would be free to change it in any way and no one way would have any preeminence over another. In

the words of Sartre, we would be in "despair." For Sartre, *despair* "means that we limit ourselves to a reliance upon that which is within our wills, or within the sum of the probabilities which render our action feasible," [18]. But for Sartre–at least early Sartre–the "sum of the probabilities" and what is "feasible" would be freely determined by our will. Despair simply means a radical freedom for which, absurdly but inescapably, we are fully responsible. In short, we can change the world any way we want, but we lack a guiding star to show the way. Literally, a *dis-astrous* condition [19].

But what if philosophy made still another turn? The advent of philosophy was characterized by seeking wisdom as a kind of knowledge for knowledge's sake, a knowing without doing. The full implications of the modern turn led to a kind of practice, a pragmatism, a doing. But in its disavowal of metaphysics–thought to be a condition of non-doing–modern practice comes down to doing without knowing, a sometimes quite sophisticated and impressive yet nevertheless mindless doing. But if, in a dialectical turn, in a kind of an *Aufhebung* of the pre-modern and modern worldviews, we come to understand that we can only know by changing and change by knowing. In other words, what if philosophy were simply to be praxis? For reconsider the tension described earlier between "theory" (*theoria, sophia*), on the one hand, and "practice" (*techne, phronesis*), on the other. In his functional analysis of the human soul, Aristotle distinguishes the rational functions that have as their object the immutable things (*nous, episteme, sophia*) from the rational functions that have as their object the things which change or that which may lead to change (*techne, phronesis).* But, for the modern critic, each of these functions (*ergon*) when functioning or actualized (*energeia*) remains a doing which is a thinking, a reasoning which may lead to other action (through deliberation and decision and choice) but which is, in the end, a function of (better or worse) *theoria*. There is something *prior* to thinking for Aristotle, and for a doing to count as an action it must be deliberate or deliberated. For the modern, the point is to *do*, that our actions, in effect, *be* our thinking, that our acts do our thinking for us. This is *technology*, the *logos* or reasoning or rationality of the *techne*, the skillful doing. It is inevitable, on this conception, that technology lift off from its being in rational beings and become a rationality of a sort in itself. One can readily see this without having read Heidegger's reflections on technology in how information technology re-arranges and re-patterns the thinking of its users. But one could see it already in the mechanistic manner in which Marxist thought quickly and inevitably became a party ideological practice that subsumed adherents and opponents alike. For all its sophistication it was nevertheless a mindless doing.

Further, in a deep sense, the disciplinary fragmentation with which we have become ensnared is a function of this mindless doing, a doing for doing's sake that parallels a knowing for knowing's sake. Neither emphasis has been salutary, and indeed it seems fair to say that the former has been much more dangerous for humanity than the latter, despite the latter's drawbacks. We now face issues of environmental sustainability caused by the progression

of mindless doing. At a deep level, this can be traced to the disavowal of metaphysics.

But this disavowal arose for understandable historical reasons. While Aristotle's distinguishing between the dual objects of thought (the mutable and immutable) did not imply a real distinction or possible separation (a point missed in the alleged tension between theory and practice, between knowing and doing), Aristotle did saddle himself with presuppositions (inherited from his teacher Plato) about the essence of reality, that reality consists of substantial things with unchanging and eternal essences, thereby larding *becoming* and *change* with an inescapable (and misleading) *stasis*. And this had all the practical, not to mention political, ramifications that its modern critics complain about.

The insight that this discussion provides is that a recovery of metaphysics is necessary to habilitate genuine *praxis*, a practice that is not a mindless but a mindful doing, not an ideological driven mechanistic practice, but a genuinely thought-filled doing and an active, actualizing knowing. The separation of thought and action leads to acting in such a way as to compartmentalize knowing, i.e., to the vulgar essentialization of departments of knowledge and the generation of academic silos of disciplines with their border guards at the ready. Thus the advent of metaphysical *praxis* or, better, metaphysically informed *praxis* and praxically informed metaphysics, demands the concomitance of transdisciplinarity.

I do not wish to reduce transdisciplinarity to metaphysics as the latter has been carried out in academic philosophy departments. Clearly, even a cursory look at the literature stamped with "transdisciplinary" belies such a reduction. And I certainly do not mean to plant my flag in the term "transdisciplinarity" and claim it for my own. It is obvious to anyone who cares to look that the term is used in a variety of senses. But I do wish to say, first, that I do not think–despite all the texts, journals, conferences, research projects, and so on that have been generated in its name–that transdisciplinarity is another academic discipline. It may *masquerade* as a discipline or be festooned with all the trappings of one. It may even be that some desire that it become one, such that one could study its "methodologies" and be awarded degrees and be certified as a "transdisciplinarian"-it might turn out this would make a good career move. But it will not change the fact that transdisciplinarity is not a discipline at all. It's very name betrays it. As noted earlier, transdisciplinarity operates by means of disciplines, between disciplines, and beyond disciplines. And this means that it operates by means of, between, and beyond the institutional practices that manifest disciplinary divisions. And that means that transdisciplinarity cannot be domesticated strictly within the academy. It is not *essentially* academic. And if it is not essentially academic, then it is not strictly beholden to the academy's rationality. This does not mean–although many might argue the point–that transdisciplinarity is "irrational." It is, indeed, *transrational*, a rationality according to the logic(s) of the *trans*.

And in this it is parallel to philosophy, which is metaphysics. Although we

treat philosophy/metaphysics as *if* it were just one discipline among others, that is an illusion. "Philosophy" has been domesticated within the academy for economic and political reasons, for purposes of command and control. But domesticated "philosophy" is not *philosophy* at all but a discourse *about* philosophy. The academy is a "knowledge factory," but the very name *philosophy* shows its aim to be wisdom and not knowledge. Wisdom may be thought of as *metaknowledge* or *metascience*, again, according to the logic of the *trans*. The confusion of these two is the undoing of philosophy and a barrier to wisdom.

Both proponents and opponents of philosophy/metaphysics have misconceived the relationship between the sciences and *metascience*. Some proponents have tried to see the difference as demanding a separation, giving the sense that philosophy/metaphysics can live on without the sciences. This leave its opponents with the sense that philosophy/metaphysics is "otherworldly" and irremediably abstract, and thus can be safely discarded. The sciences alone will suffice. And some proponents, chastened by this criticism, hoped to reconfigure philosophy/metaphysics to simple *be* a science, as if an act of humility before the grandeur of the sciences. Philosophy/metaphysics needs to be defended both from its (mono-) cultured despisers *and* its well-meaning but misled friends.

If I may put it this way, what we need is an *undisciplined* philosophy/metaphysics in order that it might serve as *transdisciplinary metascience*. But this is not in any way to say that when it comes to philosophy just "anything goes"! There is a method to philosophy/metaphysics, just as there is a method to transdisciplinarity. A *meta hodos*: a way or journey along side of, after, and beyond. It is the method of *more*. It is a way of knowing *more*. *More* knowledge and *more than* knowledge (but not other than knowledge). It is a way of attending to the ancient saying, *meleta to pan*, of "taking into care beings as a whole," as Heidegger initially translates the Greek. [20] It is a way of getting at the *all* or the *whole*, knowing that that is an infinite, open horizon, knowing that there will always (structurally) be *more*. And there is a rigor to this way, as rigorous (at least) as any found in disciplinary practices. But in another way, a way that is, let me call it, "an-archic," a way that denies there is a single, containable, manageable, *arché* or principle or foundation to knowing/doing. We are so used to, culturally and institutionally speaking, the way of the disciplines (analysis and fragmentation) that we no longer understand this other way (an an-archic holism or synthesis without homogenization, reductionism, or leveling). We must relearn it.

6.7 Conclusion

In this essay I have argued for understanding metaphysics as a way of getting at the *whole*, the *all*, or the *more* that transdisciplinary thought endeavors to pursue. I have tried to think transdisciplinarity as essentially oriented by metaphysical praxis or praxically informed metaphysics, without however delineating the elements of a metaphysics that would be adequate to this

vision. That is a project for another day, of course. For now, I can only suggest that there are post-modern critical engagements with metaphysics that hold resources for such a project. These might include Whiteheadean process thought and Xavier Zubiri's philosophy of reality; speculative realism and object-oriented ontology (Graham Harman, Quentin Meillassoux, et. al.); Basarab Nicolescu's scientifically informed epistemology and alternative logics; Roberto Poli's conceptions of levels of reality (influenced by N. Hartmann); and even non-academically-disciplined thought such as Ken Wilber's integral philosophy might prove, if critically engaged, fruitful for honing metaphysical praxis. And a philosophy of the *beyond* (*meta-, trans-*) would not be worthy of the name if it failed to engage that which is beyond philosophy (new sciences, spirituality, etc.).

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CHAPTER 7

The Transdisciplinary Carats of Patristic Byzantine Tradition

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This article presents three samples of transdisciplinary-like approaches within patristic Byzantine tradition, namely, Chalcedonian Christology (in conversation with Lucian Blaga's notion of dogma), the multilevel interpretation of Scripture in St. Maximus the Confessor, and the Maximian and Palamite ideas of the rapports between science, technology, theology and the spiritual life. The contention of this article is double. First, it proposes that within Byzantine tradition there can be traced a series of transdisciplinary features, which up until recently have remained unknown and which, to be rightly appreciated, require a new appraisal through the lens of current transdisciplinary methodology. Second, and related, it contends that contemporary transdisciplinarity has deep roots within the Christian tradition, as exemplified by the Byzantine antecedents analyzed herein, and that in order to understand better the cultural process that led to transdisciplinarity such roots can no longer be ignored.

Keywords*:* dogma, hermeneutics, included middle, levels of reality, levels of perception, transdisciplinarity, worldview.

7.1 Introduction

As a fully articulated object, transdisciplinarity is an intellectual construct for which we are indebted to Basarab Nicolescu, to whom I dedicate this article. Apart from its technicalities, simply put transdisciplinary methodology represents perhaps the most generous framework for holistic thinking, having as its foundation a vision of the dynamic complexity of reality, a vision which integrates and enunciates the mysteries of being, existence and knowledge, in all their amplitude. As a contemporary worldview, transdisciplinarity largely builds upon quantum physics and its philosophical ramifications; nevertheless, it likewise draws its power from archetypal grounds, the universe of tradition

[1, pp. 196-205]. It is unfortunate that a serious transdisciplinary exploration of these traditional grounds is still yet to be undertaken, a lacuna that herein I endeavor to partially address. A transdisciplinary interpretation of tradition is urgent today, in a time when the dichotomy of modernity and tradition jeopardizes the understanding of the very roots of Western culture, together with obscuring the Christian origins of the transdisciplinary methodology and worldview. It is the contention of this article that transdisciplinarity brings to light - or actualizes, in the language of classical philosophy - unknown potencies within the forgotten, or just superficially interpreted, abysses of tradition and the human spirit. Transdisciplinarity therefore gives a clear voice and an articulated expression to tendencies that can be found, true, very often without a conscious exercise, within various traditional cultures. In doing so, it renders a great service to humankind's experience and wisdom. For instance, and to enter the theme of this article, through the intermediary of such concepts like the levels of reality and perception, and the highlighting of the unifying function of the sacred, transdisciplinarity decisively contributes to the clarification of the *modus operandi* of the Byzantine mind, and of many paradoxical positions exhibited by the Church Fathers.

Indeed, the patristic Byzantine tradition, which I shall explore in what follows, makes no exception in regards to utilizing principles of a transdisciplinary nature [2, pp. 82-84], principles which can be found in most of its theoretical propensities and practical attitudes. I qualified as 'patristic' the aspect of the Byzantine tradition explored herein given that my examples refer primarily to the thinking of some Church Fathers from the Byzantine period; likewise, by the Byzantine era I understand the cultural history of Constantinople and its afferent regions. More precisely, I shall discuss the Christological doctrine of the ecumenical council of Chalcedon, in conversation with the concept of dogma in Lucian Blaga; this analysis will be followed by a review of some aspects pertaining to the multilevel scriptural hermeneutics of St. Maximus the Confessor; finally, I shall address the Byzantine understanding of the relationships between various areas of knowledge and experience, as illustrated by the thought of St. Maximus the Confessor and St. Gregory Palamas. My aim is double. First, it is a matter of highlighting transdisciplinarity as a logical and natural outcome of a process of cultural evolution, which, after being inaugurated by the syntheses of Philo and the early Christians [3, pp. 204-210], at some point in history included the patristic Byzantine tradition. Second, and related, throughout this article I shall point out the significant contribution of transdisciplinarity to the field of patristic studies, since it clarifies certain forgotten and misunderstood aspects pertaining to the tradition of the Holy Fathers of the Byzantine epoch. Given that my effort primarily represents an act of remembrance, and consequently my approach is historical, analytical and interpretive in nature, I have no intention of discussing the possibility of applying my findings to current issues, whether theological in scope or otherwise.

7.2 The Christological Dogma

Among his precursors in transdisciplinary thinking, Basarab Nicolescu mentions as an important contributor Romanian philosopher Lucian Blaga, a genuine 'man of the included middle' who discovered 'the contradictory complementarity' of reality even before Lupasco [4, pp. 62-63]. The reference to Blaga in this context allows me to reiterate his understanding of dogma not as formulated doctrine but as a way of thinking or a methodological approach to truth [3, pp. 198, 263], and as a 'transfigured antinomy' [3, pp. 216-227]. This highly nuanced concept is crucial to the understanding of the logic behind Chalcedonian Christology. But why do we need to visit Chalcedon? Christological logic lies at the very core of the entire intellectual, axiological and practical system of Byzantium, which in the rich diversity of its expressions offers innumerable samples of a transdisciplinary–like, nuanced and inclusive thinking. More precisely, it is the logic of unions and distinctions, of unity in diversity and of diversity in unity, a logic that Nicolescu considers to be characteristic to Tradition in general [1, pp. 179-180] and which I found to have been consciously embraced and consistently utilized by the Byzantines. In the case of the Byzantine synthesis, this at once contradictory and inclusive logic led to the emergence of a whole culture of paradoxes, whose signposts are manifest as we shall discover below in the zenith of theory, in the nadir of the practical life and everywhere in between; a culture of antinomies that are at the same time irreducible and reconcilable. By far the most obvious expression of this culture is Chalcedonian Christology, to which I shall turn a little later. What matters for now is that by understanding the structure of the Christological formula of Chalcedon we are led to comprehend the tradition it represents. This is where the recourse to Blaga's concept of dogma proves to be very useful, a concept that should not be assimilated with the current idea of dogma as an ecclesiastical decree on faith.

According to Blaga [3, pp. 264-265; 5, pp. 315-320, 389-403], there are two kinds of thinking and therefore two ways of knowing reality. The most common is the enstatic intellect, reductionist in nature and ironically associated with the 'paradisal' manner or, technically, the way of 'plus-knowledge,' a way of thinking that operates by accumulation of information and by filling the gaps in the data. Reduced to the basic operations pertaining to the human mind, the enstatic intellect rejects the mysteries, denies antinomies and avoids their paradoxical expressions, thus producing a unilaterally sketched and non-contradictory image of reality. In turn, as a less common way of thinking, the ecstatic intellect, illustrative of the 'luciferian' manner or the way of 'minus-knowledge,' is contradictory and inclusive in nature, breathing the pure air of the various mysteries and the problems they entail; in other words, the ecstatic intellect deftly moves within the paradoxical world of the antinomic objects. In line with the above, Blaga perceived the morphology of heresy (i.e. God is either one or three; Christ is either God or man) as typical of the enstatic or reductive thinking; the'paradisal' extinction of all the mys-

teries through overtly simplified representations. In exchange, he considered the Trinitarian and Christological dogmas, which are antinomic in structure and paradoxical in expression (God is both one and three; Christ is both God and man), as bearing the signature of the ecstatic intellect and the 'luciferian' kind of knowledge [3, pp. 212-215], dubbed by the Byzantines as mystical and apophatic. In a transdisciplinary translation, Blaga referred to the two types of logic, binary and ternary. The enstatic intellect arrogantly operates by simplifying the mysteries, and thus allowing the slumber of reason to continue untroubled by the fact that it accepts only the objects it could represent according to the narrow canons of binary logic, the logic of the excluded middle. In turn, the ecstatic intellect stems from a spirit that is both alert and humble, operating by the means of ternary logic, i.e. of the included middle, exhibiting the capacity to accept reality as it perceives it, in all its paradoxical and contradictory complexity, without needing'to logically formalize the contradiction' [4, p. 63]. As a consequence, when it 'dogmatizes' the ecstatic intellect aims at transcending its own limitations, at defeating the temptation of reducing the mysteries of reality, and their logical contradictions, to facile depictions [3, p. 265]; thus it secures the permanence of all mysteries, and furthermore empowers or radicalizes them [5, pp. 384-389, 398-399]. In this fashion, by changing the direction of knowledge [5, p. 392] it arrives to 'dogmatic' or radically antinomic representations of reality – paraphrasing our philosopher, dogma is the articulation of a mystery as mystery – antinomies that reach paradoxical forms through a process of scission or transfiguration [3, pp. 216-224]. Blaga found this last stage of the 'dogmatic' or intellective process, namely, the 'ecstatic' transfiguration of antinomies, to be a concession made to the human mind and its weaknesses [3, p. 221]. For instance, and to bring the discussion closer to our topic, in the Christological dogma about the Savior as both one and double [3, pp. 218-219], the process of transfiguration polishes the edges of the antinomy, or hides it to some extent, by discerning the level of the (one) person and that of the (two) natures. Nevertheless, precisely this stage of the 'dogmatic' process is of interest here since, in my opinion, it illustrates a transdisciplinary kind of thinking, as we shall see in the analysis of Chalcedonian Christology. Before that, however, a few more notes on the operations of the ecstatic intellect are in order.

In a pontifical manner, etymologically speaking, dogma (as defined by Blaga) illustrates the tremendous endeavors of the mind to circumscribe diverse and more so contradictory aspects, and therefore to bridge various levels of reality. In order to account for these levels, the ecstatic intellect walks the path of humility and challenges the fundamentally reductionist nature of the human mind, a mind that finds its natural expressions in the Aristotelian non-contradictory logic, in the Cartesian clear and distinct ideas, and in the empirical representations of positivism. Thus, moving outside its comfort zone, the ecstatic intellect seeks to position itself simultaneously on various levels of perception. The ecstatic intellect knows that both the binary logic of non-contradiction and disciplinary limitations will remain forever overwhelmed by

the complexity of an otherwise paradoxical reality; it knows that *finitum non capax infinitum* and that therefore it needs to sacrifice its peace in order to make sense of things [3, p. 203]. This realization determines it to attempt the transcending of all excessive specialization, albeit not by annulling disciplinary competences, so that it is enabled to consider the objects of its interest from a variety of epistemological angles. It is as if, when looking at a mountain – the metaphor to which I shall turn in the next section – the ecstatic intellect, typical of a transdisciplinary thinking, has the simultaneous intuition of all of the mountain's sides; it is able to circumscribe the mountain of reality from above and below, giving an account of each and every level of reality by considering them through the lens of various levels of perception.

True, it is hard to believe that a single human mind could arrive at *mathesis universalis* or be capable of all the levels of perception, although I do not doubt that in the existential and cognitive metamorphosis known as the experience of holiness, that remains an open possibility. It is more likely, however, that such an achievement is in hand for a community that operates within the parameters of the ecstatic intellect, a community which I unrestrainedly designate as transdisciplinary. Perhaps the best traditional illustration of a transdisciplinary community – guided by the principle called by St. Maximus the Confessor *synexetasis*, 'careful consideration in togetherness' [6, col. 960B] – is the synod or council, be it local, regional or ecumenical. The very concept of the synod (from the Greek *synodos*, 'common way' or 'traveling together') expresses with great accuracy the foundational principle of a transdisciplinary community. Within such ecclesiastical gatherings the objects of contention, usually doctrinal antinomies, are considered from a variety of perspectives and eventually are formulated in paradoxical terms. The classic case is of course the council of Chalcedon (451 CE) [7, pp. 33-45]. The importance of this council consists in that it articulated the Christological dogma in two different theological languages, which illustrate the perceptions of the two main schools of the time, that of Alexandria and of Antioch. The rivalry and the oppositions between these two schools are well documented. Existentially motivated, Alexandrine theology was interested in the person of Christ and the complex unity of his 'hypostatic' structure, whereas the Antiochene school, hermeneutically motivated, focused on the rapports between the two natures of the Lord. More precisely, the discord referred to the personalist orientation of the former, which found in Christology the interpretive key for the experience of holiness, and the ontological propensities of the latter, which found in the metaphysical approach to the two natures of the Savior a key to comprehending some problematic passages in the gospels. Both demarches came to be genially synthesized at Chalcedon.

Resulting from the encounter between the two theological methods, Chalcedonian Christology proposed in anticipation, beyond its doctrinal content, elements of an intellectual schema typical of the transdisciplinary approach – thus representing a genuine dogma, in the sense ascribed by Blaga. More precisely, whilst proclaiming the Christological antinomy of unity in distinction,

normative for the Byzantine mindset, this dogma discriminated the plans of the contradiction by presenting the mystery of Christ in the 'transfigured' form of a hypostatic or personal unity ('one person and one hypostasis'), echoing the Alexandrine sensitivities, and physical duality ('in two natures'), which addressed the Antiochene criteria [8, p. 180]. The instruments of this discrimination were four famous adverbs, of which two, 'undividedly' and 'inseparably,' typically Alexandrine, referred to the complexity of the person of Christ, whereas the last two, 'without confusion' and 'immovably,' typically Antiochene, signified the permanence and the undamaged aspect of both natures [8, p. 180]. In this fashion the four adverbs made possible a harmonious and creative synthesis of two different theological approaches. Thus, by being of one essence with both the Father and the humankind, the Byzantine Christ is 'truly God and truly a man' [8, p. 180]; nevertheless, at the same time he is an existential or personal unity situated beyond the two natures, divine and human, 'the way what is above nature is higher than the natural,' as later clarified by St. Maximus [9, col. 1097C]. In arriving to this conclusion, whilst making concessions to the human mind by the distinction between person and natures, the Chalcedonian dogma both contained and transcended the specific representations of the two aforementioned theological traditions; it transcended the two representations by harmonizing their main views and tenets, which before were considered as irreconcilable. This exploit was possible only given the capacity of the ecclesial – genuinely ecstatic – mind to utilize, be it implicitly, the transdisciplinary principle of the included middle. Indeed, the Chalcedonian mystery of Christ referred to the Lord as being both one person and two natures. In turn, the heretical mind, illustrative of the enstatic intellect, undertook to speak either of two persons because of the two natures or of one nature because of the single person [3, pp. 218-219]. For the reductionist mind, which operated along the lines of the binary logic of the excluded middle, the notions of unity and duality were incompatible. Instead, at Chalcedon unity and duality were perceived as equally true and mutually consistent, although on two different levels of reality. Thus the Byzantines walked into the valley of astonishment, and, to paraphrase Blaga, they did so without destroying the world's corolla of wonders and without extinguishing by their thought the mysteries encountered therein. The same 'Chalcedonian' capacity transpires through their other accomplishments, as we shall see in what follows.

7.3 Levels of Interpretation

I turn now to a special case of the widespread metaphor of the mountain, here Tabor, the place of Christ's transfiguration, as interpreted by St. Maximus the Confessor (d. 662). Although the event of transfiguration was already the object of a lengthy contemplation in his *Ambigua* [9, cols. 1125D-1137C], the Confessor returned to this topic in a section dedicated to the exploration of the mystical meanings signified by the two prophets present there, i.e. Moses and

Elijah [9, cols. 1160C-1169B]. Of relevance are the perceptions of the three disciples that witnessed the event, in the interpretation of St. Maximus [9, col. 1160B-D]. I pointed out elsewhere [10, pp. 287-288] how, whilst interpreting the significance of the event, he depicted the two prophets as illustrating two ways of the spiritual life, i.e. marriage and celibacy, which, although very different in their scope and method, are equally venerable since both lead to Christ when approached through virtue [9, col. 1161D]. In commenting on my material referred to at [10], Adam G. Cooper observed that when considered within its immediate context the symmetry I perceived in the passage is relativized by the preference of the Confessor for celibacy and other aspects related to this status [11]. Now, whether symmetrical or asymmetrical, Cooper was right to note that the rapport between marriage and celibacy cannot be properly considered outside the whole section dedicated to the contemplation of the two prophets; in fact he found in this section eight such pairs. More precisely, and according to him, in a symbolic key Moses represents the legal word, wisdom, knowledge, praxis, marriage, death, time and the sensible, whereas Elijah illustrates the prophetic word, kindness, education, contemplation, celibacy, life, nature and the intelligible. Cooper was likewise correct to observe that for St. Maximus the aspects signified by Elijah were more important than those illustrated by Moses. Nevertheless, before moving any further I would like to observe that the imbalance noted by Cooper between the two series of aspects refers in fact to the different ways in which they lead to Christ, easier and in a more difficult manner, respectively; the series associated with Moses was not altogether discarded by the Confessor, an aspect with which Cooper agreed. That said, what matters is that within the Maximian vision the aspects signified by both Moses and Elijah point to Christ, reaching a synthesis and finding fulfillment in him, a theme to which I shall return.

Given the transdisciplinary carats of this approach, which I shall address soon, of interest here is the fact that St. Maximus highlighted a variety of nuances implied by the two prophets and also that he made no special effort in bringing these aspects to a total accord. We recognize features of Blaga's 'luciferian' knowledge, which is primarily concerned with the rough contours pertaining to the mysteries and their associated problems, not with making them palatable [5, pp. 317-318]. And indeed, far from imposing the vertical reading seemingly suggested by Cooper, e.g. a reading of the Moses series in which the principle or spirit of the law would correspond to wisdom, knowledge, asceticism, marriage, life, time and the sensible creation [9, cols. 1161A-1164A], the saint rather proposed a problematic horizontal reading, in polarizing pairs, as he also did elsewhere [12, cols. 684D-685A]. For instance, in a horizontal reading, and without these pairs losing their edges, the spirit of the law corresponds to the prophetic spirit, wisdom to kindness, knowledge to education, asceticism to contemplation, marriage to celibacy, and so on and so forth. Although a vertical reading would be consistent with the bridges the Confessor built elsewhere [9, cols. 1304D-1308C] over the abysses separating realities, our text does not explicitly attempt a vertical harmonization of the

eight aspects; instead, and anticipating the transdisciplinary perspective of the levels of reality and perception, it proposes their horizontal unification, in pairs, of which four make reference to Christ and/or God as pivotal for their respective syntheses. More precisely, these pairs highlight Christ and/or God as their 'higher' points of convergence.

To be more specific, the passage proposes from the outset the presence of Moses and Elijah next to Christ as pointing to the fact that the Lord, as Logos and God, is the origin and content of all the proclamations of the Law and the Prophets; literally, Christ is 'the one from whom [originate] and about whom' are all those proclamations [9, cols. 1161A, 1164A]. Similarly, the second interpretation shows wisdom and kindness as united to Christ both directly and through the two prophets who symbolize them [9, col. 1161A]; further down, both marriage through Moses and celibacy through Elijah are in the proximity of divine Logos and lead mystically to him [9, col. 1161D]; even further down, the two saints signify the fact that both nature and time are close to God, who is their 'cause and creator' [9, col. 1164A]. All the other pairs, namely, knowledge and education, asceticism and contemplation, life and death, sensible and intelligible, are discussed only as signified by the two prophets, with no regard to their possible unification. Nevertheless, this does not mean that they could not be 'bridged' to form higher syntheses; it just means that St. Maximus was not interested in addressing such matters within this context. In various other places, the Confessor showed at least some of them as brought to a synthesis [12, cols. 668C-669D; 13, col. 681ÎŚ]. Such Maximian parallels confirm the interpretation of the whole section in terms of a horizontal unification or synthesis, and as unification with reference to the 'higher' point represented by Christ, the latter being within, between and beyond these pairs [9, cols. 1164A, 1165D-1168A] – an idea that pervades the *Ambigua* [see e.g. 9, cols. 1129CD, 1152CD].

There is no need to address the specifics of the eight pairs. In turn, noteworthy is the significance ascribed to the two prophetic figures within St. Maximus' interpretation, a significance which was considered from eight different viewpoints, antedating the transdisciplinary levels of perception. Indeed, within the Maximian multilevel approach we identify various disciplinary competences, from the study of Scripture to the contemplation of the cosmos, from ethics to epistemology, and from theory to being, all of which are complexly inferred from the symbolic figures of the two prophets; moreover, the comprehensive symbol of the two prophets present on the mountain appears to signify an overarching framework where the various perspectives converge into depicting a multilayered reality. Through symbols and beyond them, the Confessor sketched the elements of a method endowed with high transdisciplinary intensity, although he could in no way apply these elements along the lines of the modern exigencies pertaining to transdisciplinary methodology. Although in the brief prologue of the section St. Maximus reiterated that such perceptions are available only to those who, like the apostles, contemplate the mysteries of reality 'in ways that are truly gnostic' [9, col. 1160A], his hermeneuti-

cal system could be readily represented through the typical transdisciplinary metaphor of the mountain of knowledge [1, pp. 187-189; 14, pp. 46-47], as a methodical approach to reality. This metaphor conveys the message that disciplinary competences – like the various sides and altitudes of the mountain – and their outcomes should be interpreted within the framework of a whole that traverses them, is present in and between them, and likewise goes beyond them. This conclusion is confirmed by the reference to Christ, in four of the eight pairs and throughout the Maximian corpus [see e.g. 13, 620C-621C], as a 'higher' mediating principle in which can be identified the transdisciplinary included middle. For the Confessor, therefore, Christ is the ternary mediator of all polarities, which brings to synthesis all the levels of reality and perception without melting them into an indistinct whole.

The great lesson of St. Maximus' multilevel interpretation of the two prophets consists precisely in presenting the dynamic unity of the whole as effected without a reduction of the levels of perception and reality – the hallmark of a dogmatic attitude in the sense given by Blaga, and of a transdisciplinary approach for Nicolescu. As a matter of fact, it seems that the Confessor already worked out that transdisciplinary hermeneutics centered on Christ, which Nicolescu is seeking [2, p. 84].

7.4 Science, Technology, Theology and the Spiritual Life

The complexities pertaining to the Byzantine synthesis cannot be reduced to the diaphanous zones of the spiritual progress and of contemplative accomplishments, even though the value of these aspects for the human experience in general and transdisciplinarity in particular could not be ignored. In the following I shall provide examples of a practical transdisciplinary attitude in Byzantium by referring to two patristic paradigms, namely, the Maximian bipolarity of civilization and the spiritual life, and the tripartite epistemology of St. Gregory Palamas.

We have become familiar with St. Maximus the Confessor, almost unanimously considered as the most significant Byzantine theologian. One of his fascinating contributions is the elaboration of a theory of everything [15; 16], a generous multilayered representation of reality [9, 1304D-1316A; 13, 436AB] as understood by the Byzantines. This encompassing worldview, which was explored by many contemporary scholars [17; 18; 19; 20; 21], yet not in a transdisciplinary perspective, proposes five polarities or levels of reality, each level containing two elements that are either contradictory or at least engaged in tense relationships; from the viewpoint of this pattern, the five polarities look identical to the eight pairs discussed above in regards to Moses and Elijah. The five polarities (uncreated and created, intelligible and sensible, sky and earth, paradise and civilization, and male and female) appear as challenges addressed to the human conscience, the latter being called to achieve

its transcendent destiny (signified by the term *anthropos*, the being that both gazes and grows upwards) [9, col. 1305B] by synthesizing all these polarized levels. The process of unification unfolds in the inverse order of the list of polarities, thus beginning with the anthropological synthesis and continuing with the terrestrial unification of civilization and the paradise, and so on up to the highest communion, of the created and the uncreated. It is true that for our purposes the entire theory would be relevant, since it confirms the transdisciplinary carats of Byzantine thinking; however, I shall address here only the second unification, which falls within the scope of this section.

The five Maximian syntheses do not entail a fusion of the elements pertaining to the five polarities [15, pp. 139-140]; unification or synthesis takes place through the building of existential bridges between the various elements, so that both their specific differences are protected and their convergence is secured. We recognize here the traces of the Chalcedonian logic of unions and distinctions [22, pp. 22-23, 49-51; 23, pp. 200-201, 203-205]. Before addressing the content of the second synthesis, it is useful to identify the issue that it undertakes to solve within the framework of Chalcedonian logic. Behind the idea of the second synthesis there is the tension, sometimes unbearable even in our age, between the spiritual life and the world of science and technology; it is a matter of evidence that most scientifically minded people ignore spirituality and, likewise, that most people that are on a spiritual quest fear science and despise technology; however, this is not a new issue, and since it was present in his own time the Confessor felt the need to offer a solution. To depict this tension, St. Maximus chose the metaphor of paradise and the inhabited or civilized space [9, col. 1305A,D]. It must be noted that the Maximian paradise is not just an allusion to the scriptural narrative of Adam and Eve; most often it refers to the spiritual life in general or rather the experience of holiness [10].

In the days of the Confessor, still affected by the extreme spiritualism of the later Origenist tradition, certain monastic circles cultivated a kind of civilizational decontextualization that was characterized, among other aspects, by the prohibition of technology. Technology was despised for belonging with the ephemeral things and more so to the fallen state of humankind. True, following in the footsteps of St. Gregory the Theologian, the Confessor designated the paradisal or spiritual experience as 'non-technological life' [9, col. 1356A; 24, col. 632C] yet in full agreement with the Cappadocian theologian he understood by this the independence, the freedom of Christ and the saints from all tools or instruments, without implying a negative connotation in regards to technology. As a matter of fact, against the monastic milieus that displayed reticence toward science and technology in the name of detachment from things material, and likewise against those completely dependent on tools and technological means, for whom the spiritual journey was meaningless, St. Maximus proposed the integrative perspective of a paradisal life within the civilized world. Civilization, science and technology, are not inherently evil; taken at face value, most instruments created by humankind are neutral from an ethical viewpoint; the only thing that could impose on them a negative con-

notation is their incorrect, irrational employment; their misuse. The Confessor insisted on the process through which the misuse of things and instruments becomes possible. It is the unfolding of human activities in a mindless way and against nature, through orientation towards things 'lesser than the human being,' upon which the human being was divinely appointed to rule [9, col. 1308C; 13, col. 253A-D]. Somewhere else St. Maximus returned to the idea with even more intensity, by construing an antithesis between the 'original' freedom of human beings from things under, around and within them, and the present human existence that unfolds under the tyranny of necessity; necessity coerces humankind to explore the 'principles of arts/techniques' in order to make tools, upon which it depends for its survival [9, col. 1353C]. Beyond the scriptural suggestion it contains, this contrast is not about the lack of usefulness of tools; it actually refers to the fact that ultimately the human being should be the master of technology and not dominated by it, or by any anonymous powers for that matter.

Given all of this, the second synthesis cannot come as a surprise; the spiritual life and technology are not fundamentally incompatible and therefore paradise can thrive in the midst of the civilized world [9, col. 1305D]. This is precisely the message of the second Maximian unification, a synthesis which was effected by Christ who sanctified the civilized world [9, col. 1309B] and is continuously achieved by the human beings that adopt a life of holiness ('a life befitting the saints') [9, col. 1305D]. We can safely surmise from the above that for St. Maximus human perfection cannot be reached unilaterally on account of either the inner life or the civilizational progress. By promoting both aspects without advising their fusion, the Confessor reconfirmed the transdisciplinary propensities of the patristic Byzantine tradition. His solution, of a holistic kind, anticipated and made possible the Palamite articulation of the complex rapports between science and/or technology, theology and spirituality.

St. Gregory Palamas (d. 1359) followed closely in the footsteps of St. Maximus, in more than one matter. A practitioner of hesychast mysticism, i.e. the Byzantine way of the inner peace, and a theoretician of humankind's participation in the divine uncreated energies [25, pp. 234-242], Palamas was also an encyclopedic mind, like the Confessor himself and almost all the scholars of the time. The alliance between these two sides of his formation, scientific-philosophical and theological-spiritual, permitted him to undertake creative excursions into most of these areas [26; 27; 28; 29]. Relevant here is the fact that, without abandoning it St. Gregory displayed an incredible freedom from the constraints of the Aristotelian logic of non-contradiction and the excluded middle. For instance, Yangazoglou [30, p. 10] observed that in discussing demonstrative syllogisms Palamas affirmed that they are both applicable and inapplicable to God. This approach, denoting the ecstatic logic of the included middle, recalls Blaga's transfigured antinomies; indeed, further nuancing his statement Palamas discriminated the plans of the contradiction by showing how demonstrative syllogisms can be utilized in regards to divine energies but not with reference to the inner life, or essence, of God. The same goes for St.

Gregory's reference to God as 'one' and 'not-one,' discussed by Bradshaw [25, pp. 240-241].

We encounter a similar freedom in the manner in which St. Gregory operated within an integrative schema of a hierarchical type, where the word 'hierarchy' does not signify an ordering of the objects in terms of superior and inferior. More precisely, Palamas worked in the parameters of a stratified worldview for which, in a transdisciplinary rendition, the various levels of perception corresponded to the respective levels of reality. For example, in writing *A Hundred and Fifty Chapters* [31] the saint evidenced the polygonal character of his vision, by showing his acumen as both a theologian and a scientist, according to the measure of that age. What we find in this writing, perhaps to the surprise of a reader who would expect some sort of syncretistic approach, is not an amalgamation of scientific and theological data; instead, we discover a clear disciplinary demarcation of the topics discussed and the methods utilized by the author. Indeed, therein it is as a scientist that St Gregory addressed matters such as the natural energy of created things, against the mythologizing tendencies to ascribe to their movement animistic qualities [31, pp. 84-86, 88, 96-98]; also, it is as a scientist that he manifested reservations toward the questionable information gathered by sensorial perceptions [31, pp. 98-102]. Furthermore, he highlighted the usefulness of scientific research that leads to technological innovation [31, p. 102; 30, p. 14], which in turn contributes to the quality of human life. Free from any disciplinary confusion, throughout the Palamite chapters dedicated to natural knowledge there is almost no reference to theology. Similarly, in the chapters on theology – which basically constitute an overview of the classical narrative about creation, fall and salvation [31, pp. 114-150], Palamas made no reference to the sciences. The saint operated consciously on two disciplinary fronts or levels of perception, which he understood as autonomous in regards to their specific competences. In his terms, it was about the plan of natural knowledge (*physike*), which explored the diversity of cosmic phenomena, and the spiritual knowledge (*pneumatike*), competent in things 'pertaining to the Spirit' [31, p. 102; 29, pp. 40-43]. This disciplinary demarcation corresponds to the distinction, fundamental for the Palamite demarche, between knowledge within the limits of the created, and mystical knowledge, which operates beyond such created parameters [32, pp. 226, 230; 25, pp. 236-237].

What matters here is that whilst clearly demarcating the two epistemological fields, Palamas adopted a transdisciplinary attitude and did not hesitate to situate himself within both of them, in order to consider the objects at hand. In the light of this very accomplishment, Palamas himself could be considered the 'higher' point for the synthesis between theology and science! To a large extent his approach corresponds to the Maximian multilevel hermeneutics, discussed above, St. Gregory showing the rare capacity to attack the mountain of knowledge from various cardinal points; more importantly, he displayed an ability to understand the disciplinary boundaries perhaps better than anyone before him in tradition. Furthermore, by adding a third dimen-

sion, he consciously proposed a tripartite methodology that allowed him to explore nature scientifically, to interpret theologically the meaning of both human and cosmic existence, and to promote the spiritual life as a privileged way to achieve human perfection. In other words, this tripartite hierarchical, or multilevel, schema refers to scientific information, theological formation and spiritual transformation, as the perfect algorithm of a holistic progress [28, pp. 50-51; 29, pp. 41-42], in which we trace, amplified, St. Maximus' program of unifying civilization and the paradisal experience. In so doing, Palamas proved consistency with his notion of the three types of perception, i.e. empirical, reflective and mystical [31, pp. 156-158; 32, p. 236], and likewise with St Basil the Great's provisions concerning the qualities required from a Christian researcher, namely, personal purification and contemplative capacity, scientific inquisitiveness and a theological mind [33, col. 4A]. The result of this approach was not the chaos of syncretism; the three levels of perception constituted together a tree, or a mountain, of knowledge whose regions preserved their distinctiveness whilst converging into a stratified map of reality.

St Gregory Palamas' message is as generous as that of his predecessors in the Byzantine tradition; within the hierarchical schema of St Gregory, transdisciplinary in nature, each field of knowledge can bring unhindered its specific input, thus contributing to the great effort of construing a multilevel representation of reality. More so, this approach affirms the possibility for a person from the sphere of theology and the spiritual life to be able to make scientific and technological contributions, and vice versa, the possibility of a scientist or engineer to undertake the spiritual transformation. As a matter of fact, this program, which functioned more or less implicitly in the Byzantine world, proved to be a factor that generated amazing innovations that still wait for a proper appraisal [34; 35].

7.5 Conclusion

We have seen above how, through a series of theoretical accomplishments, some of the most prominent Holy Fathers of the Byzantine tradition have exhibited, more or less instinctively, the ability to utilize principles pertaining to what is currently known as transdisciplinarity. Among these principles, they copiously referred to the complexity of reality, which they contemplated as structured on various levels. These findings confirm Basarab Nicolescu's intuitions regarding the transdisciplinary propensities of the Church Fathers. We have seen also how their theoretical choices found practical echoes in the integrative attitude of the Byzantines, who learnt to respect the competences of the various disciplines, granting to all of them autonomy, the right to be, within a holistic worldview. As a result, they formed a generous concept of the possibility of experiencing a spiritual life within the context of the civilized world. The cultural history of transdisciplinarity should enshrine these contributions within its hall of fame. True, given that, according to an observation of philosopher David Bradshaw [25, pp. 263-264], the West

obstinately ignored Byzantium and its accomplishments since the threshold of the first two Christian millennia, it is no surprise that it likewise forgot about the transdisciplinary carats of the Byzantine tradition. Transdisciplinarity is the way for our culture to remember what was forgotten both in the West and among those who are the ostensible inheritors of the Byzantine tradition, namely, contemporary Orthodox Christians.

Another noteworthy aspect that emerges from the above analyses is the fact that the transdisciplinary potential of the patristic Byzantine tradition could not have been highlighted in all its power if transdisciplinarity did not literally irrupt in our day and age. As the messianic significance of Hebrew Scripture was evidenced by the advent of Christ, likewise the transdisciplinary potential of Byzantine tradition comes to light when considered through the lens of contemporary transdisciplinarity. In this sense, both the patristic Byzantine tradition in particular and the traditions of the world in general profit significantly from the light projected by transdisciplinarity upon their quests, values and aspirations.

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CHAPTER 8

Vision and Experience: The Contribution of Art to Transdisciplinary Knowledge

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The author presents the practice of art as a form of knowledge and asks: What can one know through art? What does art contribute to transdisciplinarity? From an epistemological point of view, what is the nature of knowledge available through art? Here, art is described as a material, aesthetic, experiential and visionary form of knowledge, sharing similarities with alchemy. While science studies facts, art creates meaning using metaphors and correspondences. The Chapter also discusses modes of knowing: physics and biology, for example, belong to the scientific mode. Psychoanalysis and mythology use a hermeneutic mode. Philosophy is speculative and rational. Within the social sciences, there are quantitative and qualitative modes. To approach transdisciplinary complexity, a dialogue between and across modes of knowing is more difficult, yet as important as dialogue across disciplines. Art is a significant source of knowledge, and a transdisciplinary conversation needs artists as much as scientists and philosophers.

Keywords*:* Art, Transdisciplinarity, Epistemology, Modes of knowing, Alchemy, Art as experience.

8.1 Introduction

> Goethe insistera sur les différences entre la connaissance de l'artiste et celle du savant. Celui-ci procède par analyse: il divise la totalité en ses éléments constitutifs; celui-là par synthèse: il saisit la totalité dans une intuition globale. . . . Mais il s'agit bien dans l'un et l'autre cas de connaissance.
>
> **Todorov [1].**

> Einstein's space is no closer to reality than Van Gogh's sky.
>
> **Koestler [2].**

The Franco-Bulgarian philosopher Tzvetan Todorov, introducing a collection of Goethe's writings on art [1], highlights a qualifying difference between

two forms of knowledge, that of the artist and that of the scientist. Where a scientist proceeds through analysis, taking a totality apart into its most basic elements and looking at them separately, an artist knows through synthesis, apprehending a totality in a global intuition. While the scientist uses deduction and induction to study the facts of nature, the artist uses metaphors and correspondences to reveal the meaning in nature. Science and art are complementary, not contradictory, and Todorov insists that both forms are knowledge in their own right.

There is something obvious in this idea. As quantum physicist Werner Heisenberg puts it, "who could question that the spiritual content of a work of art too illumines reality for us and makes it translucent?" [3] Yet it is rare that knowledge from an artistic source is taken seriously in academic or scientific contexts. We are not used to thinking of art as a form of research; not used to deciphering and knowing what to do with the knowledge content of art works and art processes; and not used to seeing the artist as thinker and knower – other than as a specialist of art itself. The difficulty is not only a matter of cultural stereotypes about art, for the epistemological challenge is real. I have in mind a situation where an artist had been invited to contribute an artistic perspective in a science-religion conference. He installed a series of his abstract paintings, with no other form of explanation, implying that the artwork speaks for itself. I also remember an article advocating the idea that an artwork is equivalent to a text: "Drawing on the works of phenomenological philosophers such as Croce, Dewey and Ricoeur, I argue that the artwork is a text or work that is equivalent to the written text, and, as such, it should be seen as the appropriate form for a fine art doctoral thesis" [4]. Personally, I would rather maintain that an argumentative essay (such as a doctoral thesis) and an artwork are completely different semiological and epistemological objects, and that the artwork cannot be a "thesis" in that sense. If one writes an essay based on one's analysis of an artwork, then certainly the essay is a thesis; the artwork itself, however, as aesthetic artifact, is a very different thing. We cannot just amalgamate essays and artworks; the problem is more complicated than that. I think the difficulty is worth diving into, however, for art – as investigative process – is indeed a significant source of important knowledge, and a transdisciplinary conversation needs input from artists as much as it does that of scientists and philosophers. As an artist myself, I look here at my own part of the challenge: how do I understand what art "says," what kind of epistemic modality it is, and how can I make my own knowledge accessible to other researchers in the transdisciplinary movement?

8.2 The Transdisciplinary Forum

In the 1990s, researching the interdisciplinary phenomenon in the arts[1] led me to posit a unity of art beyond the different disciplines, and to look for what is common to all artistic mediums or disciplines, both traditional and new. I began to see a certain general structure in the arts; a common process, a common function, how the arts make meaning, a common experiential nature. This suggested some kind of abstract category of "art," of which the various mediums in different cultures are specific applications. For example, if oil painting on canvas is by no means universal, there is nevertheless a concept of visual creation existing beyond visual mediums; it can even apply to other mediums such as dance (one can "draw" with one's body in space) or poetry (one can "draw" a scene in poetry). An "arabesque" is a linear pattern found in Islamic art and in music. Architecture can be understood as music, and vice versa. Numerous examples can be found: if art forms and mediums are culturally specific, some notions of composition and staging, some musical, theatrical and choreographic principles, are universal. This general category of "art", albeit conceptual, enables us to distinguish what is art and what is not art, and understand new types of work in a new medium. In this essay, the word "art" refers to this general category.

A parallel can be drawn with knowledge, where one can also envision a general, transdisciplinary category beyond the specific actualizations that disciplines are. We can also envision fields of knowledge that are not yet institutionalized "disciplines," but could be. Asserting that disciplines are complementary and mutually enrich one another, the transdisciplinary view aspires to apprehend the cosmos, history and human life in their complexity as well as their unity. The International Centre for Transdisciplinary Studies and Research, the CIRET[2], brings together artists, writers, physicists, biologists, physicians, psychologists, philosophers, theologians, monks, engineers, sociologists, economists, anthropologists, etc. The diversity of its membership in itself illustrates the transdisciplinary perspective: we believe that a global vision of the world is only possible, if at all, through the dynamic articulation of the methodologies and epistemologies of all scientific disciplines, the humanities, philosophy, and the more hermeneutic, introspective and creative modes that are literature, psychoanalysis, art, mysticism, etc. In their Moral Project, the founders of the CIRET write: "Founded on a spirit of scientific rigor, the activity of the International Centre for Transdisciplinary Studies and Research will encourage the establishment of a dynamic exchange between the exact sciences, the social sciences and art and tradition" [5]. My participation in the CIRET made me wonder about art's specific contribution to the transdisciplinary vision. I already had sensed from my own creative practice

[1] By this I mean various situations in which the creative process involves using more than one medium, shifting from one's habitual medium to another, transferring methods or forms from one medium to another or using non-traditional mediums.

[2] Centre international de recherches et d'études transdisciplinaires, http://ciret-transdisciplinarity.org/

that artistic creation is a mode of knowing [6]. Although I had never studied the natural sciences, philosophy or social sciences seriously, I was aware of knowing something about the world, aware that as an artist I am holding a piece of the whole: a non-explicit yet intense intuition of the world's invisible unity. Discussing the notion of research in an art practice, Laurier and Gosselin remark,

> When the artist is fully engaged in creative practice, there is a sense of having access to a special kind of knowledge; one feels "knowledgeable" and, in this sense, understands oneself to be contributing to the elaboration of knowledge of a special kind [7][3].

But what is the nature of that intuition? How to define that "knowledge of a special kind" elaborated through creative practice?

8.3 Modes of Knowing

Despite the word's etymology, trans/disciplinarity is not occurring only through and beyond disciplines; more importantly, it occurs through and beyond modes of knowing. For example, while biology, physics and chemistry are distinct disciplines, all three belong to the same mode of knowing, the scientific mode. Psychoanalysis, art history and mythology, three relatively distant disciplines, all use now and then a hermeneutic mode. Philosophy, itself subdivided into several specialized fields, is essentially a speculative and rational way of knowing. Within the social sciences, quantitative and qualitative methodologies are two deeply different modes. To approach transdisciplinary complexity, a dialogue between and across the different modes of knowing is just as important, if not more important, than dialogue across disciplines. But it is also a lot more demanding. It is one thing for medicine to understand and incorporate the findings of biology; it is a whole other challenge to embrace how religion or psychoanalysis view human life.

We are not used to seeing art among these modes of knowing and disciplines of knowledge. We more often see it as a mode of expression, and in the university we study art as subject matter and know-how; we are only just beginning to study something else through art, as a methodology [8, 9, 10, 11, 12, 13, 14][4]. To the modern mind, art is the antithesis of science. We are moved by the world vision expressed through works of art, but we consider that vision to be subjective and thus devoid of scientific value – the value of artistic works is more a matter of the emotions, feelings and visions they make us experience[5]. But to think that an artistic vision is not a form of knowing,

[3]The original French reads: *Quand il est pleinement engagé dans une pratique de création, l'artiste éprouve souvent le sentiment d'accéder à un type particulier de connaissance ; il se sent "connaissant" et, en ce sens, il comprend qu'il participe à l'élaboration de savoirs d'un ordre particulier.*

[4]See arts-based research and new ideas about art as material knowledge [8 to 14].

[5]This was John Dewey's leading idea [15].

one has to have equated "knowledge" with "objective truth," an equation that is neither obvious nor natural. As if we can only know objective facts. As if in order to qualify as "truth," something we grasp in the mind should be grasped unambiguously the same by everyone, beyond individual subjectivities.

8.4 The Separation of Objective and Subjective

According to the Oxford Dictionary [16], "to know" means "to have information in your mind," with this important precision: "as a result of experience or because you have learned or been told it." Yet in the last century or so, knowledge has progressively become equated with only the second option: "learned" information. In contemporary culture, knowledge is scientific knowledge, the result of scientific research, some set of data that can be printed, exchanged, quantified. It comes from reading and studying rather than from experience. To get a sense of that gradual shift from an experience of the mind to transmissible information, it is useful to remember a few key points in European intellectual and cultural history:

1. The scientific revolution, which through the new "scientific method" produced knowledge as we understand it today: objective and detachable from its context and the mind which knows it.
2. The industrial revolution, coinciding with the beginning of capitalism, which (among other things) separated work from the product of work: the worker no longer being the maker of his work, no longer the author, but rather a mere link in a production chain controlled by a firm that owns and exchanges these products for profit.
3. Cartesian dualism, which establishes an irreconcilable (irreconcilable because it is ontological) distinction between the external, spatio-temporal world of matter and stuff and the subjective experiences of consciousness.
4. The invention of art in its modern form, based on the relatively new concepts of author, autonomous work and the general public.

To these four points, we could add a fifth yet invisible one, for it is not the emergence of something, but rather a disappearance:

5. The rejection of alchemy, until then a major mode of knowing [17] whose main characteristic was to be, as Françoise Bonardel remarks, "at once meditative and operative, rather than speculative" [18]. The alchemist knew through the Work, through working, a kind of embodied or materialized knowledge, difficult if not impossible to translate into writing.

Together, the above five points map an image: that of a separation between work and its products, and between the mind experiencing the illumination of knowing and what bits of information it will be able to share. This separation

is a reduction and an objectification: human work is reduced to the production of freestanding objects to be exchanged, sold, collected; knowledge is no longer an experience, no longer the state of an enlightened mind, it is reduced only to the part that can be written down and exchanged. In that context, knowledge of the scientific and technological kind presents an obvious advantage over the other forms (embodied, experienced): that of producing those objective pieces of information that can be detached and transmitted.

The problem is not that such objectified knowledge exists. On the contrary, we are most impressed by the generative power of that epistemology: the technological and scientific advancement of industrial societies is entirely built upon it. The problem is rather that this epistemology has become the paradigm, the very definition of knowledge itself. In the arts, we have the same kind of separation between the art object and the context of its making, between the artwork and the experience of its maker. This makes possible a flourishing art market, and the overwhelming majority of art history books are in fact the history of artworks. In the end, the paradigmatic view is that art amounts to the collection of artworks available throughout the world, and knowledge is the total sum of what information is available through libraries and websites – not the illumination in people's minds, not the quality, breadth and complexity of their understanding. This reduction of knowledge and art to their tangible products may be what discredited alchemy if, as an "art of knowledge," it made the alchemist more intensely conscious and more knowledgeable but failed to produce objective information or material objects (or substances) usable by an external person.

8.5 The Experiential Nature of Art and Knowledge

But if, by knowledge, we were to mean the noetic and intuitive processes by which we know something as much as the sharable contents of what we know; if instead of seeing science, art and the various crafts as productive (in the sense of manufacturing) activities, we were to see them as domains where individuals pursue their own questions and projects in hope of enriching their personal life experience; if we were to see knowledge as a state of consciousness, as an experience of the mind; then the non-scientific modes of knowing would appear more clearly as full-fledged epistemologies. We would see, too, that knowing has an effect on the knower's consciousness and intelligence, on the refinement of his or her senses and sense of being alive and an integral part of the world.

The Greeks had two distinct words for "knowledge": *γνώσις* and *έπιστήμη*. The former, "gnosis," is related to an Indo-European root (g′en-, g′nÅÐō-) [19, 20] which also led to the English *knowledge*, the Latin *noscere* and the French *connaissance (conoscere)*. The other Greek word has given us *epistemology*, a more recent term meaning the science of knowledge. *Gnosis* refers to the type of knowledge we have of a person, a place, a phenomenon: to be familiar with, to know from experience, from the senses [21]. *Episteme*, on the other

hand, means the knowledge we acquire through studying and exercising [21]. The verb (*epistamai*) means *to know* in the sense of having the knowledge of something, to know how to do something, to hold information in our mind. The first type (*gnosis*) is intimate and difficult to put into ordinary discourse, while the other on the contrary is all very transmissible. It is knowledge of the *episteme* kind which is objectifiable and verifiable, while knowledge of the gnostic kind is experienced and integral.

Naturally, we find the two types, in varying proportions, associated with any subject. But the scientific ideal hopes to purge the *episteme* type of knowledge of any contamination by the subjectivity of *gnosis*. And it is precisely because of its pursuit of objectivity that science appears to be the opposite of art, for art is as "gnostic" as science is "epistemic," so to speak. We know through art as we know a person or a place; that is, through relationship, participation, intimacy. If one wants an objective view of some place, then scientific studies and climate and geological data would be more informative. But if one wants to know something about its beauty and its atmosphere, then one needs the work of a painter, a photographer, a filmmaker, even a dancer or composer. Yet these artists would express those subjective dimensions not through structured discourse, but through immersion: they would not tell us something *about* the place; they would propose an aesthetic experience. Actually, the verb "express" in the previous sentence may be misleading; in the end, each person has their own experience, commensurate with the intensity and the level of their engagement with the work. In other words, art leads to experiential knowledge, while science leads to objective knowledge and the speculative method of philosophy leads to rational understanding. As Susan Sontag remarked,

> A work of art encountered as a work of art is an experience, not a statement or an answer to a question. Art is not only about something; it is something. A work of art is a thing in the world, not just a text or commentary on the world.

The paradigm of dualistic opposition that structures Western thinking and the Western worldview makes a distinction between the nature of a mode of expression (such as art, dance, poetry and so on) and that of a mode of knowing (such as science, philosophy and other forms of investigation). But while it is necessary at times to distinguish between expression and experience, there is no reason to see that distinction as mutually exclusive. Art is neither only one nor only the other: it would be more appropriate to view art as a mode of *manifestation* – an idea already implicit in the concept of *creation*. Art does not express something external or remote; it is not "about something." It is itself that something, as Sontag said. Unlike the ideas, feelings and impressions that we verbalize or describe, the meaning of a poem or piece of music does not pre-exist: it comes into existence with the work. This is why art can be at once a mode of expression and a mode of knowing. Artists, through the images and the forms that they generate, the structures and relations they put in place, set the parameters of *an experience to be lived* in a spatio-temporal

dimension that the artwork carves out of ordinary space-time, giving it form (in/forming it).

8.6 Alchemical Mediation: Integral, Holistic Knowledge

This experience is possible because art is material; it happens in real life, in space, time and matter. Although its logic is poetic, metaphorical, aesthetic and subjective, the creative work confronts the artist with all the ordinary laws of physics, especially for the manipulation and organization of the materials, but also – more importantly perhaps – for achieving the aesthetic effect, the interplay between harmony and dissonance, balance and imbalance, etc. The laws of classical mechanics, acoustics, geometry, chemistry, etc., continue to apply in the creation of art projects. More broadly, there are all the contingencies of reality: time, space, budgetary and relational constraints, etc. Art cannot exist only in the mind, in Idea form (a major difference, here, with philosophy); it has to materialize whatever idea it is "about," or otherwise give it shape, as in the case of non-material forms such as music and poetry.

These material and spatio-temporal contingencies and constraints are not unfortunate limitations to the clarity or quality of a so-called "message" the artist may have wanted to convey, had she had access to the infinite possibilities and subtleties of language. Art is not some imperfect or imprecise language, and certainly not a primitive form of language compared to philosophy or mathematics.[6] On the contrary, technical limitations, a certain lack of skillfulness, chance occurrences, accidents and material resistance add power and complexity to the meaning of the work. This mandatory passage through matter and external reality adds important layers of meaning. The laws of mechanics, acoustics and chemistry, and all the constraints of reality, actually help the work reach beyond the artist's imagination: the artwork is the result of a confrontation between the artist's idea and reality. It is here that art and alchemy, as Michel Caron and Serge Hutin remark, seem to share a similar epistemology:

> To the traditional alchemist, the oratory and the laboratory are always intimately joined: the originality of alchemical gnosis is that it rests on an absolute correspondence between the stages of illumination and the successive material operations. [25][7]

Like the alchemical Work, the artwork realizes this "absolute correspondence between the stages of illumination and the successive material opera-

[6] This, I believe, is what Hegel thought when he professed the absolute superiority of philosophy over art.

[7] The original French reads: *Pour l'alchimiste traditionnel, l'oratoire et le laboratoire sont toujours indissolublement liés: l'originalité de la gnose alchimique, c'est qu'elle s'appuie sur une correspondance absolue entre les étapes de l'illumination et les opérations matérielles successives.* Nicolas Bourriaud [26] also mentions this *conjunctio* between the oratory and the laboratory in art.

tions." In a remarkable book on alchemy and art [18], Bonardel described the dynamic relation between the respective potentials and limits of Matter and Spirit, imagination and the real, as a form of "balancing." More than balancing, in fact, I think it is a question of activating one through the other. The various arts, in that regard, effectuate a different balance: music, dance, visual arts, sculpture, theatre and literature each involve a different ratio between material and spiritual components, between space, time and ideas, between human and form, between imagined and real, and so forth. Different works set in motion different proportions of matter and spirit, technique and inspiration, tradition and innovation, technology and mythology, concept and chance, preparation and improvisation. But it is in the various articulations of the ratio between human genius and the forms that structure reality, that art *makes happen* (in lived reality) an illuminating moment, a heightened meaning, a unique or new feeling.

In this way, we might consider art and alchemy as two domains of a single mode of knowing, for they share the characteristic of being at once "operative and meditative," as Bonardel puts it [18]. That is, they share a rigorous *conjunctio* of the material and the spiritual. Because artistic creation requires a continuing conciliation (or balancing) between aesthetic and symbolic intuitions and material resistance, it is a mediation between the physical world and the psychic or spiritual world. Bonardel [27] explains that alchemy "corporealizes the mind" (the coagulating function) and "spiritualizes the body" (the dissolving function). For Hegel, art is the visage of *the immaterial in the physical world*, the *manifestation* of the spiritual [28].[8] And Sontag [22] insists that art does not represent something invisible or immaterial, it IS that invisible or material thing.

8.7 An Experience of Integration and Meaningfulness

In order at once to materialize and spiritualize, operate and meditate, art presupposes an integrated universe, a monad, where the psychic and the material are not separated. According to Umberto Eco, the medieval mind defined aesthetic pleasure as being that "state of mind when the spirit recognizes in something material the same harmony that is inherent to its own structure" [29]. In other words, we experience grace and beauty (aesthetic integration) when we perceive in something – a work of art or some natural or architectural arrangement – an inner coherence resonating, harmonically so to speak, with our own psychic structure. The homology between matter and spirit and

[8] As philosopher S. Pierre states, "*Au cœur du spirituel, l'art est un compromis entre l'esprit et la matière; il opére la spiritualisation du sensible.... Hegel amène un troisième terme dépassant le dualisme de l'idée et du sensible. L'art, par la manifestation, occasionne ce dépassement. En tant que rencontre, l'art ne saurait se réduire à une simple reproduction. Il est la manifestation de la fusion du spirituel et du sensible.*"

between world and self, the correspondence between the structure of man and the structure of the universe, is a great archetype of traditional, pre-scientific philosophies, from ancient hermeticism to Renaissance philosophers (such as Paracelsus [30]). "That which is below is like that which is above, that which is above is like that which is below," says the opening sentence of the *Emerald Tablet*.

As Bonardel points out, if this is indeed an archetypal way of envisioning the universe and our place in it, then it cannot have disappeared from culture. It must still be living somewhere, in new forms: "in such places," she says, "where the impulse to Work, and the act itself, still endures"[18][9]. And I agree with her that one place where its persistence can be traced is modern and postmodern art and literature. This way of thinking, which is about correspondence, reverberation and resonance, allows us to feel and experience underlying connections, an underlying unity in the world. As John Dewey remarked,

> A work of art elicits and accentuates this quality of being a whole and of belonging to the larger, all-inclusive, whole which is the universe in which we live. This fact, I think, is the explanation of that feeling of exquisite intelligibility and clarity we have in the presence of an object that is experienced with esthetic intensity.... [The] work of art operates to deepen and to raise to great clarity that sense of an enveloping undefined whole that accompanies every normal experience. This whole is then felt as an expansion of ourselves [15].

To "know" something does not imply only having information, it implies understanding it – which means seeing how it connects with the rest, where it is located in the big patterns of the world. While an analytic process gives us information, a synthetic, integrative one leads us to understanding, to meaning. Meaning is a gestalt; it is something we feel, that we grasp as a whole. Our current culture prefers the concept of meaning to the old concepts of beauty, grace and integration, but ultimately they all point to the same thing: to sensing an underlying coherence in the world, of which we are also a part. In addition to all our scientific information, we also need to feel a coherence, to feel that we live in a meaningful world, that we are meaningful in that world. Contemporary art has put aside art's traditional association with beauty and harmonic proportion, but it has kept meaning, or more precisely, *meaningfulness* as its main project.

The systems theorist, anthropologist and naturalist Gregory Bateson worried about the fragmented and parcelled results of scientific research and began looking for another approach, one that would allow us to grasp the unity of man and the universe [31, 32]. In a brief posthumous article entitled "Our Own Metaphor" [33], he states a perennial question as a general problem – an even more important question than Leibniz's "why is there something rather than nothing?": "What can we know?" Bateson sees two possibilities. The first says:

[9] In original French: *Ne faut-il pas s'enquérir aujourd'hui du Grand Œuvre sur les lieux où perdurent encore le désir et l'acte mêmes d'Œuvrer ...?*

> If epistemology must always come between me and my organic perception of the world, and similarly must always come between me and any understanding of myself; if my epistemology is the organizing principle of all my understanding; then I can never know anything. My machinery and processes of knowing simply constitute one enormous blind spot. A spot through which I cannot even see that it is blind [33].

This is a familiar position, and one that makes scientists, philosophers and ordinary people shrug powerlessly: our sense apparatus (eyes, ears, touch, brain, etc.) is so limited that we can only know a ridiculously narrow slice of the nature of the universe. We realize that all experience is ultimately subjective, that our epistemological machinery is "systematically fallible [33]." Having stated that, however, Bateson emphasizes the word "systematically": if there is anything *systematic* about our subjective perceptions of reality, then another pathway is possible:

> There is the interesting possibility that we might attach meaning to the word "systematically." If the "self" as a perceiver were *randomly* fallible, then there would be no hope of any knowledge or understanding. But I am (personally) sure that neither perception nor even dream or hallucination contains more than a very small random element – and that random component always only indeterminate within a limited subset of alternative possibilities [33].

Thinking that our sense apparatus might be, not a random collection of limited perceptive abilities, but a systematic arrangement of specific capabilities, leads Bateson to that other, fascinating, possibility: What if our inner world is "our microcosm; and our microcosm is an appropriate metaphor for the macrocosm?" [33] There are thus two possibilities: one is that our sensory apparatus limits and prescribes too much of what we are able to see of the world, so we cannot know the world or ourselves in any real sense. The other possibility is that our sensory apparatus, being the creation of nature, is a reflection of it. Our senses and our mind have evolved from natural processes; we are wired according to those processes. So we *can* know the world because our perceptions are not hopelessly random. They are in systematic correspondence with the world; the form of our thinking is metaphorically related to the form of the world.

Bateson then adds: "And now, it begins to look... as if there is a macrocosmic natural history with which all the little natural histories are so conformable that understanding a little one gives a hint for understanding the big one [33]". His thinking here meets the Emerald Tablet and resonates with Renaissance philosophers who hypothesized a homology among the natural world, the heavenly plane of stars and planets and the spiritual plane of soul and God – all three planes, or "cosms," being reflected within the human person, as the microcosm containing all three [34]. Dismissed by Cartesian thinking and scientific positivism, this hermetic principle is at the root of divination systems such as astrology, the I Ching and the Tarot. It also inspired nineteenth-century Romantics – Schelling, for instance, explicitly established the correspondence: "Spirit is invisible nature, nature is spirit made visible."

It is interesting that Bateson did not want to choose between his two options. Rather, he wanted us to entertain both, for each one corresponds to a different way of knowing: we recognize science and a lot of twentieth-century philosophy in the first option, and poetry and art in the second option.

8.8 Art among the Creative Modes

> Man has a visible and an invisible workshop. The visible one is his body, the invisible one is imagination (mind) [35].

Following a proposal by Heisenberg [3], I will call art, myth, poetry and religion the "creative modes" of knowing. They are creative not because they involve imagination and imaginary content (although they do), but creative in the sense that they "make happen" their vision, and that vision is a shaping force in the human world. Heisenberg, who borrowed the term "creative forces" from Goethe, sees religion as the leading example of this epistemic category. Religion's strength, here, is that its view of reality is shared by large groups of people. But while the experience of art (making or contemplating art) tends to be more personal and intimate, it is not of a wholly different kind from religious experience. If we accept the definition of these creative modes, or forces, as being when the mind changes or affects reality, then what we have is a huge category, one that should include religion, psychoanalysis, philosophy, literature, art and myth, as well as qualitative research in the social sciences. And we have subcategories, in which we find at least five different modes of knowing: speculative (philosophy), hermeneutic (psychoanalysis, religious studies, exegesis, art history), phenomenological (qualitative research), revelatory (religion and mysticism) and imaginative/material, such as art and possibly alchemy. Art is special in the sense that it does not interpret or analyses personal experience that has happened or content that is present in the mind; it *creates* or sets conditions for such content to emerge from an experience.[10] As I remarked above, art doesn't tell, it makes happen.

Within its own subcategory, art also differs from alchemy in that it does not search directly for a hypothetical truth about the self and the world; it seeks rather to generate new possibilities, to explore new emotions, affective states and ways of being, to make visible, audible or perceptible something that is a priori invisible and perhaps not yet in existence; to extend the realm of what a human being can feel. Dewey speaks of "an expansion of ourselves." As the twentieth-century composer Karlheinz Stockhausen puts it: "The role of the arts is to explore the inner space of man; to find out how much and how intensely he can vibrate, through sound, through what he hears, whichever it is. They are a means by which to expand his inner universe" [36]. Art and poetry are concerned with what is not yet visible, what is not yet realized,

[10] We could certainly debate to what extent this is not what psychoanalysis and self-discourse also do.

what does not exist yet – "fabricating solid worlds that answer to immaterial truths," in Annie Dillard's words [37].

Naturally, one could argue that all truths are inventions, that religions and scientific theories are great myths.... Indeed, in Mircea Eliade's *L'épreuve du labyrinthe* [38], we read that he viewed religions as great artistic works[11].

But unlike these creations of a collective genius, art is conscious and deliberate with regards to invention, and this intentionality, the systematic aspect of art-making in consciously creating situations to be experienced, makes a world of difference with the other modes. There is also an aspect of individuality and singularity, even intimacy, related to art, especially in the making: the artwork is the creation of one or a few individuals. But the argument is interesting; if we were to admit more widely the fictional and even artistic nature of religion and science and start exploring the consequences of that realization, it would be a complete revolution in human culture and certainly a major step for the transdisciplinary movement.

8.9 Transdisciplinary Dialogues beyond Modes of Knowing

I will end this too-succinct presentation with a few remarks on the possible dialogue between and beyond modes of knowing. Science, philosophy, the social sciences and art each have their own language and worldview, specialized jargon and symbolic systems such as chemical formulas, mathematical equations or music scores. When Heisenberg wanted to speak with non-physicists about how our minds order the profusion of reality, he wrote a philosophical essay. I could never begin to understand one line of Heisenberg's equations, but I understand his 1942 manuscript. In a way, the present essay is a response to his: a physicist and an artist speaking the same language – non specialized discursive language. In the arts, the "content" is in the object itself and the process of its making. But for a transdisciplinary dialogue to take place, the different modes must explicate how they work and how they know what they know; their system must be made visible and understandable beyond the specialized vocabularies and conceptual specificities of their respective fields. Everyone, artists included, needs to understand the premises, assumptions and workings of their own epistemology. What can we know through art, which cannot be known otherwise? What does science allow us to know and what is irremediably out of its reach? What is visible to me that is invisible to you? Simply put, I do not think that it is enough for artists to offer their works to other thinkers, saying "here, look for yourself": it would only put them in a position of receptors and hermeneuts; it would not inform them about the epistemic potential of art or its limitations or, by comparison, about their own

[11] Roquet remarks that "*Les religions [pour Eliade] sont des œuvres admirables, pleines de sens et de valeur: tout autant que L'Odyssée, ou La Divine Comédie, ou l'œuvre de Shakespeare.*"

epistemology. And so, they will not know when to turn to artists for specific questions that are not answerable in their own field. The point is not to determine what one can know *about* art, but rather what one can know *through* art.

8.10 Remarks

A transdisciplinary conversation is always grounded somewhere in the field of epistemology. Artists must find ways to describe or give access to the inner workings and the noetic processes of the artistic *poiesis*. And to achieve this with any degree of specificity and precision, one needs to write and share in a conversation on transdisciplinary epistemological issues which is happening in discursive language – the already available, albeit imperfect, *lingua franca* of transdisciplinarity.

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CHAPTER 9

Educating for Joy

Antonella Verdiani, *researcher and trainer, France.*

The disciplinary fragmentation matches with the dangerous fragmentation of the human being, the body becoming separated from his emotions, separated from the intellect, which is separated from the spiritual mind. The most obvious consequence is the loss of the joy of learning, of teaching ... the joy of simply living. My thesis is that education can bring humans back to their true nature, which is joyful. Educating for the sake of joy is possible; many experiences exist that can be reproduced. This article will highlight those offered by a system known as "integral education". But above all, what do we mean when we speak about "joy"?

Keywords*:* education, training, joy and happiness, educating for Joy.

9.1 A "nonsense" in a world in crisis: the Joy[1]

Every day experts analyze the world's crisis in terms of their science: from the economic clashes to the environmental pollution and to the loss of ethical values, we are over-informed, aggressed, often driven to despair by various data, theories and predictions, mostly catastrophic, that scientists produce in order to alert the mankind and its planet. Logically, the time has come for humans to take refuge underground, to raise food reserves in the bunker or, worse, to prepare for a mass evacuation to other planets ... My proposal here is not to succumb to such a pessimism, not to follow only the voice of the scientific reason (although necessary), but by a real shift, to take the opportunity [1] offered by the crisis in order to include in our lives a value forgotten by the modernity, that of joy. As a journey of hope, education has to rediscover its initiatory role in the evolution of humanity.

The school system is getting every day worse, and the reforms of the educational Western systems seem to be resistant to any innovation that takes into account the "existential" dimension of the individuals, the students and the

teachers; such negligence could be one of the reasons for the present malaise. In addition to that, we might also consider the increasing fragmentation of the disciplines in the schools and universities today: from 50 specializations in 1950, we moved to 8000 in 2000 [2]. In these "towers of Babel" of the knowledge, the students learn to study the reality through a magnifying glass, analyzing the world from different disciplinary angles. Therefore, by focusing their minds on separate fields of the knowledge, they risk to interpret the reality as an "unstructured" set of puzzle's pieces. The university in particular is heading for a subdivision and fragmentation of knowledge, which becomes more esoteric and anonymous [3].

The disciplinary fragmentation matches with the dangerous fragmentation of the human being, the body becoming separated from his emotions, separated from the intellect, which is separated from the spiritual mind. The most obvious consequence is the loss of the joy of learning, of teaching ... the joy of simply living. My thesis is that education can bring humans back to their true nature, which is joyful. Educating for the sake of joy is possible; many experiences exist that can be reproduced. This article will highlight those offered by a system known as "integral education". But above all, what do we mean when we speak about "joy"?

9.2 Joy and Happiness

In everyday language, the word joy is associated to an emotion, a transient state. Yet, its original meaning is anything but ephemeral as the distant Sanskrit etymology takes us to the root word *yuj* (the same as *yoga*), usually translated as "union of individual soul with the universal spirit. [4]" There is here a sense of reliance (connectedness) between the earthly and the heavenly, from the human to the divine and amongst men, which gives to the joy a sacred place that is lost in time, especially in the Western culture. When the connection is restored, the joy indirectly enters in all the aspects of life and creates the feeling of *happiness* (*joie de vivre*), a feeling of exaltation experienced by the totality of the consciousness, all the dimensions of the being. From a simple state of emotion, joy becomes a state of mind, a manifestation of the reliance of the individual soul with a higher dimension. Consequently, it pervades the whole being and connects itself from top to down, from inside out, the subject and the object, the self and the others.

It is important to make a semantic distinction between *joy* and *happiness* (often confused) in order to deeply explore our field, that of education. The word *happiness*, as a state of (mainly) material wellness, is very popular today. Over the past ten years, the researches on this subject are at the core of several disciplines and domains, concerning not only the health, the medicine and the psychology, but also the economic and social sciences, including therefore the science of education. In the modern psychology in particular, the research on this subject develops increasingly in the '80s. To quote a few names among the best known, Veenhoven, published in 1984 the *World Database of Happiness*

where he measured the level of happiness world-wide (121 cases in 32 countries) [5]. At the same time Diener, another world-renowned psychologist, establishes some correlations between the welfare and the theoretical (abstract) progress made by individuals [6]. A little later, Csikszentmihalyi [7] brings the research forward in defining happiness as a state which is independent from external conditions, but rather dependent on "how they are interpreted", because they arise from the orientation of individuals to material or intangible interests [8]. We can also quote the Nobel laureate economist Daniel Kahneman, who first had the merit of bringing psychology and economics together with his concept of *National Well-Being Account* [9]. What is remarkable in his classification is the difference between the measures of well-being and those of economic performance, hence the conclusion that very little material comfort comes in the perception of happiness [10].

9.2.1 Neuroscience and Philosophy

The research on happiness concerns different disciplines and theories, such as the cognitive psychology or the neurosciences. For example, the theory of the two brains [11] point out that *the emotions* and*the feelings* of joy, [12] love and compassion are located in a specific area of the cerebral cortex, the same which is stimulated in a deep state of meditation and peace. This discovery, fundamental for the sciences of education, opens up to another level of reality, a peaceful state that can be achieved through methods like non-violence and peace education [13]. Therefore, a question maybe raised: does this sense of joy and the attitude to peace come from the same source of the human being?

Neuroscientists Beauregard and Damasio try to answer this specific question by focusing on the observation of more complex states of mind and emotions, such as the trance or the mystical experience of compassion, and achieve results that distant themselves from their predecessors. According to Beauregard (and his test case on Carmelite nuns in a state of meditation), there is no specific brain region that is activated during the mystical experience. In other words, there is no "God spot" in the brain [14]. For the purposes of this article we agree with Damasio [15] (related to the Spinoza's immanence) when he affirms that, considering the capacity of the human being to produce, think and act on his emotions, the consciousness can spring from the meeting between emotions and the rational brain.

9.3 Philosophers of the Joy: from Spinoza to Sri Aurobindo

"Because it aims at something eternal and infinite, love fills the soul of pure joy, a joy free of sadness," [16] says Spinoza (1632 - 1677), whose clear thought continues to inspire modern philosophers [17]. For him, philosophy is the love of truth and love is the truth of joy while its aim is to create an ethic of

happiness and freedom. Spinoza gives to joy a central place, a "transition from a state of lesser perfection to a higher perfection," [18] related to the fulfilment of the desire (*conatus*), which is the most powerful state for the human being. In his Ethics he describes joy as an *affect* (an emotion investing the whole body, object of the Spirit), as *Transitio* (because it is unstable, in becoming) and as *Love* (because a non-loving joy would stay ignorant). Joy is about, Spinoza says, "loving everything in the eternal necessity of the whole that is God," through an ethic of love which is not the Plato's *Eros*, but rather the *philia* of Aristotle and Epicurus, or the *agape* of Jesus or St. Paul. This brings us to the spiritual and religious traditions of humanity, while renouncing to the transcending character of the religions. For Christianity in particular, joy is a state of enlightenment that can be achieved only in a celestial dimension, the "Kingdom of Joy" where the eternal alliance between God and man is restored [19]. This confers a power to a higher reality, while according to the immanent visions of some, all reality is created by nature.

Equally in contrast with the transcendent vision, the materialist ideology brings back to the individual a complete freedom of action. From the perspective of the secular and positivist education, joy primarily rises from the freedom of learning (as the French movement "Education Nouvelle" reaffirms, for example) when the child is free to act, create, observe and to understand in working together with others. The principle of freedom has also influenced one of the few contemporary educators who has worked on the concept of joy at school, the French researcher George Snyders who sets up his approach on a materialistic vision. According to him, school is the theatre of the social change, a place where joy becomes "proportional to the efforts and the obligations" [20] . "We must struggle, hold on" [21] in order to study, for example, the masterpieces of literature; by this sacrifice, students will discover the joy of loving the style of writing and may thus contribute to the progress of humanity.

9.3.1 Ananda, the Divine Joy

So far, our exploratory journey has taken into account mainly the Western philosophical vision. In the East, which is non dualistic, the separation between being and the cosmos does not occur, and the link with the totality of reality continue to exist. In this regard, the Indian philosopher Sri Aurobindo (1872 - 1950) is an important reference because he establishes a bridge between spirituality and education. His concept of integral education is born of the experience of integral yoga, the *Purna Yoga*, which is based on *Ananda*, the divine joy.

In Sanskrit, the word *Ananda* means the joy and the radiation of *soukham*, the state of inner well-being, the highest spiritual experience "... which illuminates the present moment of bliss and is perpetuated in the following moment until its forms a continuum that could be called *joie de vivre*." [22] It's the *sat-chit-ananda*, the continuum "existence - awareness - bliss", the "happiness

of becoming", the perfect expression of Lila, the "Game of the Lord" [23]. Subjacent to human nature, in ordinary life this truth is hidden: everything in the student's work is thus to learn to live "inside" in order to awaken to the calm, joyful and powerful presence which is "in us, our Self more real". Educator above all, Sri Aurobindo identifies in the attendance of art and poetry a way to approach this "delight of the universe" which is the true flavour of life. The final freedom will be acquired by the confrontation of "all the shocks of existence" and not by the withdrawal or a passive renunciation. Become neutral in contact with the pleasures and pain, the soul is thus led to an invariable state of rapture, the divine Joy.

The descent of spirituality in the matter is the sense of integral yoga and Mirra Alphassa, known as the "Mother" (1878 - 1973), will continue the task initiated by Sri Aurobindo, translating it into educational practices at the Ashram in Pondicherry. In her yoga, she describes the joy as immanent and transcendent at the same time, intrinsically linked to human nature, since "all existence is based on the joy of being and that without that joy of being there would be no life [24]." Here, the higher (transcendent) dimension is a fundamental aspect of the human being, living in the present (immanent) and therefore accessible to everybody through a process of continuous education. The reliance with this joyous transcendence is possible without necessarily implying any religion or dogmatic path [25]. Recognize the joy in its dual nature of emotion and state, this is the task of the teacher.

9.4 Educating for Joy

Several happy experiences exist worldwide, in Eastern and Western schools; nevertheless I decided to cross the borders of Europe, looking for the source of "integral education". In this Chapter I will limit myself to one example (among others who are also relevant) as a possible response for educating to joy. My assumption is that integral education through a transdisciplinary approach is one of essential path to inner Joy. The case studied by my research in India from 2006 to 2008 [26] is the "Free Progress", which was created in 1960 in Pondicherry at the Sri Aurobindo International Center of Education (SAICE), currently being reintroduced in the modern multicultural schools of Auroville [27].

The educational system of "Free Progress" is still considered as one of the most original concept in terms of experimentation, based on the following principles:

- education has the task of guiding the individual in the exploration of self- discovering;
- the growth of awareness and consciousness is proposed to be the unique way for humanity to go beyond the current crisis which arose from an imbalance between a disproportionate material progress and an inadequate spiritual progress;

- the most important issue of human existence is ontological, because it concerns the ultimate aim of life.

With reference to the last principle, the notion of integral approach is intended to develop all the dimensions and aspects of the human being: the physical, the vital, the mental, the emotional and the spiritual.

9.4.1 The "Free Progress"

The "Free Progress" experienced a new pedagogy which was free from tests and exams in order to create an atmosphere through joyful learning [28]. The system was called "free", because students would be given the choice to study individually with a teacher or in a group, and choose their own subjects, while they can "progress" toward the highest expression of their inner power and knowledge. The study subjects and topics were selected according to their own interests, under the guidance of the teacher. Here the teacher embodies the role of "the one who dispels the darkness" (in Sanskrit *Guru*), in an attitude defined as being close and distant. In the traditional and experimental school of the Ashram, the "Free Progress" system is currently available from the higher secondary level students, while in Auroville some schools experience it right from the elementary grade. My investigation led me to note the dramatic positive impact of such pedagogy on students of all ages: the sooner they are free to move towards their inner interests, the more they will be able to build a confident personality, curious and open to the world. "Freedom means being able to choose. Choice means that everything is proposed and that the student decides what its nature needs for her/his progress" [29]. Therefore, it is not necessary in such context for the teacher to "pre - guide the student or require him to converge to a curriculum that does not fit his own interests." as Sri Aurobindo affirmed [30].

The common element in such schools is the sense of wellness and the joy which are visible in the luminous eyes of the children. Students and teachers agree: "the basic culture of this method is about guiding the child to the joy of learning. It is far from any form of punishment, or the desire to get good grades, or to be "the first". It is about learning for the joy of learning" [31]. By observing the behavioural pattern in the classroom, we can affirm that the "Free Progress" is an educational process which gives joy and satisfaction both to the student and the teacher. Some questions arise at this stage: would it be possible to achieve such a goal in our (Western) schools? And if the answer is yes, by what means? What should be the attitude to assume in the relationship between teacher and student, a fundamental basis for every educational method?

9.5 A Path for Innovation

Few preliminary indicators are needed here in order to start a process of innovation in our schools as well. The first one defines the learning path as an experience of the indefinite and the infinite, which is about "to allow the gifts of universe to enter in ourselves" [32] in a way that is not fixed beforehand, but also implies the possibility of making mistakes, [33] incorporating uncertainty and complexity, "knowing through the unknown" [34]. The subject's participation, defined as the binomial partnership "teacher / student", founds the basis for this transdisciplinary methodology. Both of them are involved in the learning process, assuming that:

- nothing can be taught (the teacher is a guide, he learns with his students);
- the student is not a recipient to fill in, he has his own interests, his desires, which require to be recognized and promoted at any age;
- the spiritual dimension, as well as the mental and physical, has its place in the educational process and must be integrated into an approach that goes beyond religions. This means that the existential questions asked from the students, even the younger, must be listened;
- the time, with its rhythms, has an educational value in itself, where the slow and rapid growth is allowed.

This will naturally lead to a pedagogy that can, in an unprecedented way, be based on a new concept of education and learning process, and that can be described as fractal [35]. Concerning the learning process in particular, the fractal way of teaching will no longer follow a succession of linear and rigid steps, but as a system complete in itself, a smooth and uninterrupted concentric spiral (as the fractal image shown in Figure 1). According to this method, the teacher will introduce the students to a general overview of the new program in order to make them sensitive to its richness and complexity. In this manner students will be able to establish a connection with the rest of the existing disciplines and further deepen the individual interest by a set of specific modules, following a program designed for each one. For this pedagogy to become "fractal", these modules must reflect the entire program, as well as the holographic vision (in which every detail contains the vision of the whole).

9.5.1 The Joy, "emotion – guiding thread"

What happens to the role of the joy in this journey? We might ask at this point. It will serve as our pathfinder, an "emotion – as the guiding thread". Even when ephemeral, this educational process can work with the emotion of joy, although, we leave room for its reception and allow it to follow. This is the first task for the master, a task which he can do by following the main thread of joy in himself, while he will recognize such an emotion as the expression

Figure 9.1: Fractal.

of emotional capital defined in a variety of colours. But we must be careful, because joy contains also suffering, so it is "integral". The state of joy is a "founding element", "independent," and "paradoxical" as Nicolas Go states, it can arise from anywhere, even in dramatic situations. Thus, "a joyful person is neither essentially exuberant nor over enthusiastic, and also he never detracts from the joy, including - indeed, we should say – even when in grief and sorrow, and even when in the very heart of barbarism" [36].

At this stage, we could imagine an ideal new path in education, where the presence of a "joy – emotion" could be the starting point toward a "Joy – state of mind". The central moment of this process is represented by the relationship between the teacher and the student which, based on mutual respect, which will be developed in four main steps:

1. Acknowledging
2. Resonating
3. Revealing
4. Joy as awakening

1) Acknowledging in order to reveal ("entering in oneself while opening to the other")

To be emotionally touched means to be open to "move inside" and change our inner attitude. To arrive at this, we should return to the school of emotional

intelligence,[37] to that of the intelligence of the heart, [38] while the heart is the only place where the necessary link with joy can be restored. We must first recognize the role of "joy – emotion" in the fluidity of the learning process, because it plays on the learner's abilities to memorize, retain information, concentrate and focus the attention. The master as well as the student should first recognise it in themselves: it would mean teaching and communicating with joy and pleasure. This reminds us of the indispensable place of Eros in education, an ensemble of desires, pleasures and love of transmitting knowledge to the students, which will enable us to "overcome the enjoyment attached to power, for the sake of the fulfilment of the joy of giving" as Edgar Morin says [39].

Then there will be the joy of acknowledging when students, for example, will be in contact with the Arts (Sri Aurobindo, Georges Snyder, Nicolas Go, etc.). They will create their own masterpiece (Steiner) or they will be amazed by Nature (Ecole Nouvelle, constructivism, etc.); or moved by sharing with others (education for peace, conflict prevention). In this triangle between the attitude, the mastery of the subject and the discipline, the teacher will have to adopt a transpersonal posture, which is "the domain of Art, if not as much as that of Science" [40]. During this initial phase, he will spot out the attitudes of students, their tendencies, passions, difficulties, mistakes, but without judging or evaluating them in close grids. One must recognize in order to know: the progress through acquiring knowledge will reveal itself in the educational process and, in case when an assessment (without giving notes!) is necessary, it could be mutually realized in this dialogue between students and teacher.

Often remaining in the background, while engaged in his own activities in the classroom (of the primary school), the task of the master would be to stimulate curiosity in the students: he is also reading, writing or painting and using other materials. While letting himself being guided and he will rely on his own intuition, according to an inspiration comparable to the state of enlightenment of the artists [Ramirez [41]. The sense of perception also plays a role as an important tool in this process, as the manas of Indian psychology, centralizing and coordinating actions of mind, such as telepathy, clairvoyance, listening capacity and intuition. These tools enable the master to awaken the others, according to the concept of teacher's role described also by Krishnamurti. Acknowledging in order to reveal to oneself and opening to others is founded on the attitude of seeing, observing, not judging, and encouraging the awakening of curiosity.

2) Resonating ("to hear with the ear of the other"

Resonance is a phenomenon to be understood as not only physical hearing, but also intellectual, emotional, that pervades the mind and it must be upheld in the entire being. Thanks to this resonance, the teacher will understand if the activity chosen by the student experience any joy. This implies that, to

put it in the words of professors of the Free Progress school, the teacher is first connected to his own "presence", in tune with himself, and that he is fully aware about his own truth before he is able to hear the other, "hearing with the ear of another [42]".

Empathy, a value on which all the methods of education for peace and non-violence, are based, is the key to understanding what other people experience and establishing harmonious relations. It demands that one listens to oneself with one's entire being, in full spirit, which requires emptying one's mind. When this condition is met, one succeeds in capturing directly what appears before oneself, that which can never be heard by the ear or understood by the mind. When one connects to this sensation it causes joy, a joy which is no more of the realm of emotions but that of the being itself. It is the joy which "can be conceived and experienced in the present. (...) It is a resonance, an ethic, the source of all creation .... " [43].

3) Revealing

At this stage, a closer relationship could be established with the student to understand if the activities in which he is engaged, reveal his true nature. It is for this reason that the previous step – that of resonance - is fundamental: the teacher will use here not only his capacity as a psychologist and educationalist, but he will apply also his intuition. Thus, he will not encourage his students to choose activities that peremptory or permanent, but he will rather lead the students' curiosity towards creative activities. The joy one experiences that causes self-discovery, the teacher will never forget to incorporate not only the successes but also their difficulties. These difficulties are not considered as failures, but seen as challenges during their educational growth.

If there is no joy for learning, doing or studying, this will reflect immediately in the student's behaviour and the teacher will then intervene the process to discuss with the students. Otherwise, if the students feel that they are in resonance with their real nature, the joy will automatically reflect. The joy as the guiding emotion is not a superficial one, it is not an excitement but rather an appeasing force.

4) Joy as Awakening

For the master to rediscover his role as a consciousness raiser, the first step would be to raise his own consciousness. In a perpetual mood of creation, he will be a seeker of truth, not necessarily a perfect yogi, but a being that never hides from himself, as mentioned by Auroville teachers. In this education system, acts are as important as their as their behaviour, because, "being an educator, it is finally showing the way by what we do, what one is" [44]. This signifies that one remains in the attitude of humbleness, and that "one knows that one does not know." He knows that while he discovers himself, he is also in the learning process, as Jacotot, the "ignorant Master" of Jacques Rancière [45]. Far from being trivial, this is about a radical change in the approach to

teaching which can transform our way of thinking not only about the education but also about the world.

The aim is to gradually reveal the joy, it must be stimulated through activities that involve all dimensions of being: the physical body (through relaxation and movement in consciousness), the mental being (by the concentration, the stimulation of imagination and creativity) the spiritual being (by the opening of the heart, silence of mind and meditation). It is a journey discovering of the higher Self that "educating for joy" offers, which corresponds more to the choice of "secular spirituality" (Barbier, Compte Sponville), rather than a religious one. This will be about "a practice of wisdom which goes beyond reason, and accomplishes itself in Art, Laughter and in the Sacred, and questions itself on the possibility of a singular joy" as reflected in the wonderful words of Nicolas Go [46]. It is the joy that emerges from the realm of emotions and becomes aspiration of the being to unite with the Absolute.

Different from the "joy – emotion", the "Joy - state of mind" will be recognized from its durability and its autonomy, independent from external causes that determine it. It is for teachers and students, to open up to the inner dimension that is broader than the domain of psychology, because it contains the whole, in the process of awakening. The Joy of Awakening is the ultimate aim of education: its nature is transcendent and immanent at the same time, becoming thus *trans-immanent*. It is the integral part of the living, of the body, of the matter, of the reality and it travels not only through all these and goes beyond the Nature, but also surpasses the boundaries, while connecting to the wider a wider dimension.

Guided by the transdisciplinary approach, we could now recognize the nature of the subject in its "joyous essence", non-fragmented, the One with the Whole. The Joy finally finds its original meaning, a union between individuals and also between the individual and the dimension of the Absolute. The word education rediscovers its lost meaning, it "leads", it "nourishes", and it "brings out" what is best in us. Applied through participatory processes in schools, with the engaged involvement of all parents and teachers, "educating for joy" will have the task to guide present and future generations. It will highlight what they conceal most valuable in their being, the joy of living life fully.

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27. Defined by its inhabitants, a "laboratory" of humanity, Auroville is supported since 1968 by the Indian Government and UNESCO. Auroville "wants to be a universal town where men and women of all countries can live in peace and progressive harmony above of all creeds, all politics and all nationalities. The purpose of Auroville is to realize human unity "(http://www.auroville.org, accessed: November 14, 2012). The city now has about 2200 inhabitants from 44 different countries.
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31. Interview with an Auroville teacher, February 29, 2006.
32. L'Autre marche, (The Other Step) an installation by Trinh T. Minh-ha and Jean-Paul Bourdier at the entrance ramp of the Quai Branly Museum in Paris.
33. In this posture, errare (from the Latin word) will not necessarily mean to be wrong, but to experiment, to "go here and there", looking for new leads.
34. Trinh T. Minh-ha and Jean-Paul Bourdier, op. cit.
35. Therefore, Professor Joel de Rosnay evoked the image in a 1996 interview to the magazine *Vers l'Education Nouvelle* (Towards New Education), No. 477-478, where he first mentioned the concept of "fractal education". The father of the fractal is the mathematician Benoit Mandelbrot who described the irregular structures created by following specific rules, in a homothetic process. In the

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About the Author

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CHAPTER 10

Transdisciplinary Methodology in Research and Education: The EMMY Case

Liviu Drugus, *researcher and trainer, France.*

This paper sums up some of my previous ideas on transdisciplinarity applied during the last years. My pedagogical experience enriched with situations solved by me through transdisciplinary methodology/ thinking, i.e. the levels of reality paradigm, theory of Complexity, and the logic of the third included. These three pillars of transdisciplinary methodology are used in the sense described by Basarab Nicolescu. That is why I consider EMMY is a quite concrete application of transdisciplinarity to a better understanding of human behavior. Here are some of my ideas I am using in the teaching process: a) there is no more "science", but only the triadic process of research, cognition and (new) knowledge; b) EMMY is an application of transdisciplinarity as a methodological tool; c) there are no "social sciences", but a united and interconnected corpus of relevant knowledge on humans and their behavior.

Keywords*:* transdisciplinarity, methodology, End Means Methodology (EMMY), transdisciplinary research, transdisciplinary teaching and evaluation, postmodern logic, triadicity.

10.1 Introduction

Time is more and more proving that modernity has (almost) closed its eyes and that postmodernity asks for its own life and identity, i.e. for new ways of thinking, of teaching and evaluating of human knowledge. My PhD thesis [1] (Drugus, 1998), written in manuscript form in 1984 and sustained only in 1996 when political framework changed (a bit...), contained an embryo of my *End Means Methodology (EMMY)*. EMMY is a para-disciplinary way of thinking and an alternative way of teaching economic disciplines, combined with managerial, entrepreneurial, anthropological, political, ethical, psychological, sociological, historical and legal dimensions of any human action. Since the

80s my teaching was not at all a classical one, but a perpetual dialog (Q & A) on things around the main humanistic themes, with the accent on creativity and alternative answers to older problems. My preoccupation was to better understand and define human action (thinking and sensing – as preparatory phases towards an effective and efficient action). The very essence of any conscientious human action/ behavior is *decision*. How people make and take good decisions in order to attain their desires/ wants/ purposes/ aims/ ends is the most important tool a graduate may have in her/his mind in order to make a good living for her/him and for her/his family. My first published article (1972) was on "Information and decision" [2] (Drugus, 1972) and its humanistic essence is still valid nowadays.

Since then (1971 – 1976) my research activity at Romanian Academy (Iasi branch) was not only on economic issues, but represented a humanistic view on individuals' desires & purposes (i.e. ends), ways of satisfying these (i.e. means), and ways of improving the results (effectivity) of any human action. As a consequence, I was interested in American (economic) radicalism and have chosen this theme as main subject for my PhD thesis (1976 – 1996). American (left) radicals underlined their preoccupation for human dimension of economic activities (anthropocentrism). To better understand the roots and essences of (American) radicalism I have read both sociological, philosophical, historical etc. branches of this research trend and realized that only an interdisciplinary and holistic view may help me to understand any of its particular preoccupations. Interdisciplinarity was my preferred research theme and it was my meeting with Basarab Nicolescu in 2000 (in Iasi) to channel my interdisciplinary interests towards transdisciplinary research, with his historical contribution of defining the three pillars of transdisciplinarity: levels of reality, complexity and the logic of the third included. As a member of CIRET (2000) I dedicated all my research efforts to apply the transdisciplinary vision to my university courses. It was quite natural to observe that my triadic vision on human essence (the human continuum of end-means-end/means ratio) was a transdisciplinary one. In 2005 I founded at George Bacovia University in Bacau, Romania, a new journal called "*Economy Transdisciplinarity Cognition*" (www.ugb.ro/etc) with Basarab Nicolescu as member of the Editorial Board. All of these motivated me to use more and more the transdisciplinary methodology in almost all my courses at George Bacovia University. One of my master degrees taught courses ("*Research methodology and management of research*") is, as a matter of fact, applied transdisciplinarity, i.e. End-Means Methodology as a research transdisciplinary tool applied to research activity. Although the "official" name of this course was "Methodology of scientific research", I changed not only its name, but its content as well.

10.2 Words, Words, Words... From the Confusing Words: "Science" and "Discipline" to the Integrative Word "Knowledge"

I suggested to my students that the word "science" is, nowadays, a quite confusing one, due to its overuse, misuse and abuse of its presupposed self induced "power". Nor any research is "science", nor any academic discipline is a "science" and not every university teacher is a "scientist". Reading John Horgan's book "*The end of science*" [3] (Horgan, 1996) stimulated me to enlarge the demonstration of the inappropriateness of this word ("science"). Finally, I concluded that the problem is a nominal and semantic one, a problem of definition and of adequacy between a word and its content. My solution was a radical one, i.e. I cut the Gordian knot by simply eliminating the confusive word and replacing it with another one, at a higher level of reality and generality. I proposed to use, instead of "science", knowledge (the old name/ meaning of the Latin word "scientia"). This simple replacement of a confusive word is itself an application if transdisciplinary thinking, i.e. of using the first pillar of it, *levels of reality*. The segmentation of knowledge into "scientific" and "nonscientific" was a break/difficulty to unification of "science" with religion, philosophy, art etc. As a matter of fact, it is not about putting together two different things as "science" and religion, but about interconnecting two or more kinds of knowledge (empirical and transcendental) under their common name – Knowledge. As a result, instead of "science" we may use *empiric research and cognition* and instead of religion we may use *transcendental cognition (knowledge)*. Put together these two kinds of empirical research and transcendental knowledge, it comes that we are studying things at a higher level of reality. In my opinion, art is the third included among, across and above them, just because this way of knowing things is empirical and inspirational/ transcendental. As a result, I obtained a new knowledge continuum called empirical research-art-religion. All of them are truly inseparable and part of the holistic vision on our environment. All these three are under sign of generality, i.e. of philosophy. Modernity generated (ultra)specialized knowledge (disciplines and "sciences") and postmodernity is obliged now to stimulate integrative knowledge.

Much of the debate focused on how to obtain more new info, new knowledge, new methods and new methodologies is, as a matter of fact, and first of all, a discussion on words' meanings. As a result, a lot of efforts are made to define and redefine concepts, with the unpleasant consequence of a bigger and bigger relativity of these concepts, theories and paradigms. A lot of confusion was growing instead of heaving more clarity and simplicity. That is why, at my first visit in Western Europe, at Paris, Sorbonne University, in *August 1900*, at the First International Conference of ISINI (International Society of Intercommunication of New Ideas) – a society founded by the Romanian thinker Anghel N. Rugina, in Boston, 1988 - I communicated my (older) proposal to redefine the essential concepts and the main disciplines studying the human behavior.

I multiplied half of A4 sheet of paper with the following content: *Politics = ends; Economics = means; Ethics = end-means adequacy; and added a transdisciplinary equation: Economic = Politics = Ethics.* In my mind the three former distinct disciplines are similarly with a trilateral pyramid: every of three triangular faces of the pyramid are quite identical as compared one with another, although every one is situated in a different place. For sure, this abrupt way of radical change generated resistance and ignoring. But, little by little my theory (EMMY) was more and more known and accepted, both in Romania and abroad. Google showed me that in USA there is learned, used and applied a new vision called Means-End Theory. Anyone can see it is about *End Means Methodology* written other way... Very recently (November 2012) an American professor taught a lesson about entrepreneurship using as a main idea a scheme about goals and means, quite similar with my article from 1972. It is not my intention to claim any priority or merits. My declared end is to be of some help in improving the effectiveness of teaching and learning, improving human life and behavior by making and taking good decisions using EMMY and its schemes for evaluating the human action results.

Although that times I hadn't such a philosophical perspective in my mind, for sure that preoccupation for concentrating information in simple and few words is an expression of what it is called today in poetry as minimalism. Otherwise, my vision could be named as *maximalism*, just because a maximum of information should be concentrated into one and single concept/ word. In a convergent vision, minimalism and maximalism are presupposing each other, so it is possible to speak about a mini-max cognitive vision, i.e. minimum of words and maximum of meaning. Concerning meanings I add that it is a pity that American culture is using "knowledge" and European culture is using "information" for one and the same reality. These differentiations may cause confusions in a much globalized world. It is not only about words, but about meanings and their very clear definition. The confusing terms (science, social, knowledge, information etc.) should be clarified by common efforts. In my opinion, the lack of free competition in academic & research sector (or, similarly, the excessive support offered by state to this sector) is one of the principal causes for generating confusion, for lack of preoccupation to really adding something new to the already acquired knowledge

In my vision, the postmodern age is characterized by the ever growing role and importance of information/ knowledge, research/ searching for knowledge and of cognition/ adding new knowledge. Transdisciplinary thinking is part of this revolutionary change that would radically transform our lives. Here is a very good description of this cognitive context in which transdisciplinary thinking may and must develop as quick as possible: "*This revolution recognizes the changed world in which we live. A world in which: information is readily and easily accessible; where change is so rapid that traditional methods of training and education are totally inadequate; discipline based knowledge is inappropriate to prepare for living in modern communities and workplaces; learning is increasingly aligned with what we do; modern organizational struc-*

tures require flexible learning practices; and there is a need for immediacy of learning" [4], (Hase & Kenyon, 2000)."

10.2.1 From Complexity to Simple, Essential and Compact Ideas. Complexity May Be Solved Using Levels of Reality and the Included Middle (the Logic of the Third Included)

Edgar Morin [5], (Morin, 1982, 1990) wrote a lot about complexity and how to deal with it, opposing this paradigm of complexity to the paradigm of simplicity. As far as I understood that, simplicity is defining disciplinary modernity (Cartesianism), and complexity refers to transdisciplinary postmodern knowledge. But, one description of the principles that describe the "paradigm of simplification" is: "*the principle of reduction (narrowing the understanding of a whole to the knowledge of the basic elements which constitutes it) and the principle reducing the knowledge of organizations to the principles of order inherent to them (laws, invariants, consistencies, etc.*)". See: [5] (Morin, 1982, 1990) apud: [6] (Alhadef-Jones, p. 479).

Here appears a contradiction between what Morin and I do understand by complexity. In my opinion, modernity was that one which generated not only a lot of (new) disciplines and sub-disciplines, but generated a fabulous growth of every discipline at such dimensions that no human being may know its real and integral content, all ideas proposed or demonstrated a.s.o. Let me take the example of Economics. Since Hesiod, Aristotle, Smith, Rothbard, von Mises and Marx and until the growing number of Nobel prizers there is a huge amount of writers, professors, researchers and practice people that use concepts in function of their own beliefs, contexts and audiences. This created a real complexity concerning (for the beginning, with) one discipline, not to mention the thousands of disciplines that are not able to properly communicate among them and establish links, bridges or common spaces for dialog. Day by day the complexity is artificially (but inherently) and unnecessary growing inside disciplines and among them.

Value is a presupposed quite clear concept, but discussing on added value, surprisingly, there appears a lot of meanings and definitions of value. For example, in my vision any value is defined by the ends (goals, purposes, targets, aims etc.) someone is wanted to be reached as a consequence of a certain combination and consuming of means, able/ adequate to the desired ends. Other people consider value simply as "something important for me". Of course, personal desires are important for everyone, but sometimes they do not have the degree of acceptability from the human context they are living in. There are desired ends that are destroying a lot after their accomplishments (e.g. extracting oil is destroying Earth underground). I consider end/means definition of value is open to be operationalized and to help people to understand the actions of others and to take "right" decisions from different points of view.

Economy and Economics do not refer to the same "values" people have in

their minds all over the world. For example, Western cultures depict economic activities more rationally, in terms of ends and means, but Eastern (Asian) cultures depict economy more in terms of environment and the human life connected with a specific natural context. In my opinion there is no real conflict among these two visions.

What to do? To let them (disciplines, theories) die under the huge pressure of the immense quantity of concepts meanings and systems of thought specific to every discipline, i.e. under the quasi infinite complexity? My answer is: simplification, reduction of all these immensities of artificially multiplied knowledge to small and manageable dimensions, able to make more sense in comparison with the previous complexity. Finally, my proposal is not to reduce or to annihilate complexity, but to extract senses and essences from it and to work with them. For example, Economics could be reduced at its essence which is "*combining means in order to attain desired ends*". As a result under the name of Economic "sciences" we have Accountancy, Statistics, Macroeconomics, Finance, Marketing etc. etc. Similarly, Politics could be reduced at "*proposing ends in function of usable means*", and all knowledge about this item should be unified under the name of Politics. Ethics could be reduced at "*permanently adequating ends to means and means to ends*". Of course all these refer to human beings and their behavior/ action/ activity. These three disciplines are easily to be seen and considered as ONE or as a continuum, concerning ALL human aspects, but only through their (common) essences. I also applied here the transdisciplinary solution of getting a higher level of reality, above complexity, starting from disciplines until integrative knowledge. Andrew Sage [7] (Sage, 2000) is putting an equal between transdisciplinarity and "integrative knowledge" and I do agree with him and with the editors of the book that includes his article.

Let me use a quite common example to prove the utility of my above proposals. Writing this article concerns a lot of human dimensions: a political one (defining my end – writing this article - in function of my means: time, ideas, ability, desire to publish etc.), an economic one (using and combining my means/ resources), an ethical one (fitting/ matching/ adequating my means to my end and to others' ends), a managerial one (thinking, feeling and writing as a concrete activity of using my ends, my means and my way of adequating them), a legal one (respecting rules, laws and regulations imposed by the Editorial Board) etc. Finally, writing an article has its own history (and this article will be history soon, no matter if published or not), has its psychological and sociological dimensions etc., etc. As a result, I'll concentrate a lot on (correlated and integrated) knowledge about my and general human behavior describing the process of writing an article (a human action). That is why I do consider/ think that education should start up (gymnasium, grammar school) with this kind of transdisciplinary, less disciplinary, essentialized and compacted kind of knowledge. Only faculties will/ may introduce students to certain (narrow) disciplines (but still using transdisciplinary methods and methodologies) and only master and PhD degrees will create specialists in a

narrow field of reality, but with the big gain of having the simplified complex background in their minds. Nowadays, specialization (I mean teaching through specialized disciplines) begins in the first year of gymnasium and only postdoctoral studies try to enlarge again the complexity of the domain and to make connections with strange disciplines. It is interesting to mention here that it is not about a fight against disciplines but about an intelligent and useful equilibrium between disciplines and transdisciplinary vision. The old Latin name of the discipline was disciplina/ discipulina and this meant instruction, knowledge. Finally, both disciplina and scientia referred to knowledge and this is an extra argument to the necessity to name all of them with a single word: knowledge. We need now more and more global/ general/ unified knowledge, just because all is globalizing nowadays: economy, political activity, ecology, research, monetary and many other dimensions of reality.

In a quite interesting book, **Paul Heyne** [8], (Heyne, 2011) explained why there is not a good economist that one who is only an economist. He said that "*A better economist should understand that (s)he can obtain some gains in negotiations with other specialists from other domains. A specialist with a good economic thinking is studying the human condition and may enrich herself/ himself from changing ideas with other specialists which are studying the human condition, beginning with philosophers, political scientists, and sociologists and ending up with literary critics, art historians and cultural anthropologists. If you intend to continue your studies, then you should not ignore and completely eliminate the other humanistic disciplines*" (my translation from Romanian edition) [8]. My conclusion is that **Heyne** is making a plea in favor of general knowledge on human, not in favor of a quite specialized homo oeconomicus. But, my point of view is not to let this getting of new knowledge from negotiators or colleagues from other fields, but from school itself, and not necessarily as part of specialized disciplines but as part of a general knowledge (transdisciplinarity) on human behavior and ways of correct thinking. Fortunately, in Romania there is a bigger and bigger quantity of experiments, articles, pleas and mass-media articles able to generate more and more favorable attitudes towards transdisciplinarity. I'll give some examples in the following chapter of this article.

10.2.2 Using Transdisciplinary Thinking Based on Levels of Reality in Solving a Quite Complex and Paradoxal Problem: Which was First, the Egg or the Hen?

At a course lesson on transdisciplinary methodology, two years ago, I insistently asked students to put questions, be those strange ones or complicated problems to try to solve them using the components of transdisciplinary methodology. A student put the very old problem of "which was first: the egg or the hen"? Many laughed at, some tried to explain how simple is this problem to solve, and I remembered that only some days ago I listened to radio about a very serious research that implied many Nobel prizers in physics,

chemistry, biology and medicine. They were asked to have a special holidays having fun in a tourist residence, but to work hard and give "scientific" answer to an ancient problem: which was the first, the egg or the hen? They seriously worked and offered interesting and lucrative hypothesis and demonstrations. Finally they reached a consensus and offered to the entire world the much waited answer: it was the egg at the very beginning of the evolutionary process, just because without this "seed" it was impossible to have a hen. I was quite amused hearing this answer and remembered that in grammar school a teacher asked us the same question and I and other people gave the same answer as the Nobel prizers... Students were a bit amused and a bit disappointed that the answer was so naive and well known... But I denied this answer and told to students I simply did not agree it. Why? How? Smiles appeared on students' faces: "this professor have an excessive good impression about him...". Immediately, I used the transdisciplinary methodology with its three pillars founded by **Basarab Nicolescu**. I said that the answer is not acceptable just because we may ask: but before the egg, who gave birth to it? Who was the primordial HEN to create at least an egg? The answer offered both by any schoolboy or schoolgirl and a strong team of scholars was generated by a linear thinking at one and the same level of reality. But, at a superior level of reality we may find another answer. So I did, and invited students to climb up at a superior level. I suggested them to think at a pre - Big Bang time, when our Universe was quite concentrated with all Information, Energy and Substance in it. All planets, seeds, beings, ideas, energies and substances, beings (hens included...), vivid things (eggs included) were there. At that level of reality it is a nonsense to ask which part of that primordial Atom was first, which one the second, and so on. All components co-existed simultaneously and continuum; no one was differentiated and no sequence existed. It is the same thing as asking which molecule of water is prior to a molecule of wine in a glass of wine & soda. So, we have to compare the two answers: the pre – Big Bang and the post – Big Bang. Of course there are two different realities (levels of reality). In pre – Big Bang situation both hens and eggs were there without any temporal sequence. In post – Big Bang situation, time and succession appeared. In this new level of reality the ancient question makes sense and the logical answer is based on this. As a result, Nobel prizers were right in a temporal pre-Big Bang sequence, but this sends us to the pre-egg time. To conclude, we have two true and non-contradictory answers at two different levels of reality. Of course, a lot of new consequences appear from here.

10.2.3 Logic of the Third Included - As a Solution to Problems from Different (More Complex) Levels of Reality

The included middle (third included) is a logical operation by which two relatively opposed things are better understood and interconnected by a third one that links the previous two. This eternal seeking for harmony was de-

layed by the binomial thinking and the study of the opposites. Modern times accelerated this disjunction tried to separate things in order to better know them (analysis) although a synthesis was all the time recommended. Postmodern times (after 1950) tried to deconstruct this way of obtaining new info and proposed a synoptical and synthethical vision, in which not only the opposites were on the first plane, but the third medium term that linked them. In such a way a dyadic view was replaced by a triadic one, with a deeper and better understanding of things. Although this view increased complexity, this is to be preferred just because complexity may be solved with the help of new soft and technologies. See, in this respect, a Romanian contribution to complexity problem: Radu Dobrescu [9], (Dobrescu, 2005) http://ace.ucv.ro/sintes12/SINTES12_2005/COM
PUTER%20ENGINEERING/06.pdf .

End Means Methodology (EMMY) [10] (Drugus, 2011) is based on triadic thinking, simply because we are living in a three-dimensional space and a three-dimensional time. "Trans" is the old name for three. As a result transdisciplinarity is based on a special triadic logic called logic of the third included. Logic of the third included is an intrinsic part of End Means Methodology (EMMY) when establishing the set of triads describing human existence and its environment. For short these triads are:

- temporal: past-present-future
- spatial: micro-macro-mondo (or: smallest-medium-biggest)
- structural/ existential: Information-Energy-Substance
- human action essence: ends-means-ends/means ratio
- theoretical description of any human action: politics-economics-ethics
- practical description of human action reality: policy-economy-morality
- transcendental Christian reality (Holy Trinity): Father-Holy Spirit-Son ("*Tres unum sunt*")

A lot of triads there exist and built up our world and its understanding (e.g.: point-line-plan, introduction-content-conclusion, etc.). It is easy to observe that the first component of every of these seven triads appears as most important to us, but the middle term is the unifying one and it may be considered as the third included, a third one element which is the common essence of all three. This explains why our world is built as it is known to us. More than that, the medium term (third included) cannot have a distinct/ isolate existence apart from the other two elements. But it is quite interesting that every one of the three elements may play the role of the included middle among the other two, just because all three elements are part of a unified entity. This observation helps us to seek for the unity of things and not for their separation and segmentation (as modern Cartesian wisdom learned us). This kind of thinking is not necessarily a postmodern contribution, but as Basarab Nicolescu recently said in an interview afforded to Iulian Boldea and published in

"Familia" / ("Family") magazine (which appears in Targu Mures, Romania), it is well known from Aristotle and Stefan Lupasco [11], (Boldea, 2012).

10.3 Transdisciplinary Teaching and Evaluating

My older proposal in favor of proposing/ imposing transdisciplinary teaching not at the academic and post academic levels, but at the gymnasium and high school levels could be simply put as such: kindergarten, grammar school, gymnasium and high school should have transdisciplinary/ holistic/ general knowledge level; and specialization could appear only beginning with academic level. As a matter of fact it is not to oppose or contradict the two ways of teaching: disciplinary (specialized) teaching versus transdisciplinary (non-specialized) teaching, but most important is to use specific ways of combining them with different charges. In favor of my proposal comes a quite genuine experiment led by prof **Mirela Muresan** [12], (Muresan, 2010) at "Moise Nicoara" national college from Arad, Romania. The alternative learning meant a new way of teaching: without disciplines, without marks and evaluators tests, but with team teaching and creative learning. It is worth mentioning that a specific structure was created ad-hoc. It is called **The Transdisciplinary Center of Educational Applications from "Moise Nicoara" National College, Arad, Romania**. Here is a short description of a transdisciplinary successful experiment, description made by Professor Mirela Muresan herself: "*During the last 5 years more than ten TD projects were conceived and performed at the "Moise Nicoara" National College, from Arad. The first one started in 2008 and its outcomes are described in a book published in Romania, with a foreword written by Basarab Nicolescu (1). The last one took place this year in the frame of "the different school week" provided by our Minister of Education. It was called A Transdisciplinary "Reading" of the Water and it is described in our "T" Journal (2). All these didactical experiments attempted to apply the TD methodology in the classroom. The experiments of "Moise Nicoara" College were the first ones performed in Romania in the field of the high-school education. These experiments proved that transdisciplinarity is not a utopia. Transdisciplinarity can be transformed in a current practice in school; but to pass from theory to practice means new problems and questions searching for new answers. In my opinion, the most valuable thing is the fact that these didactical transdisciplinary experiments succeeded to identify some important reflection points which are absolutely necessary for applying the transdisciplinarity in public education. Some of these questions are: what a transdisciplinary curriculum means? What does it really implies? Could we practice the transdisciplinary methodology within the frame of a disciplinary designed curriculum? Could we conceptualized the "didactical border" between inter/pluri and transdisciplinary approach in the teaching-learning process? Which is the difference between the "transversal competences", "cross-curricular" ones and the "transdisciplinary competences"; or could we speak about TD competences without enlarging the definition of the concept? Which would be the correct re-*

lation among information, competences and values in the educational process? the right balance among to know/to do/ and to be?All these questions were also refreshed during the recent International Colloquium organized in Arad, Romania, the first one of the kind in our country. (3)

1. Muresan, M., coord. (2010), Transdisciplinaritatea de la un experiment spre un model didactic, Junimea, Iasi, with a foreword written by Basarab Nicolescu
2. Muresan, M.,(2012) A Transidsciplinary "Reading" of the Water, in "T" Journal, no.2 edited by The Trasdisciplinary Center of Educational Applications from "Moise Nicoara" National Colege, Arad, see http://www.moisenicoara.ro/t-journal-no-2/
3. International Coloquium "Transdisciplinarity in Primary, Secondary and High School Education", http://www.moodle.ro/edutd ".

Another example is that of **Adina Sorohan, professor at the National College "Lucian Blaga" Sebes, Alba, Romania**. Here is her contribution to transdisciplinary thinking at pre-academic level, depicted in her own words: "*In 2010 I started to apply the classes I teach a series of workshops which enable students to perceive different levels of reality, to develop the types of intelligence: analytical, emotional and bodily, to learn to communicate, to acknowledge the existence of diversity in unity and of unity in diversity, to rediscover nature as the origin of everything that surrounds us, which leads to the regeneration of senses, emotions and thoughts. In* ***The lyrical text: a transdisciplinary approach (high school level)*** *(2011), efforts are made to discover, understand, analyze and interpret the lyrical text from several perspectives, against a background of labyrinthine recesses which intertwine and complement each other from playful activities, methods of synthesis, all to uncover the sublime beyond what the lyrical universe appears to be at first reading. In* ***The perception of the lyrical text through the sense*** *(2012), I proposed an initiation in the perception of the lyrical text through the senses, varying the methods of perceiving the poetic message, interpreting the levels of the lyrical text, corroborating personal experiences with the emotions transmitted by various layers of the poetic text*".

It is interesting to observe that the pro-transdisciplinary activity in Romanian education (under the guidance of Professor **Basarab Nicolescu**) generated a lot of preoccupations to implement the new transdisciplinary vision in teaching in this country. Even the concrete measures are still to be taken, the Minister of Education, professor **Ecaterina Andronescu** [13] seems to be in favor of transdisciplinarity in recent declarations since October 2012. I'll translate some of these thoughts and hope they will be transformed into practical attitudes and methods of teaching: under the title "*The teachers are those who are overcharging the curriculum" she underlies that "textbooks should contain only the essential things for a certain discipline. Teachers are those who overcharge the content of a discipline; they try to tell pupils all*

things they know. A lot of info could be obtained from alternative sources as is internet. A textbook should comprise the skeleton of a certain theme, and after that the pupil may add new info on it. It is necessary to start dialog with universities in order to prepare them for a transdisciplinary teaching". Unfortunately, this seems to be only an electoral discourse just because nothing happened since then.

The traditional education (teaching and evaluating) is under fire all over the world. When things are not going well the main cause is found in the education court. That is why even American education system is criticized and some proposals to change it are already done. Here is an announcement of this kind recommended to future entrepreneurs: the accent is put on free thinking, self confidence, initiative and creativity.

Debbie Ruston posted a job: CONSULTANTS/HIGHER EDUCATION PROFESSIONALS - An ACCREDITED Curriculum That is RE-Inventing & Transforming Education -'"According to the US Dept of Labor: 65% of today's grade school kids will end up at jobs that haven't been invented yet. As an Educator, or someone that works with Educators, you probably recognize the changes needed in our educational system. A recent study determined that 80% of college grads can't find work. The dropout rate is massive. Generation Y are moving back into their parents homes after college. We are seeing a massive shift in thinking and individuals are realizing that to take control of their futures in this changing economy, they must stop relying on employers and governments to provide solutions. We must prepare for the new economy by creating self reliant, visionary entrepreneurs, which provide opportunity for themselves and others. How can educators effectively teach students how to successfully move into entrepreneurship, and take this control of their futures, when they have never been an entrepreneur, and are only trained in traditional forms of employment? Our Multi-Award Winning Curriculum offers proven, dramatic results which will prepare students to successfully enter into Entrepreneurship. We offer a Success Education curriculum that will transform the thinking of the students and prepare them for an entire lifetime of success. Users will learn to let go of ego, take on a higher level of personal responsibility for their own lives, learn how to set meaningful goals and a plan of action on the achievement, create a stronger sense of teamwork, improved attitude and commitment, a higher level of integrity, ethics, co-operation, will build confidence, leadership skills, and strengthen decision making skills, which will prepare students to create a successful, self reliant future for themselves - important in today's economic world, where individuals can no longer rely on corporations/government to provide solutions for them. Students will also learn how to utilize Social Media to build their own business brand. Our virtual community provides a private platform for the organization to communicate, recognize and incentivizes, to build a more committed, more positive interaction among users." (This Ad was extracted from internet)

I'll try to expose here my own experience in teaching transdisciplinarity or using transdisciplinary thinking in teaching and evaluating. I consider trans-

disciplinarity as a new way of thinking reality and its complexity by interconnecting ideas, things, concepts and methods in specific and creative modes, without limiting or bordering "domains", "fields" or "feuds". Modernity exaggerated and extremised the Aristotle idea of discipline, later on called "science" (or "scientific" disciplines). The so called "scientific" research proves not to be so "scientific" as it pretends to be. Not every PhD thesis is a real contribution to the growth of "science". "Science" comes from Lat. *scientia* = knowledge. In my opinion it is better now to use other two words instead of "science", i.e. to specify some of phases that are describing the process of production of new knowledge: a) research is the first phase of observation, formulating of hypothesis and testing them; b) cognition (or the cognitive process) c) (new) knowledge is added to the old one. As a result of replacing "science" with one or more of these stages, we may speak about researchers but not about scientists/ scholars, i.e. not any/ every scientist is a researcher (see serendipity in research), and not any/ every researcher is a scholar (adding new knowledge to the old one). Using the right word to describe the right quality/ status/ position of someone implied more or less in research activity.

I use transdisciplinary methodology when teaching Management. I gave up the hundreds of definitions to this activity (and theoretical approach) by re-defining it simply as thinking-feeling-deciding continuum concerning establishing ends, choosing means and continuously supervising the degree of adequating/ equilibrium between the proposed ends and the chosen means. This way of understanding and describing human action could be called Machiavellian Economics (a book with this title "Machiavellian Economics" was written by Alan F. Bartlett [14] in 1986, republished (revised edition) in 1987 and bought by me in September 1990, but with different content from my EMMY. See [14], (Bartlett, 1987). I may call it *Machiavellian Management*, just because the essence of management was clearly essentialized by Machiavelli: "ends justify means". Of course, Machiavelli was not published and teached in communist Romania, but my EMMY put this managerial essence in other words: "end-means-end/ means ratio". I must recognize here that I was attracted by the harsh criticism addressed in that period to the "hypocrite and bourgeois" writer Niccolo Machiavelli, but I often suggested that Machiavelli was right.

10.4 EMMY as a Transdisciplinary, Postmodern, Holistic and Integrative Vision on Human Action in the Knowledge Based Society

10.4.1 Towards a New (Postmodern) Theory of Efficient Human Action

Human action is and will be a permanent component of any human context, although in postmodern times human thinking will be extensively computer-

aided. In this case, the prime and decisive element of obtaining better results will still remain the human brain, respectively the human action in its theoretical-projective phase. In consequence, we will approach the human action theory from a postmodern perspective with inherent nuances and differences as compared with the human action theory as it is defined in the classical works of libertarians L.W. Mises and Rothbard Murray.

The modern theory of efficient human action (praxeology), with well-known predecessors, such as T. Kotarbinski and others uses the theory of human action applied strictly to a defined economic context, in a narrow sense as sector of production of material goods. Therefore, the optimization of human action by classical praxeological approach strictly aimed the increase of the value of some indicators, such as: productivity, economic efficiency, industrial and agricultural output etc. Without denying the utility and functionality of such specific approaches in my postmodern vision, I will enlarge the area of economics, with direct consequence of emphasizing other dimensions of optimising human action. Thus, instead of the modern concept of optimization, we suggest the use, on a large scale, of the concept of *adequation*. The difference between the two concepts consists in the fact that the first one is mainly quantitative while the latter is mainly qualitative. Moreover, while the concept of optimization supposes the exact measuring and even an elaborated set of mathematical tools, the concept of adequation appeals to ineffable and difficult to measure elements, such as: intuition, imagination and inspiration. All these dimensions are not opposed to those elaborated by econometricians, statisticians and economists in the classical sense, but they are complementary, integrative, part of the postmodern holistic and transdisciplinary epistemology.

For the elaboration of the concept of *adequation*, a series of stages were developed:

- The redefinition of some disciplines, both quantitatively and qualitatively; quantitatively - by enlarging the area of a certain discipline and qualitatively - by extracting essences of every discipline and by redefining their concepts.
- The redefinition of the relations between disciplines and adding, along with the disciplinary approach, the interdisciplinary and transdisciplinary approaches.
- The permanent concern to integrate the analysed contexts into neighbouring ones, with a larger or narrower area. However, the rule will be the concern for the integration in larger fields, which supposes both a holistic vision and the finding of new epistemological visions. For example, the logic of the included middle generates permanently and continuously new levels of reality, respectively larger contexts able to help understand previous contexts.

An example of transdisciplinary, postmodern vision in the field of human action theory is my 35 years old “End-means methodology” (EMMY) which

suggests a triadic approach, a compacting and essentializing of certain disciplines from the so-called "social sciences" (This term of "social science" is already obsolete, confusive and with too many definitions to be accepted. A critique of this pair of words will be the content of another article). The starting point of this new vision was represented by the attempt to essentialize and find the defining elements of human being, of human action respectively. In time, there has been consolidated my conviction that it is quite specific to all human individuals the idea of finality, instrumentality, and subsequently, of adequation between the aimed finalities and the used instruments. The finality can be suggested by the concept of "purpose" or "end", the instruments by the concept of "means" or "resources", and the compatibility between them is suggested by the phrase "end-means adequation". Moreover, for every of three essential characteristics of human being (end, means and end/means ratio) is necessary to establish three theoretical approaches/ fields. Thus, the field of studying ends is subject of the field (discipline) called Politics, the field of collecting, combining and consuming means being subject to Economics, and the field of adequating ends and means, both at individual, group and society level being subject to Ethics. This has given rise to a rather strange conclusion at first sight, but perfectly logical and explicable in further phases, that the three dimensions/ fields (politics, economics, and ethics) have a common substance, that is the binomial pair "end-means". In order to make this conclusion more comprehensible, I offer the following demonstration:

- Politics is the field of establishing **ends** in accordance with the existing **means**;
- Economics is the field of collecting, combining and consuming **means** in order to reach a pre-established **end**;
- Ethics is the field of simultaneous and continuous adequation of **ends to means** and/or **means to ends**.

It is obvious that the three fields defined by means of the concepts "*ends* and *means*" are inseparable and impossible to understand their significance without considering them as a unitary whole. That is why I called this triadic complex as the politics-economics-ethics continuum. In order to better suggest the very essence of this continuum I called it End-means methodology, for short EMMY. I have appealed to this vision on the human existence and action in order to emphasize the concept of **adequation**, which I considered a more integrative and knowledge-generator one in comparison with the concept of optimization.

This new EMMY vision has also generated another audacious hypothesis, that of equalizing EMMY and management. This new hypothesis has determined the redefining of the concept of *management*, under the form of triads, having in their centre the concepts of *ends* and *means*.

10.4.2 Management as a Specific Way of Optimizing Human Action

There are a lot of definitions for management as a theory and a human practical action. Theoretically, management describes the essences of human being and of human action. These essences were considered: finality, instrumentality and the permanent adequation of instrumental aspects to the teleological ones (or vice-versa). For short, I consider a triadic approach which aims to be holistic, postmodern and transdisciplinary, as well. In this respect, the fundamental structure of any human action is end, means and end/means ratio.

I mean by ends the broadest category of teleological aspects, which is all intentions, desires, hopes, plans, strategies, visions, aims, purposes, targets and so on. In short, any purposeful and consciously-intended action is part of this large category - ends. I realise that the common meaning of ends makes direct connections with finitude and with something which implies no continuation. In my vision, ends refer simply to something to be fulfilled in the future. Of course, this accomplished human action (initially viewed as an end) transforms immediately into a means that may be used to attain a lot of different purposes. In my definition of ends I imply unconditionally the necessary means to attain a specific end. This restriction is essential for defining future ends in a quite determined connection with the necessary means to attain it. In other words, it is improperly said that someone is establishing an end without immediately adding the necessary means. Otherwise, such ends could be simply dreams or - better - utopias. I take as a companion to this short demonstration Stephen Covey [15], (Covey, 1989) with his well known book "The Seven Habits of Highly Effective People". The second habit is: "Begin with the End in Mind". For a summary description of this formative book you may see: http://en.wikipedia.org/wiki/The_Seven_Habits_of_Highly_Effective_People

On the other hand, the means are defined as all kind of instruments (things, ideas, energies, techniques, combinations, resources etc.) meant to contribute concretely to attaining a specific end. Like in the case of ends, the means could not be defined if some misses to mention "What for?" This is a quite clear distinction which differentiates EMMY by the libertarian theory where the Austrian schools economists are using ends and means separately without connecting them immediately and specifically. In this case I may call my new vision as neo-libertarianism, or as I told it some lines before – Machiavellian Management (in spite the negative attitude towards Machiavellian thinking some may have).

As about the third term *end/means ratio*, this is viewed as a simultaneous and continuous act of having in our minds ends and means in order to compare the degree of adequation among them. This triadic process helps us not to forget the interrelationship between ends and means, on the one hand, and the necessary adequation among them.

Management theory, defined in a neo-libertarian and EMMY style tradition

is defined as "thinking, feeling and acting/ deciding". All these three categories are strictly connected with ends, means and end/means ratio. Defined in such a way, management could be easily applied to practical day-by-day activities and not only to firms, corporations or states. Families, groups and institutions are practicing management in a quite "scientific" way...

The process of continuous and simultaneous adequation of ends and means is the best way to harmonize human action, to reduce any waste and to be able, at any moment, to know where you are. The process of adequation/ harmonization is, as I already mentioned above, a mental one and not a mechanical or mathematical one. More than that, the literary expression of ends and means needs a more complex training of managers, including: communication techniques, precise writing, essay writing, report writing and literary style. Sometimes, a metaphor or a comparison may help more than any sophisticated mathematical demonstration that could be true for some seconds or for a very short period of time.

10.5 Conclusion

This paper is not only a synthesis of some of my previous ideas and articles. The attentive reader may found here new proposals, classifications and clarifications that may help improve our dialog on Management, Politics, Economics, Political Economy, Ethics, Law to mention only some of the older modern disciplines which could be usefully melted into EMMY or – same – Management. Many professors felt scared with the spectre of not having their beloved discipline in curriculum. I suggest there is no reason to be scared; there is reason to be scared only for maintaining this strange educational system more and more professors and graduates are denying for its inefficiency, waste of time and less of openness to creativity and innovation. Of course, transdisciplinarity and its new visions are not panacea, but at least is trying to offer new solutions and a large terrain for debate.

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CHAPTER 11

Practicing Transdisciplinary Methodology within the Frame of a Traditional Educational System

Mirela Mureşan, *"Moise Nicoara" National College, Arad, Romania.*

Everybody knows that the present educational system is mostly built on disciplinary teaching-learning basis: disciplinary curriculum and assessment, disciplinary specialization of the teachers, disciplinary diplomas etc. The topic of this study-case offers the opportunity to look for some proper answers to the following problems: could the transdisciplinary methodology be applied within the frame of a disciplinary system of education? How could it be done? What would be its challenges, limits and perspectives? The case represents the transdisciplinary didactic experiments conceived and performed at "Moise Nicoara" National College from Arad, Romania, during the last five years. The term and concept of "transdisciplinarity" will be used as it was defined by Professor Basarab Nicolescu.

Keywords*:* transdisciplinary education, curriculum design, transdisciplinary teaching and learning, competences, values.

11.1 Introduction

Conceptual Guidance

Transdisciplinarity (TD) is a term and a concept that is largely used today, in many fields and all over the world. Presumably, it is most frequently used in the educational area. Yet, unfortunatelly, this term is used in various meanings which bring about conceptual deviations, semantical slippings that give rise to dangerous confusions. The present day scientific community has not yet a terminological and conceptual consensus on "TD". The most frequent and inconsistent uses of this term and concept, entailing errors in understanding and application – aim at the confusion between *pluridisciplinarity-interdisciplinarity*,

on the one hand, and TD; on the other hand, on the relation among them as well. Paradoxically, the same phenomenon happens in Romania too, all the more as the "father" of TD , the author who consecrated the new concept of TD in the international area, professor Basarab Nicolescu is Romanian.

Therefore, we do consider that a minimal updating of the concept of TD is absolutely necessary, taking into account the given definition in Basarab Nicolescu and CIRET group view. According to this view, **TD is a methodology**. This methodology is based on the already known three axioms that design it. Greek philosophers believed that an axiom is a claim that is true, without any need for proof. The truth of an axiom is taken for granted [1]. Hence, in Basarab Nicolescu's view the three axioms the TD is based on [2]:

a. ontology - Levels of Reality and the Hidden Third,

b. the Logic of the Included Middle,

c. epistemology – knowledge as an emergent complexity.

TD cannot be understdood and applied in the absence of full consideration given to the above mentioned axioms. To ignore or to eliminate one of them triggers about the risk of a falsification of the TD concept, the risk of erroneous slippings, and applications of the latter, in all areas.

Theoretically, the possible need of a fourth axiom, with reference to axiology was discussed [3] Nicolescu, believes that the TD methodology does not require a separate axiom for axiology while others feel that this issue is not yet resolved, that we need to have further conversations about the need for a TD theory of values (a TD axiology pillar) e.g., Cicovacki, [4]. Nicolescu's position on the matter is clear: "there is no need to introduce values as a 4th axiom" [5]. In more detail, he believes "we have to limit the number of axioms (or principles or pillars) to a minimum number. Any axiom which can be derived from the already postulated ones, has to be rejected" [6].

A new clarification we intend to outline comes from the mistaken or malicious interpretations of TD. Therefore: What TD is not? Firstly, TD **is not another discipline**. According to Nicolescu's consecrated definition, "Transdisciplinarity concerns what is at the same time between disciplines, inside various disciplines and beyond any discipline. Its aim is the understanding of the current world and one of its imperatives is the unity of knowledge" [7].

Secondly, as I have already stated, since TD has to be looked upon as a methodology, there is no place for **confusion** between TD and ***a method***, as it happens many times when one tries to apply it, mostly in education. Reducing TD to a method implies a flagrant amputation of its own essence. "Methodology" is not just a "method"; methodology is the philosophical basis for method. Method and methodology are sometimes used as though they were synonyms - but they aren't. *Methodology* is the study of methods and deals with the philosophical assumptions underlying the research process, while a *method* is a specific technique for data collection under those philosophical

assumptions. A methodology is a system of methods and principles for doing something, for example for teaching or for carrying out research.

Thirdly, TD – as methodology – *is not a religion, or a dogma, an ideology* to serve some group, economical, social or political interest. This is obviously transparent for anyone who tries to understand TD basic axioms and has a good faith.

Consequently, we can firmly state TD to be the conclusive factor in knowledge paradigm changing for the 21st century. New methodological keys are hence offered by the recuperation of the Subject place in knowledge, by the logic of the included middle, by a new understanding of Reality – according to the ontology of Reality levels and the Hidden Middle – and by the realization of the incompletness of knowledge. These outcomes open a large opportunity for many applications in various fields: education is a privileged one.

In our opinion, TD can offer a sustainable solution to the educational crisis mankind is facing nowadays; we dare say that it could be the only solution to this problem and furthermore; transdisciplinarity could stand as a viable solution to the problems of the 21^{st} century human society as well.

11.2 Transdisciplinarity in the Present Days Education: Delors' UNESCO Rapport on Education

Many people might ask why an imminent change of the educational paradigm would be necessary nowadays. Philosophers, sociologists, psychologists, and researchers in the field of education, as well as parents and students all agree - expressing the idea in various ways – that something is 'rotten' in the education aria. But they can hardly see the roots of the problem and are hardly capable of searching possible solutions. After decades of disappointing educational outcomes, it's time to work on some educational possible solutions.

The present day public education in most countries is working on a curriculum based on "disciplines"; it was accepted by the tradition of an encyclopedic paradigm of knowledge. Such a curricular model does not venture to build a holistic (integrated) outlook on the world and knowledge; human knowledge is still reduced to a truncated approach to reality, without connections; there is a dangerous discontinuance between the inner and outer reality between the subject and object of knowledge. Wililam Grassie proposes in his article called "Reinventing Science Education in the 21st Century" a great change of the curriculum. "The fundamental problem underlying the disjointed curriculum is the fragmentation of knowledge itself. Higher education has atomized knowledge by dividing it into disciplines, sub disciplines, and sub-sub disciplines – breaking it up into smaller and smaller unconnected fragments of academic specialization, even as the world looks to colleges for help in integrating and synthesizing the exponential increases in information brought about by technological advances" [8]. In his opinion "The solution to "disconnected ideas,"

Table 11.1: Learning to know.

Actual Approach	**TD Approach**
Fragmentary knowledge (partial meanings)	Holistic knowledge (global/general meaning)
Disciplinary curriculum	Inter/pluri/transdisciplinary curriculum
Mostly rational knowledge	Balance among rational, affective, corporal knowledge
Logic of the excluded middle (or/or)	Logic of the included middle (and/and)
TO KNOW	TO UNDERSTAND

"dry facts," and the "fragmentation of knowledge" may well be in recognizing that the history of the universe, the evolution of life, and the rise of human civilizations are in fact a *unified story* and best taught that way". This Big History curriculum has been tried with great success by a few pioneering colleges and disparate high schools. This approach engages students in profound questions of meaning and purpose, virtues and values, in ways that are respectful of science, supportive of thoughtful religion, and conducive to civil societies. [8]

A lot of others experiments of changing education in the perspective of TD methodology has been developed in many countries in the aria of higher education system. The ones from Mexico and Brazil are mentioned by Russ Volckmann and Sue McGregor [9].

The truth is that the same issue occurred in Europe too. The famous Delors rapport at UNESCO has revealed the need of changing the education according to the requirements of the 21^{st} century society. The International UNESCO High Commission for Education in the 21^{st} Century presided by Jacques Delors has written out a report (1994) where, in Ch. IV, the idea of a new type of education that should focus on four main pillars was stipulated :*to learn in order to know, to learn in order to do, to learn in order to live along with others, to learn in order to be* [10]. This program – theoreticaly possible even in the frame of the traditional educational system – would be completely inefficient from the practical point of view. Hereinafter, I shall try to sketch a connection between the TD outlook on education and the traditional system one; I shall preserve as criteria the four basic components as they were presented in the above mentioned report. The following synthetical schemes will easily point out the deep changes brought out by TD educational approach as opposed to the present day one in the school system [Table 1, 2, 3, and 4].

In an attempt at a synthetic outlook on everything previously stated, we feel that we are entitled to sum up the following conclusions: TD education is an absolute, integral education for any individual, it is able to ensure self-

Table 11.2: Learning to do.

Actual Approach	**TD Approach**
Emphasis is on professional competence for insertion in the labor market	Emphasis is on "life competence" (insertion in the society and universe)
Fragmentary evaluation (scaled competences, "hic et nunc")	Integral evaluation (individual creative potential)
Process evaluation heavily quantitative	Process evaluation heavily qualitative
"Horizonta" formation	"Horizontal" and "vertical" formation
To act efficiently	To think, to feel, to act in a creative manner
Routine	Joy
TO DO/TO ACT	TO MAKE/CREATE

Table 11.3: Learning to live with the others.

Actual Approach	**TD Approach**
Importance of the individual (the difference matters)	Importance of the individual and universal (the identity matters)
Social desirable attitudes and behaviors	Human desirable attitudes and behaviors (transhumanism)
"Horizontal" integration (a single Reality level)	"Horizontal" and "vertical" integration (a plurality of Reality levels)
WITHIN THE SOCIETY	WITHIN THE SOCIETY AND UNIVERS

Table 11.4: Learning to exist.

Actual Approach	**TD Approach**
Human existence/ life according to moral values of the society	Human existence/life according to moral values of a certain society and culture but also universal human values
Material existence	Material and spiritual life
Personal/individual dimension	Trans-personal dimension
Surviving (concurrence, competition)	Living (self-harmony, with society and universe
TO EXIST	TO BE

harmony, harmony with society and the universe; so that every individual be able to understand both the meaning of his own existence and the meaning of existence in general. It is the only way to "cure" the specific symptoms of the complex crisis mankind is facing today: "the loss of meaning and the universal hunger for meaning" [11].

11.3 Romanian Experiments in the High-School Education at "Moise Nicoara" National College, Arad

"Moise Nicoara" National College is the best college in Arad and one of the most well known college in Romania due to its students and teachers' staff. It was founded in 1873 and became famous in time because of a lot of Romanian academicians, and important writers, scientists, musicians etc. who graduated from this college [12].

The interest for transdiciplinarity is a consistent proof for the creativity of the teachers' staff and the capacity to research in order to be updated and innovate in the field of education. A lot of interesting inter/pluri and transdisciplinary didactical projects were conceived and performed during the last five years. That is why last year "The Trasdisciplinary Center of Educational Applications" from "Moise Nicoara" National College, Arad was founded - the very first in Romanian secondary education. One of its important instrument of dissemination of TD didactical experiments is The "'*T Journal*". It is an on-line journal written in Romanian and English as well which promotes the TD applications in Romanian secondary education [13]. These projects have practically proven that the TD approach of teaching and learning is possible and effective in a real school. From these attempts to apply the theory, serious reflection issues have arisen. Finding proper answers to them means contributing to the enrichment and refinement of the TD methodology itself.

The approach was not meant to tend to a theoretical contribution to TD, but to its applications in education. We only attempted to see how to transcend from theory to practice, i.e. how to adjust the theoretical aspect of TD to the actual use of the educational issue areas. These experiments intended to prove that the TD approach applied to the teaching-learning processes is likely to work in school: hence, an exquisite prospect for the education of the future generations could be generated.

The theoretical background of all experiments was of course the theory of transdisciplinarity as it was conceived by Professor Basarab Nicolescu. In order to have a proper idea of this projects, a detalied description of the first and last TD experiments performed at "Moise Nicoara" College will follow. The both experiments were coordinated by Mirela Muresan.

The first complex TD experiment started in 2008 and it was carried out as it is described in the book published in 2010 in Romania [14]. Basarab Nicolescu wrote the foreword of this book and he pointed out the following:

"We are in front of an event book. A blazing-the-path book. A cornerstone which will mark the history of education in Romania.(...) We are congnizant and follow diligently all TD experiences in the high school systems in many countries (e.g., in Brasil, a large scale experiment took place for several years). Hence we can state, without any hesitation, that the Arad experiment is both the most successful and biggest potential educational product to export in any country of the world. The great discovery achieved by the Arad experiment participants is the fact that *disciplines are masks of TD* – an axiomatic truth, able to inspire any worthy project for an education able to face the huge throws of the century we are living in" [14].

This first experiment was also described in an article entitled "The International Journal of Learning" written by Muresan M, and Flueras J., [15]. The article aimed to answer to the following questions: what kind of educational paradigm would be available for the future society (what would be its "philosophical" basis) ? What would the "educational ideal of the 21^{th} century"' look like? In what way could TD be applied to educational issues? How could it be implemented to the public education? How could the bridge between the TD knowledge and the TD teaching-learning process be crossed? The following description of this experiment is partially taken from the above mentioned article [15]. The project was carried out for two years, involving activities attended by high school students and teachers. The target-group consisted of 23 students from the 9^{th}, 10^{th}, 11^{th} and 12^{th} grades. These activities took place in parallel with the official curriculum that was taken as a reference frame. The activities extended over 10 weeks every Saturday morning. The 17-teachers team (Mathematics, Physics, Biology, Literature, Music, Drawing, Geography, Religion) prepared ***transdisciplinary syllabus*** which was applied to the target group of the students.

The TD target of this project was to show the students that a *unity of the world and knowledge exists.* The main objectives in accordance with which the content was built were the following: developing students' interrogative abilities (asking questions); developing students' *abilities to understand* fundamental truths (about nature, humankind etc.).

The syllabus of the project was established after taking into account a generous topic, generous in the sense that it should belong to each discipline, it should transgress the disciplines, and, at the same time it should be beyond any discipline. A metaphorical title was given to the topic: "*The Anonymous Behind the Mask*". It deals with the relationship between essence and appearance, between what can be "seen" and what is usually hidden, in both the outer and inner universe, on both a human and cosmic level. The content of the curriculum was structured on three learning unities as follows:

- The *"masks" of the human being*: the scientist, the artist, the religious man, the social man;
- The *"masks" of the world*: the infinite, the space-time, the gold-number, the Mobius strip, the camouflage in nature;

- *Beyond the mask.*

The weekly meetings were organized as workshops. While attending these workshops, both teachers and students experienced unique feelings. These workshops were all based on *dialogue* and *debate*. While attending these activities, all participants experienced amazing revelations about: the resemblance between scientific and artistic imagery, the representations of the *infinite* in Mathematics, Physics, Religion, Poetry, Music, Sculpture; about the divine proportion of *the golden number* and its presence in the cosmic and human body architecture, in painting, architecture, sculpture; about the issue of the camouflage and its forms in nature, in the social and individual life, about the need for camouflage in plants, animals, human beings and sacredness, as well. *The Mobius strip* was another challenge: its effective manufacturing by hand and pointing out to its properties represented the starting point for discussing its presence in topology, physics, chemistry, biology, literature and film, music, religion, architecture. Its presence in the ordinary life was discussed as well as its philosophical meaning.

The relationship between*portrait, self-portrait and mask* was also a core point of the debates concerning "the masks of the human being". The didactical scenarios we made up emphasized the subtle connection between the aesthetic and the ontological: as God made the human being after his image and resemblance, the work of art is, on its turn, a kind of a self-portrait of the author. How could we rebuild the "image" of the author behind all his creation. The art works (in literature, music, painting and sculpture) are but different *faces* of the creative artist, thus the cosmos and the human being are but different *faces* of the divine creator. The topic concerning the masks of the social human being produced an ardent debate on the totalitarian periods in the history of mankind: a fragment from the Bible's *Genesis* and from Andersen's story – *The New Clothes of the Emperor* were the starting point to remake the need for a "mask".

The main idea, which was progressively born during the workshops, was the fact that, behind the mask, the essence of both the human being and the world is the same, but in most cases it looks like a "Great Anonymous" due to the lack in our capacity to adequately understand the truth. Sciences, arts, religion, mythology, they all assert the one and the same truth. In this respect, through the information they provide, and through their specific investigation methods, the disciplines are also "forms / patterns" of knowledge, and the truth always stays *in, among* and *beyond* them. Progressively building this idea during the workshops could help students develop their abilities to understand fundamental truths (about nature, humankind etc.), [15].

The last transdisciplinary project was performed this spring, in the frame offered by our Ministery of Education: "Another School-Type Week". Its title was *A Transdisciplinary "Reading" of the Water*[16]. The project targets focused both on experiencing a TD teaching-learning methodology and on setting up a holistic integrative view of the knowledge of water, developing a positive, desirable attitude able to contribute to an education for the qual-

ity of human and planetary life. The project contents were conceived and structured in order to get a synthesizing view on many dimensions and significations of water, able to transcend the borders of the "classical" disciplines; the main outcome was to help teachers from different disciplines to teach together, as a team. The interactive workshops alternated with explanations, power-point presentations, debates, topic-oriented visits, artistic creations and performances.

The syllabus of the project was structured in three learning units as follows:

1. The Philosophy of Water (sacred dimension)
    - Water in cosmoghonical "scenarios"
    - Water in folklore rituals, in religious rituals
    - Symbols of the water: living water/dead water; holy water, healing water
    - Christening water and Flood water
    - Water wisdom: syntagms, proverbs, sayings
    - Water messages: crystallization experiments
2. The Water life (profane dimension)
    - Water as chemical substance; properties
    - Planet water: roles, functions, dangers, threats
    - Water crossing the human civilization evolution
    - Water and the human body; intra-uterine water
3. Aquatic imaginary aspects (artistic dimension)
    - Water images in literature, music, painting etc.

The three modules pointed out many and unexpected properties and meanings of water and generated a great deal of discussions and debates: teachers and students as well were challenged to answer many questions and problem-situations that came out from the new information issued during the presentations. The answers to the final questionnaire form, which was conceived as a feed-back, fully confirmed this aspect. Here are some problems students confessed they will keep thinking about: *the role of the water in the act of creation, the religious meanings of the water, the water in the human body, the subjective images of the water in artistic representation, the vital link between human being and the water, the spiritual force of the water, the significance of the Flood, the water magic power, why does water have so many powers?, why does water react to feelings ?, is there water on other planets ?, how was water created?, why is man wasting so much water instead of appreciating it ?, does water have feelings?, and so on.* **Moreover,** *a student has sincerely admitted: every time I will use tap water, from now on, I shall think twice in order not*

to waste the water that came in my house with such difficulty, thanks to so many centuries of civilization.

This interrogative-reflexive part – started in students mind – seems to be the major gain of the project. Thus, there was a privilege for all participants (teachers and students) to get and give information, to share their own opinions, beliefs, to confront ideas, due to this different school week.

Water was "read" by their mind, heart, sensorial attitude, into a valuable process of TD knowledge. The visit to *the Water Tower* of the town built in the 19th century facilitated the real knowledge of the objects and instruments that were used during the centuries by the rural and urban civilization concerning the use of water; the creative workshops facilitated unexpected "meetings" between poetry, music and painting in the artistic imaginary frame of water; the presentations revealed the magic powers of the water in the Romanian folklore, mythology, the astonishing Bible significations of the water and its use in religious rituals; the scientific outlook on water brought forward for discussion its physical-chemical properties, its role in the human metabolism and in all living beings. Emoto's experiments presentation was a great challenge too. Students could express their artistic vision on water – by words, colors and sounds: they selected the proper music for the poetry texts they were reading, they painted their own "view" on water, starting from a blue drop, and transforming it in their soul's colors, they wrote interesting essays. They have imagined an ocean storm as in Turner's paintings – using the fingers and palms only, to produce the sound of the rain drops and then the sound of an unexpected storm accompanied by thunders; a valuable symphony was created and performed using "water glasses". The series of unexpected experiences concerning the knowledge of water could go on indefinitely. It's would be worth describing each module, one by one, but it would take it much time [16].

11.4 Limits and perspectives: Questions, Worries and Chalenges

Different obstacles occurred while performing these TD projects within the frame of the traditional system of education. Why?

First we had to build the teachers' team in order to be qualified for this kind of experiment and to accept to be volunteers. Then, we had to find the most efficient strategy to attract the students to this new way of teaching-learning process. But the main challenge was to decide upon the topics of the two projects. We had to find large and generous topics, suitable to a TD approach. The bridge between *inter-, pluridisciplinary* and transdisciplinary seemed to be more difficult to build from the didactical point of view. If, theoretically, the problem was clear enough for us, didactically, we did not know initially how to solve it. Solutions emerged along the way, but questions remained, as we were not yet convinced we made the intended jump completely

[15].

Another difficulty was to design the syllabus. Setting up competences was the most difficult challenge for the teachers' team. From a TD point of view, competences should cover all the three levels: individual, social and cosmic, in order to build the ultimate human being. On the other hand, these competences should also harmonize the dimensions of *to know, to understand and to create*. How can one achieve the "trans-relation" that could connect to know, *to understand and to create?*

As Muresan and Flueras have already written [15] the concept of *cross-curricular (transversal) competences* used in the modern theory of education is not the same as the *transdisciplinary competences* in the way we understand this concept. Transversality refers to fragments of the world (fragments of both subject and object), and does not refer to the sacredness as a *tertium datur*: "Transversality is almost always horizontal", when transdisciplinarity, which is at the same time across and beyond, is vertical. [17]. It seemed impossible to state these desiderata as "competences". How could competences of the *ultimate human being* or *integral education be formulated*? Are there "competences of the being"? The common understanding of the concept of *competence* is based on the idea that it concerns something which compulsory must be "quantified"; if not, it cannot be accepted as a "competence". The human values, attitudes, behaviors that are built up by education, remain out the educational system evaluation and cannot be evaluated inside the institutional, official forms of the public educational system. It is possible to formulate competences for "to know" and "to do" but not for "to be". So, a virgin, vacuum area in education sciences is revealed. *Crossing (transversal) competences* in the modern curricula, are also limited to "to know" and "to do / to make" even if they cross disciplines and their afferent methods; they focus only on "the exterior human being set up" and not the "interior human being creating". From my standpoint, it would be wrong to build up synonymies between them and the so-called *transdisciplinary*. "*Transdisciplinary competences*" should point to the foundation of both the interior and exterior human being. Features of the ultimate human being are not yet set up in competence terms, nor are they yet quantified and standardized. I wonder if such a thing could be possible. Additionally, the targets, forms and proper evaluation instruments are not established.

The most difficult thing in performing both experiments consisted not in finding out the proper strategies and methods to conceive the steps of the didactic enterprise, but in what way we could awaken the *wonder*, and produce in our students that *inner experience* which is a fundamental component of understanding. If we sometimes succeeded to push the "inner button", we have also to accept that it was a random or spontaneous or momentary case. It could not be controlled in any way, and, even less, could be not valuated in its depth, dimension or its consequences. All this was exclusively due to the didactical vocation and skillfulness of the teacher, to his empathy and not to some previous planning. In sum, we are not able to build up a pattern

scheme or script to replicate the effect or to decide on any didactical method or strategy. This proves once again that the TD learning is something alive, has no previous rules: "being" has no patterns. [15]

New problems came up: we had to prove intellectual and affective mobility, to deal with new situations, to make use of play-related capacities, tolerance, openness and patience, to be prepared for a continuous adaptation to our students' demands. The most important challenge we met, at the beginning, was to get the students beyond their usual way of thinking. The students were used to think in terms of *yes or no, correct or incorrect, true or false* terms. They were uncomfortable with the lack of a rational conclusion or a clear, definitive, precise answer. They found it hard to accept that there might also be answers of yes *and* no, *true* and false type at the same time, and the fact that reality was in a continuous dynamics. The intuition of the fact that we are and we are not at the same moment, the universe is and is not the same, a thing is not only what we know about it at a given moment, the fact that there is an invariant *what* in all entities was an important step we made in the dialogue with them [15].

These experiments proved that transdisciplinarity is not a utopia. TD can be transformed in a current practice in school; to pass from theory to practice means new problems and questions searching for new answers. To prove – in a convincing way – the important potentialities the TD has was also a result of these projects.But, in my opinion the most valuable thing is the fact that these didactical TD experiments succeeded to identify some important reflection points that are necessary for applying the TD in public education. Some of these questions are: what a TD curriculum means? what does it really implies? Could we practice the TD methodology within the frame of a disciplinary designed curriculum? Could we conceptualized the "didactical border" between the inter/pluri and transdisciplinary approach in the teaching-learning process? Which is the difference between the "transversal competences", "cross-curricular" ones and the "transdisciplinary competences"; or could we speak about TD competences without enlarging the definition of the concept? Which would be the correct relation among *information, competences* and *values* in the educational process? the right balance among *to know/to do/ and to be*?

All these questions were also refreshed during the recent International Colloquium organized in Arad, Romania, the first one of the kind in our country [18]. More than 200 participants were present: teaching staff from primary, secondary and high school education and also from university education, educationalists, students interested in educational issues, managers and parents. The Colloquium *Transdiciplinarity in Primary, Secondary and High School Education* aimed at a basic establishing of a working team, at a national level, able to provide hands-on solutions for implementing the transdisciplinary education in the Romanian educational system and, moreover, for a future curriculum design guidance. The participation of Professor Basarab Nicolescu was a great help for us in our attempt to find solutions for the TD application in the Romanian secondary education.

11.5 Conclusions

The case study – as presented here – has tried to point out what questions could arise from practising the TD methodology in the frame of a "traditional" educational system: what the challenges of a such an approach are, what kind of obstacles are to be faced, and so on. All these are aiming at identifying possible reflections on moving the deck between TD methodology and its applications in school practice. Keeping in mind all the outcomes of this case study, we will try to sum up.

From the beginning, we should like to focus on the *limitations* the TD methodology practice implies, in the frame of the traditional educational system in Romania. The first limitation is the *coercive force of the system*, totally inadequate to the TD practice. This kind of force refuses – from the very start – the ongoing of the TD activities in the frame of the official established curriculum; hence the TD activity processes can be developed only as alternatives to the official curriculum: optional courses, volunteer activity of the teachers and students or, in the most fortunate case, as the "Another School-Type Week".

The second limitation springs from the *asessment system's incompatibility*, as it has been implemented in the present day educational system. This system assesses quantitative aspects to the injury of the qualitative ones. The asessed competences are standardized and scaled "hic et nunc" detrimentally to the qualitative assessment.

The third limitation is the *lack of qualified human resources* able to implement a TD teaching-learning process, as well as the impossibility of teachers to work formally as a team in the class.

The fourth limitation is *the resistance, opposition force of the collective mentality* to any kind of change, actually the fear of the new and of the experiment. It is, in fact, the refusal to change a structured curriculum that was practised disciplinary for centuries; the fear to lose the disciplinary specialization because of the Td opening; this kind of fear comes obviously from the lack of a right understanding of the TD methodology. Opposition may be generated, on the other hand, by some social-political circumstantional interests which refuse to see the educational benefit in the long run; these interests are holding on to the pseudo-payoffs of immediate, visible outcomes.

Obviously, this case study pointed out remarkable *prospects* as well: these spring from the TD methodology applications in education (not only at the high school level). This last aspect would certaintly necessitate a longer time period. A complete TD education desideratum would need to change the whole educational paradigm that – in turn - would need a new setting of the educational ideal, according to the TD axioms. These axioms generate – in their turn – a new value system. All these imply the setting up of a new TD curriculum and an adequated strategy in the human resources training such an entreprise would entail. Last but not the least, a new "didactics" is needed: this has to be compatible with the TD methodology.

How to achieve these desiderata ? There are no unique "prescriptions". Romania has started to set up *centers* and *nucleuses* for TD methodology dissemination, both in high schools and universities. One can even state there is a "TD trend" to struggle for the implementation of TD in education: books and journal publishings, conferences and symposia on TD topics, setting up TD projects and programs (of lesser or greater scope), good practicing exemples dissemination etc. All these are due – in our country – to local initiatives which were professionally sustained and stimulated by professor Basarab Nicolescu. We hope to be on the right path.

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CHAPTER 12

Transdisciplinary Collaboration in Designing Patient Handling/Transfer Assistive Devices: Current & Future Designs

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Many health care facilities deal with challenges associated with safe patient handling and movement. Back injuries are a serious problem for nursing personnel who perform frequent patient handling activities. The main objectives of this study are to demonstrate the necessity of patient handling/transfer assistive devices, explore the economic benefits of them, review current assistive patient transfer devices, and investigate design parameters of an ideal patient handling/transfer assistive device. This Chapter also focuses on the importance of the transdisciplinary collaboration in developing and designing patient handling/transfer assistive devices.

Keywords*:* transdisciplinary research, patient transfer/handling, assistive devices.

12.1 Introduction

Health care workers have higher rates of work-related musculoskeletal injuries when compared to the general population. These musculoskeletal injuries can occur due to mechanical stress placed on the ligaments, bones, muscles or supportive tissues of the body. The comparison between health care staff and other industries shows that between 1980 and 1992, the injury and illness rate for nursing home workers increased from 10.7% to 18.2% among the nation's 1,506,000 nursing aides, orderlies, and attendants (US Department of Labor, Bureau of Labor Statistics, 1994). Due to 1994 Bureau of Labor Statistics data, nursing home workers face the third highest rate of occupational injury and illness (221,000 cases in 1994) among all US industries. The biggest portion of back injuries can be related to events that occur during the handling and

lifting of residents. The injury rate for the health care sector was higher than the average for all other industries combined between 1996 and 2000 years in Canada (Workers Compensation Board of British Columbia). Approximately 5000 nurses were surveyed in 2001 and results indicate that 85% of the nurses experienced back pain at work (The American Nurses Association, Nursing-World.org Health and Safety Survey, September 2001). Another example, the injury rate per 100 Full Time Equivalent (FTE) workers for the Acute and Long term care sectors in British Columbia were 6.4 and 10.7, respectively, while the injury rate for all other industries in BC was 3.7 in 2001(Workers Compensation Board of British Columbia, 2002).

A study called NEXT (nurses early exit study) [1] is also investigated in European Union in 2003. The aim of this study was to identify why nurses are leaving their profession earlier than members of other professions. The study indicates that almost all European Union countries have a lack of active nurses and the situation is expected to be worse in the next 20-30 years. Several reasons contribute to this situation: the population of young people in the working age will decrease, while the older people in the working age will increase and also the number of people who need care (over 64 years) will increase.

The procedures which involve repositioning, transferring and lifting patients are considered the most painful for care giving personnel. The main and hardest patient handling tasks can be listed as: bed to chair transfer, chair to bed transfer and patient repositioning task in the bed. These tasks can have more or less risk on the musculoskeletal system with respect to patient weight, capability of patient, frequency and duration of the lifting, workplace geometry and environment, stability of the patient, and the horizontal and vertical position of the patient relative to the health care worker [2-6].

Definition and solution of the patient transfer/handling problem with respect to different discipline approaches is surveyed from the literature. Different discipline approaches, such as business and administration, health care personnel education, engineering, and social sciences, have been found [4, 7, 8, 9-15].

Traditional prevention to this problem based on teaching workers proper body mechanics while manual lifting, has not yielded widespread success in reducing injury rates. A possible reason to why safe patient handling/transfer trainings did not work in practice is the job of the health care workers can be very hard and stressful. Thus, they cannot apply the required movements for safe lifting [17-24].

The stressfulness of patient handling and transferring tasks can be overcome by using today's common assistive devices like overhead (ceiling) lifts, floor lifts or stand-up lifts. However, there are still weak points to be developed in these devices. For example, mobility of ceiling lifts is limited by rail tracks, and installation of rail tracks is not only expensive but also troublesome. Stand-up or standing lifts are limited by their functionality on the tasks, because they are designed to be used in only from a seated to standing

Table 12.1: Physically Demanding Tasks Identified by Different Studies.

Skotte et al. [2]	lifting from bed to standing on the floor	repositioning on wheelchair
Hye-Knudsen et al. [3]	from lying to sitting on bedside or vice versa	repositioning on wheelchair
Garg et al. [5]	transferring patient from toilet to wheelchair or vice versa	wheelchair to bed or vice versa
Callison et al. [6]	bed to chair or vice versa	bedside commode to bed or vice versa

position lifting task for patients who can put weight on their feet. Mobility of floor lifts is limited because of size of their base due to concerns of stability and also in the literature, they are defined as difficult to use and time consuming with respect to overhead lifts.

The purpose of this study was to identify and evaluate not only the different disciplinary approaches to define the problem but also different approaches for the solutions to the problem. In the light of this variety of definitions and solutions to the problem, a transdisciplinary collaboration for the solution of the problem is proposed. Different discipline standpoints such as economical, biomechanical, psychological, cultural, and educational are investigated, to find a convenient solution for musculoskeletal injuries related to patient handling/transfer tasks.

12.2 Identification of the Patient Handling/Lifting Tasks

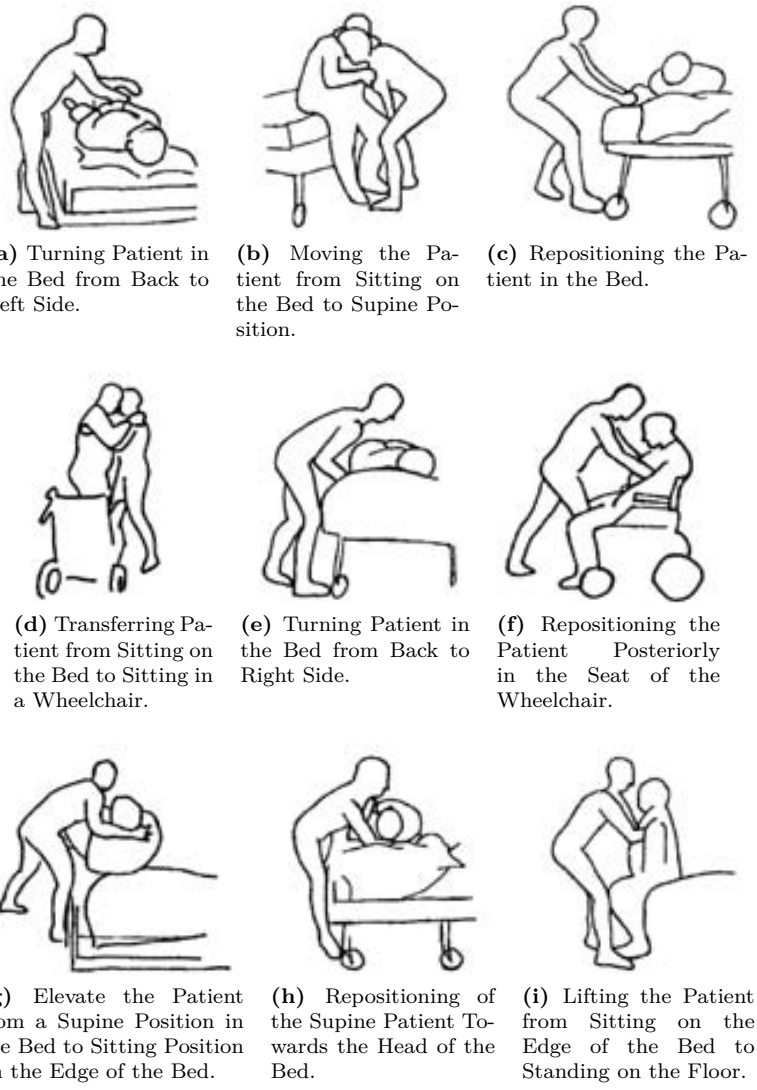
The definition of the problem starts with identifying physically demanding patient handling and lifting tasks that the health care personnel encounter almost every work day. The risky tasks in terms of overexposure of ergonomic stress on health care staff can differ in acute care and long term care facilities. Thus, both need to be investigated. Table 1 shows the list of physically demanding tasks identified by different studies.

Physically demanding tasks have been identified in long term care facilities in order to understand which tasks expose nurses to ergonomic stresses. Patients in this type of facility need less assistance from health care personnel than the patients in acute care facilities.

Skotte et al. [2] used a dynamic three dimensional biomechanical evaluation technique to investigate the low back loading during common patient handling tasks which are shown in Figure 1. Ten female health care workers participated in the study and performed nine common patient handling tasks on male stroke patients. Patient handling tasks were classified into three groups: lifting, repositioning, and turning. The maximum compression on low back in two lifting tasks (lifting the patient from bed to standing on the floor and repositioning the patient in the wheelchair) was found to be significantly higher than all other tasks.

Hye-Knudsen et al. [3] examined the kinematics of thoracolumbar spine during common patient handling tasks. The aim of the study was to find the relationship between musculoskeletal injuries and asymmetric working postures which are seen more frequently than industrial material handling operations. Ten female health care personnel participated in study by applying nine different tasks. A lumbar motion monitor was used to obtain kinematic data and also muscle activity was recorded by surface electrodes. Displacements and deflections were found significantly higher on the following tasks: from lying to sitting on bedside, from sitting to lying on bed, and repositioning on wheelchair. Patient handling/lifting tasks which include usage of assistive devices are also investigated in the literature. Dutta et al. [4] measured the peak external hand forces and external moments on the lower back while using loaded overhead and floor lifts (see Figure 2) which are operated by one or two caregivers. Forces and moments are estimated from the ground reaction forces and motion capture data. Use of overhead lifts caused significantly less back loads than use of floor lifts. However, two caregivers working together did not reduce the loads in the use of floor lifts, when they used overhead lifts the loads in the operation reduced. Because overhead lifts generated lower loads on caregivers, they are predicted to reduce the risk of back injury to caregivers. In a preference survey conducted among the caregivers, majority of caregivers preferred overhead lifts to floor lifts. However, overhead lifts require installed tracks to operate which makes them highly restricted in terms of mobility and availability. Thus, there is still a need for a better floor lift.

Another nursing home ergonomic evaluation study was conducted by Garg et al. [5] among 38 nursing assistants who performed 16 different patient handling tasks related to low back pain. The data is collected by videotaping and surveying nursing assistants. Garg et al. [5] found hardest tasks to be transferring patient from toilet to wheelchair, wheelchair to toilet, wheelchair to bed, bed to wheelchair, bathtub to wheelchair, chairlift to wheelchair, weighing patients, and lifting patients up in bed. Transfer times, lack of accessibility, patient safety and comfort, physical stresses associated with the devices, and lack of skill were some of the reasons for not using the assistive devices. Also, environmental barriers like confined spaces and stationary railings are observed. Additionally, frequency of patient handling tasks is examined. The five most frequent tasks were toilet to wheelchair, wheelchair to toilet, wheelchair to bed, bed to wheelchair, and bathtub to wheelchair. It is noticed that the list



(a) Turning Patient in the Bed from Back to Left Side.

(b) Moving the Patient from Sitting on the Bed to Supine Position.

(c) Repositioning the Patient in the Bed.

(d) Transferring Patient from Sitting on the Bed to Sitting in a Wheelchair.

(e) Turning Patient in the Bed from Back to Right Side.

(f) Repositioning the Patient Posteriorly in the Seat of the Wheelchair.

(g) Elevate the Patient from a Supine Position in the Bed to Sitting Position on the Edge of the Bed.

(h) Repositioning of the Supine Patient Towards the Head of the Bed.

(i) Lifting the Patient from Sitting on the Edge of the Bed to Standing on the Floor.

Figure 12.1: Common Patient Handling Tasks, [2].

of hardness and frequency of tasks follow each other.

Since most existing studies on patient handling have been conducted in long term care facilities, Callison et al. [6] investigated musculoskeletal injuries due to patient handling/lifting in an acute care facility. Different from long term care facilities, the main goal in an acute care hospital is to stabilize the patient, treat the illness or condition, and discharge the patient home or to another type of facility, such as long term care. Thus, generally in acute care facilities, patients are unstable, unpredictable and their mobility can be limited by the

(a) Overhead (Ceiling) Lift. **(b)** Floor Lift.

Figure 12.2: Overhead and Floor Lifts with Quick Fit Slings, [4].

medical condition. Therefore, it's important to identify patient handling tasks in acute care facilities. Survey and work sampling methods are used to achieve this goal. The nurses ranked the most physically demanding patient transfer tasks as follows: bed to chair, chair to bed, bedside commode to bed, and bed to bedside commode. On the other hand, the least physically demanding task was side to side transfer. Also, it is observed that the majority of transfers were handled without using assistive lifting devices.

12.3 Different Discipline Standpoints to the Problem

According to the literature survey of patient transfer/handling related papers, solution of musculoskeletal injuries related to patient handling/transfer tasks includes not only an engineering perspective, but also social sciences, business and administration, medical sciences (biomechanics, physiotherapy etc.), and statistics (surveys, interview etc.) point of view.

12.3.1 Business and Administration Standpoint

Reducing patient handling injuries can result in considerable economic benefits to employers, as well as prevention of significant pain and suffering for workers.

Analysis by Chhokar et al. [7] about musculoskeletal injury trends in the interval of three years pre-intervention and three years post-intervention of implementing use of patient handling/transfer assistive devices revealed a significant and sustained decrease in days lost, workers compensation claims, and direct costs associated with patient handling injuries (see Figure 3). The pay-

back period was estimated assuming that pre-intervention injury costs would either continue to increase (0.82 years) or plateau (2.50 years) in the year immediately preceding intervention. The rapid economic gains and sustained reduction in the frequency and cost of patient handling injuries beyond the first year strongly advocate for ceiling lift programs as an intervention strategy. Figure 3 shows the economic benefits of assistive patient transfer devices in three years after installation of ceiling lifts. Based on this rate of savings, a payback period of 2.50 years is required to recover the initial investment of $344,323 for the intervention. Assuming that the claims costs would have continued to increase through the post-intervention period, the extrapolated direct costs for the three years post-intervention would have reached $1,559,349. Using this approach of economic estimation, a total of $1,257,605 was saved during the three years post-intervention, with payback of the initial investment occurring within 0.82 years.

In another study by Randall et al. [8], the cost of related injuries can be staggering, having a direct impact on the afflicted persons and the institution. After evaluation of alternative means of reducing the risk of caregiver injury in conjunction with the need for more frequent patient handling, a commitment was made to invest in ceiling lifts as a means to an end.

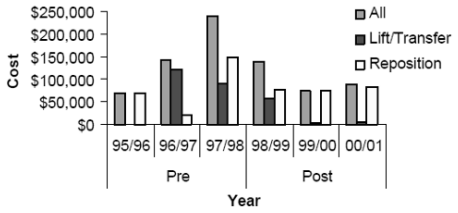
Miller et al. [9] state that there was a 70% decrease in claims cost related to health care staff injuries at the intervention facility using assistive devices, accounting for a decrease of 18 days lost. In comparison, there was a 241% increase in total claims costs at the comparison facility, with an associated increase of 499 days lost during this same time period.

12.3.2 Biomechanical Standpoint

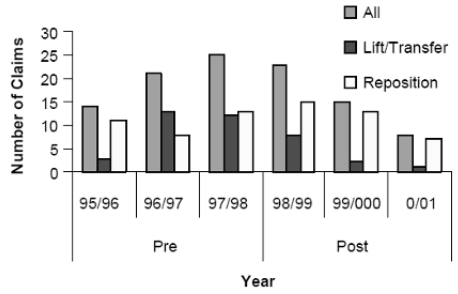
The study of approaching the structure and function of biological systems (generally humans) with the methods of mechanics is called biomechanics. Biomechanics is closely related to engineering because regular approach in biomechanics is to use traditional engineering methods of mechanics to analyze biological systems.

Loads on back of health care personnel are analyzed in two different biomechanical analysis papers [10, 11]. In both studies, obtained back loads are compared with the back-compression criterion limit (3,400 N) recommended by the National Institute for Occupational Safety and Health (NIOSH, 1981 and 1994). Movement analysis methods were used to obtain the kinematic data, and they used force sensors on hands and feet to obtain the external forces. NIOSH also suggests a maximum permissible limit of spinal compression of 6,400 N.

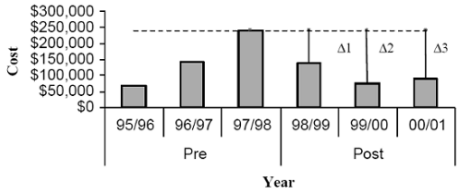
Daynard et al. [10] measured data entered to a biomechanical model by using movement analysis methods, and biomechanical model was used for calculation of the compressive and shear forces on the spine (L4-L5) by taking into account the subject's height, weight, and gender. This study was more comprehensive than the study conducted by Zhuang et al. [11], because the



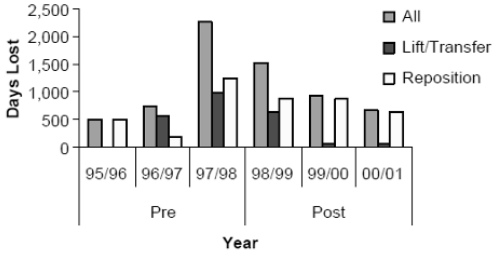
(a) Total Cost of Claims Pre and Post Intervention.



(b) Number of All, Lifting/Transferring, and Repositioning Claims.



(c) Claims Cost for All, Lifting/Transferring, and Repositioning Claims.



(d) Days Lost for All, Lifting/Transferring, and Repositioning Claims.

Figure 12.3: Economical Benefit Graphs, [7].

cumulative spinal load was considered by multiplying the duration of the task with the spinal load. Additionally, the study involved a control group, five different tasks, and two different patients. Results revealed that both education/technique training and new assistive handling equipment reduced spinal loading in several tasks. Lack of training for bed to chair transfer and chair boosts of patients resulted in spinal loading which was risky according to NIOSH. However the examination of cumulative spinal loads showed that the use of assistive equipment increases exposure to risky spinal loads, as more actions are required to complete the transfers.

Zhuang et al. [11] aimed to evaluate the effects of resident transfer method and resident weight on the biomechanical stress to nursing assistants while performing a bed to chair transferring task. In the light of this evaluation, re-identifying the methods could reduce the biomechanical stress to the nursing assistants. Twelve transfer methods (nine battery-powered lifts, a sliding board, a walking belt, and a manual transfer) were evaluated. A three dimensional biomechanical model was used to estimate the L5/S1 compressive force with the inputs of body posture, hand-force magnitude and direction, and the anthropomorphic data. In the results, it is clearly mentioned that nursing personnel were exposed to excessive biomechanical stress when performing resident transfers without using any assistive device (avg. 3487 N). Average back-compressive forces associated with using ceiling and floor lifts were smaller than NIOSH criteria. Thus, the spine loads were reduced in use of ceiling and floor lifts, unlike the other assistive devices and manual transfer methods.

12.3.3 Social Sciences Standpoint

Influence of culture, experience, and psychology on decision making plays an important role in the solution of patient the handling/transfer problem. In this section, papers in the literature related to these effects are discussed.

Effects of training and experience on patient handling/transfer tasks were investigated by Hodder et al. [12]. Three different tasks (patient reposition from side of the bed, head of bed, and patient transfer from bed to wheelchair) were performed by health care personnel both experienced and not experienced on training. Data was collected in terms of trunk kinematics and muscle activities. Results indicated that experienced staff use up to 18.1% (maximum voluntary excitations) less muscle activity. Furthermore, the study revealed that mechanical lifts are still not practical in all hospitals and home care.

Another study on the effects of caregiver experience on patient handling/ transfer tasks was conducted by Dutta et al. [4]. Peak external forces and moments, which are generated on low back, were measured when the caregivers used floor and overhead lifts. Twenty caregivers were categorized as experienced and less experienced and performed five different maneuvering tasks with assistive devices. Motion capture and ground force measurement techniques were used for collecting the data. Findings showed that experience

significantly affects the difficulty of use of floor lifts, while it does not play a significant role on overhead lifts.

Myers et al. [13] introduced the cultural effects on adaptation of the health care workers to patient lifting devices. A sociological and anthropological view of culture explored specifically how work culture or safety culture might be involved in workplace safety. Cultural facilitators and barriers of nurses and physical/occupational therapists in two acute care hospitals were examined by using audio recordings and text data. Data revealed that both adopted a "patient first" approach which includes usage of lift devices highly dependent on patients' benefit and not necessarily for staff safety. Another finding was that the implied purpose of patient lifting devices clashes with the nurses' cultural emphasis on compassion, and with physical/occupational therapists' cultural emphasis on independence Ìű except when use increases patients' independence. The study also discussed that cultural expressions involving the nature of care giving in between health care professionals may affect the tendency to adopt safety measures in complex ways. In this matter, the authors suggest that workers' understanding of the purpose of their work, and acceptable means of conducting it, should be understood before implementing safety interventions.

Furthermore, Chany et al. [14] explored how staffs personalities can be linked to load on the spine during repetitive lifting of patients. Twenty four participants were divided into two groups: novice and experienced. Spine compression, anterior – posterior shear, and lateral shear were measured to define the spine loading. Participants were categorized into personalities with respect to Myers-Briggs personality type indicator and performed repetitive, asymmetric lifts. Sensing versus intuition is one of four dichotomies in Myers-Briggs personality type indicator, and they are the information-gathering functions. They describe how new information is understood and interpreted. Individuals who prefer sensing are more likely to trust information that is in the present, tangible, and concrete. On the other hand, those who prefer intuition tend to trust information that is more abstract or theoretical, that can be associated with other information (either remembered or discovered by seeking a wider context or pattern). The results indicated that intuitors are exposed to higher spinal loads than sensor personality type. Novice lifters typically encountered greater spinal load. Moreover, perceiver personality group received greater spinal load than judgers' personality group.

The psychophysical evaluation of nine battery-powered lifts, a sliding board, a walking belt, and a baseline manual method for transferring nursing home patients/residents from a bed to a chair was targeted in the study of Zhuang et al. [15].The psychophysical evaluation included investigation of the effects of resident transferring methods on the psychophysical stress to nursing assistants performing the transferring task. Evaluation also aimed at identifying transfer methods that could reduce the psychophysical stress reported by nine nursing assistants. The results showed that the psychophysical stresses on nursing assistants were significantly reduced with the use of the assistive de-

vices on resident transfers with respect to transfers with the baseline manual transfer method. Moreover, the basket-sling lift and stand-up lift were preferred methods, and the assistive devices' resident comfort and security ratings were greater than or equal to the baseline manual method.

12.4 Current Designs and Solutions to the Problem

12.4.1 Current Patient Transfer Devices

In all of the referenced papers of this section, floor and ceiling lifts are found as the most helpful assistive patient transferring devices. A ceiling lift consists of a ceiling mounted track, an electric motor, and a patient sling used to lift, transfer, and reposition patients/residents (see Figure 4). One or more staff members are capable of placing a sling on a patient/resident and hooking it onto the ceiling lift. Ceiling tracks can be configured in numerous arrangements to accommodate many beds within a single room and possibly multiple rooms. In general, there are two different types of ceiling lift motors: portable and fixed. Portable motors are favorable than fixed motors because of their following features: ease attachment and detachment from the ceiling lift tracks. Floor lifts require much more space than ceiling lifts to operate while ceiling lifts require significant structural modifications in patient's room. Thus, ceiling lifts are preferable for newly constructed facilities.

Hasanat et al. [16] evaluated ceiling lifts in comparison to floor lifts based on transfer time, patient comfort, and staff perceptions in three long term care facilities with varying ceiling lift coverage. The time required for transferring or repositioning patients along with patient comfort levels were recorded for 119 transfers. In the three facilities, 143 health care workers completed the survey on their perceptions of patient handling tasks and equipment. For both transferring and repositioning tasks, staff preferred to use ceiling lifts and also found them to be less physically demanding. Duration of bed to chair transfer tasks in ceiling lifts was found to be less than floor lifts with 156.9 seconds and 273.6 seconds on average.

Also, Miller et al. [9] indicated that staff perceived that using ceiling lifts compared to manual methods put them at significantly ($p<0.05$) less risk of injury. Seventy five percent of staff preferred to use the ceiling lifts over any other method for lifting and transferring residents. This study demonstrated that incorporating ceiling lifts into the design of a new multi-level care facility reduced patient handling injuries and decreased perceived risk of injury among health care staff.

12.4.2 Training Programs

Training programs play an important role in prevention of possible musculoskeletal injury due to patient handling/transfer tasks, if the training program

(a) Manual Transfer Method.

(b) Walking Belt.

(c) Sliding Board.

(d) Floor Lift.

(e) Ceiling Lift.

(f) Stand-up Lift.

Figure 12.4: Types of Current Patient Handling/Transfer Assistive Devices, [7]

can be successfully implemented by health care personnel. The studies in the literature [17-24] defining and evaluating patient handling/transfer training programs are surveyed in this section.

A method based training approach has traditionally been used to solve the problem of back pain related with patient handling. A study was conducted by Hignet et al. [17] to examine if the competency-based training changes the behavior (physical and cognitive) for patient handling tasks. Sixteen health care organizations in the UK participated from the acute and primary health care

sectors. Behavioral data was collected by observations and interviews during two patient handling tasks (sitting to standing and repositioning in sitting). The results designated that more positive safety principles of organizations make the tasks more complex, and thus influence the decision making about the patient handling tasks.

Creating safer working environments for nursing staff was the aim of the study of Nelson et al. [18]. On this matter, a multifaceted program was designed and evaluated for the effect of the program on injury rate, lost work days, job satisfaction, self-reported unsafe patient handling acts, level of support for program, staff and patient acceptance, program effectiveness, costs, and return on investment. Twenty-three high risk units in seven facilities participated in the study over two nine month periods, and data was gathered through surveys, weekly process logs, injury logs, and cost logs. The rate of musculoskeletal injuries was significantly decreased, while the total number of lost workdays was decreased 18% which is not statistically significant. Significant cost saving was also achieved in this study. In addition, the study states that "over the past 30 years, efforts to reduce work-related musculoskeletal disorders in nurses have been largely unsuccessful." [18].

A patient handling training program was evaluated in the study of Cornish et al. [19] by surveying student nurses. A survey was completed by 106 students which was 34% of overall students. This participation rate can be considered as an evidence of the perceived low importance of patient transferring and handling. Most completed responses were gathered from child branch students, while mental health students responded to this study by a low percentage of 9%. Students observed if the patient handling techniques are applied in practice, and 60% of the students observed assistive device use where needed in practice. The students were asked if there is a difference between training scenarios and practice, and two key findings were revealed: poor practice and constraints on practice. Poor practice includes poor posture of staff, use of inappropriate techniques, use of incorrect equipment for the task, and a lack of safety checks. On the other hand, constraints on practice issue includes a lack of appropriate equipment, lack of time, lack of staff and perception of the situation as an emergency. The need of better equipment for patient handling and transferring was exposed by the reported results of students about use of equipment in practice: it was sometimes (43%), most of the time (36%) or always used (6%) rather than never used (1%) or hardly ever used (14%).

12.5 Transdisciplinary Collaboration in Assistive Device Design and Development

Effective research activities in an inclusive setting require intensive and continuing collaboration of all members of a research team. There is a movement away from the traditional multi and interdisciplinary models, in which

researchers work jointly but from each of their respective disciplinary perspectives to address a common research problem. Within many fields, such as medicine, biosciences, and cognitive science, there is growing awareness of the need for transdisciplinary approaches [25-27].

As the complexity of new patient assistive device development processes increases, the design process must include transdisciplinary collaborative knowledge synthesis provided by a large number of experts (actors) for integrated solution. Transdisciplinary research teams (patients, nurses, medical doctors, engineers, medical technicians, clinical psychologists, physical therapists, and architects) confer a distinct advantage and play an important role in developing a good design that complies with human factors and ergonomic principles [28]. In this model, actors work collaboratively for the common goals (designing an assistive device), using shared methods and techniques, sharing responsibility for planning, sharing of information for problem solving and decision-making, and assessment. The design that does not consider collaborative efforts of actors along with the use of poor technology may result in poor quality, and unsafe, inefficient, and high cost design. Approximately, 5,000 types of medical devices that are used by patients around the world have device-related problems [29].

Although new technologies are an essential part of our global information society and they play an important role in our daily lives, the values of a specific technology may not be realized due to four general drawbacks [29-32]:

- poor technology design that does not adhere to human factors and ergonomic principles,
- poor technology interface with the patient or environment,
- inadequate plan for implementing a new technology into practice, and
- inadequate maintenance plan.

User (patients, nurses, physical therapists, and others) involvement that incorporates human factors within the assistive device design and development, offers many possibilities that allow the development of safer and more usable medical devices that are better fit to users' needs. User involvement of assistive device design and development at different stages of the design process such as design concept development, testing and verification and deployment stages are the key elements for successful design. This process is crucial for capturing users' perspectives and their inputs during the development stages. Assistive device users are dissimilar in several characteristics, such as needs, skills and working environments. This is also an important consideration for incorporating users' perspectives in the design and development process.

Medical doctors, as part of the collaborating team, also play an important role in the transdisciplinary effort to provide appropriate assistive technology or prescribe a particular device for different patients.

Figure 5 shows transdisciplinary collaboration to design new assistive device between designers (design team, architects, and medical technicians), ser-

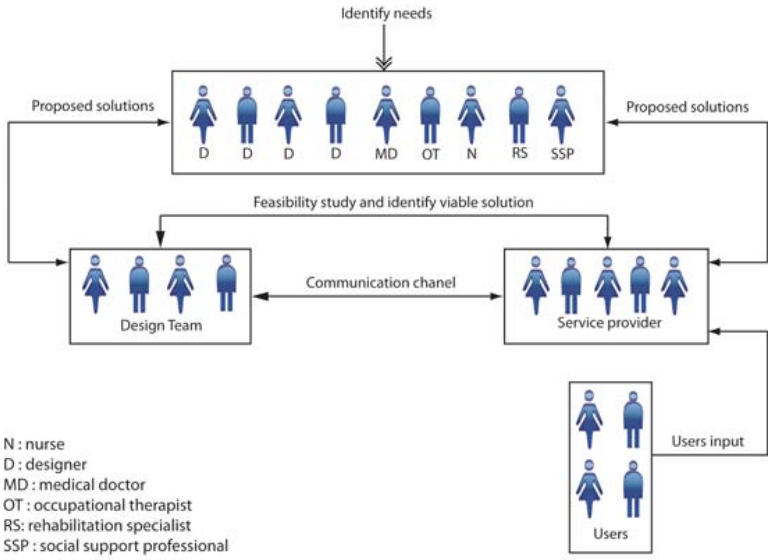


Figure 12.5: Transdisciplinary Collaborative Design Process.

vice providers (medical doctors, occupational therapist, nurses, rehabilitation specialists, social support professionals "clinical psychologists"), and users (patients). As shown in Figure 5, the design process begins with an identified need that can be satisfied by assistive device as a result of collaborative effort. Considering alternative solutions at beginning of the design process, during the concept stage is the most important. In the transdisciplinary collaboration process, service providers serve as a communication channel between designers and users. Designers and service providers make initial contact with users to create ideas. After feasibility study and a thorough selection, these ideas go into research development by designers [33, 34].

As with any design project, the design of an appropriate assistive device benefits from a cross-disciplinary collaboration. This transdisciplinary collaboration may even include social, cultural and religious considerations during the design process.

12.6 Design Parameters of an Ideal Patient Transfer Device

Besides the features of the current designs, the new design of assistive device for patient handling/transfer should be retrofit-able to a conventional patient's bed. It should be user friendly for ease of use and should require less training than current designs. It should be capable of multi tasks like toilet

to wheelchair transfers and transferring to patient cleaning facilities, and to utilize the device for more cases, portability and mobility must be increased. Moreover, abortion of process in case of emergency should be included for safety reasons. The durations of the tasks should be reduced, because the duration of the tasks is directly related to risk of being exposed to excessive spinal loads and duration is pretty high in floor and ceiling lifts [16]. The assistive devices can be made more time efficient by replacing the sling with grips or handles since preparing patient for sling is one of the most time consuming parts of the process. Installation costs should be reduced. For example, installation cost in ceiling lifts was estimated by OHSAH (2003) as $3,500 per bed [9].

Randall et al. [8] describes the process that was used for the selection of a ceiling lift manufacturer to be partner in reducing the risk of caregiver injuries and to fulfill the need of more frequent patient handling. The important design parameter outputs of the ceiling lift selection process can be summarized as: Lift weight capacity, vertical lifting distance, simple and smooth operation, the battery charging system, scale features, lift utilization diagnostics, easily disinfected surfaces, sling variety, staff education and training and ease of maintenance.

Eight design parameters were found for assistive devices in the study of Radovanovic et al. [35] as follows: weight, height, level of consciousness, mobility in bed, transfers from bed/stretcher or bed/chair and vice versa, walking, catheters and equipment, and patient environment. The assistive device validity was established based on content and construct validity. Surveys were used to validate the product. The results of the study showed that the assistive device seems to be reliable and valid for patient handling assessment.

12.7 Conclusion

The National Institute of Standards and Technology estimates that 20.6 percent of Americans have some sort of disability. For disabled people, assistive devices are essential to help them perform everyday tasks. Many simple devices were used to create superior independence for people with disabilities. Assistive devices range from something as simple as a bar attached to a bathroom wall to assist disabled people getting on and off a toilet.

In this Chapter, the importance of patient transfer assistive devices is demonstrated. Then the importance is supported by two biomechanical analysis papers from literature. Also, economic benefits of patient transfer assistive devices are shown by related papers in literature. Moreover, social sciences standpoints are examined. Limitations of current designs are found and design criteria of new devices are determined. Finally, the distinct advantages of transdisciplinary collaboration in assistive design and development are discussed.

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CHAPTER 13

Major Language, Minor Destiny? The Space of Francophone Liberty: The case of the writer Marius Daniel Popescu

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As a semiotic being, producing sense, man lives in a symbolic universe, where language plays an essential part. For a writer, the choice of a "major" language, like French, is problematic because it represents the beginning of a complex process, sometimes conflicting, involving two or several cultural traditions, history and life experience. But it is also a chance to define a francophone polyphonic "space", beyond all geographical or institutional considerations, beyond physical space or concrete time, where a writer (like the Romanian-Swiss one, Marius Daniel Popescu) feels free to develop, throughout a language which is different in many ways from the classical French, a new literature, disregarding traditional genres and usual constraints.
Keywords*:* Francophone literature, dialogism, polyphony, in-between, linguistic over-awareness, deterritorialization.

13.1 Introduction

Man is a semiotic being, an enunciating subject [1] who generates sense and, in his turn, interprets the meaning of the words and gestures of another person. In spite of the material appearance which surrounds us, man lives in a symbolic universe in which language plays an essential part. Since a very long time – not to say since always – the social being has no longer found himself in the immediate presence of reality, his knowledge is intermediated by language, which has as a consequence the fact that, according to Ernst Cassirer, he "converses constantly with himself. He has so much surrounded himself with linguistic forms, artistic images, mythical symbols, and religious rites, that

he cannot see or know anything without interposing this artificial mediating element." [2]

It is by means of language that man inherits a complex system of values in the form of traditions, religions, morals, arts, etc., a system he carries on and/ or transforms. This process is especially obvious in the field of literary creation which, transposed in a "major" [3] language, may touch and influence a greater number of persons and, little by little, change their mental frames or the life vision.

Another direction of our approach focuses on Francophonie, especially francophone literature, which we consider to be problematic in more than one respect. To begin with, the Francophonie seems to engender paradoxes: on the one hand, it reunites around one language, a major one – French –, on the other hand it expresses more than ever before the linguistic and cultural diversity of people. The Francophonie is also problematic as, seemingly glossocentric, in reality it configures an identity starting from multiple and not always convergent or harmonious elements. Dressed in monolingual arrays, but in order to speak about multiculturalism and otherness. Fiercely defended in its virginal purity at home, but in other regions constantly and deliberately associated with the most creative activity, the one which gives a language its primary liveliness and richness. The supreme paradox is perhaps the one of this logic of exclusion: the Hexagon turned the French language into an enclave surrounded by academic and legislative walls, while elsewhere it is a fertile ground, a generative matrix, a flexible and malleable flesh, promised to all, accepting sacrileges and twisting in the name of the liberty of thought and writing. Nothing is more refined but also more difficult to get to than the classic French, nothing richer and more effervescent than this creolized language, born from the mix of all the frustrations, the humiliations and the dreams of beauty. The French does not really feel at ease with the French language, the francophone does. The former hardly has the right to touch the language, to feel it, to abuse it, to love it, and to hate it. He has to respect it, to look after its eternal endurance, to contemplate it on a pedestal. The francophone may undertake any audacity that his language often forbids and discovers with wonder a space without fixed strings, a moving root.

It is in this area of exceptional liberty given only by language, without geopolitical or institutional limits, that one can find the specificity of the "francophone space", brilliantly illustrated, among others, for several years, by the Romanian writer established in 1990 in the French-speaking Switzerland, Marius Daniel Popescu. He did not know any French before arriving in Lausanne, today he writes all his texts directly in this "no man's langue," as it was called by another great stateless Romanian, the poet Gherasim Luca. He feels free and he refuses any literary yoke – a type of liberation which did not manifest itself in his first writings in Romanian. Perceived as an area of cognitive, pragmatic, and emotional freedom, the Francophonie is open to the linguistic and even symbolic delights forbidden to native speakers. As the contours of this notion remain vague, the great writers who illustrate it (Kundera,

Makine, Chamoiseau or Mabanckou, for example) take advantage of it in order to create for themselves a fictitious because fictional identity, relatively free in comparison with the mother tongues as well as with the adopted tongue. A word-play, a play with time, with the "I," everything is allowed. It seems that we have more freedom in the language of the other, which, after all, very soon is no longer completely the language of the other, as it receives a transplant of cultural weight and becomes embellished.

13.2 The Constraints of a Major Language

The meeting of two different cultural areas, although related, belongs to the field of cross-cultural semiotics which encounters the set of issues belonging to *deterritorialization* [4], and favours the notion of the *in-between*. It seems that this non-space has always been a fertile ground and an area privileged by the archaic Romanian mentality and, later, by these writers who knew the glory in and by means of French as an adoptive language, like Cioran, Ionesco, Panait Istrati and many others.

Daniel Sibony [5] defines the *in-between* as "a type of break-link between two terms, with the distinctive feature that the space of the break and the one of the link are greater than we believe them to be." In other words, in the space of the in-between the break appears where the space of another link opens, the one of recruitment and of integration. Any piece of writing practices the in-between of two languages, a symbolic and mythical area where the source language, silenced and relegated, is potentiated, it invests the field of the unconscious, while the linguistic code of the new language of expression is actualized, giving birth to a new language and to the author's style.

For the francophone writer, the existence of this intermediary area with vague contours brings to the front the issues of the *écart* in the novel. What is this frontier writing, floating between fragments reminding of its strangeness, either by its ontological charge of a vision nourished by the experience which is unknown to the receiving language, either by a metalinguistic plunge to the primary roots of the word? Lise Gauvin [6] has already discussed about the *linguistic over-awareness* of which the francophone writers testify in various manners, in the sense that they offer, at the heart of their identity issue, an analysis of language and the manner in which the connection language/literature is articulated in different contexts. According to Gauvin, these complex relations are at least competitive, if not conflicting, an opinion with which we disagree, as the scope of the reasoning of those who choose French as literary language is much beyond the agora of a bilingual confrontation. A proof, among others, is this example of *ars poetica* by Marius Daniel Popescu:

> You tell yourself that you have just written a text with a girl and a woman, with poetry and prose in its words, before the words which you have just written, before the words that you are going to write, there is a sort of embryo of the text to come, of the text which

> can be published-the published text and you place this embryo before the words begin to inscribe themselves somewhere: any piece of writing needs perceptions, plans or mental spontaneities which form in your case the beginning of every text: once you begin to transform the embryo of the text into words, you subject yourself to rules which disrupt this embryo, which invite it to grow, to become a text which can be published following the traces which we call words and which, strangely, join together without forming crossroads, squares, sidewalks.

The genes of literature, of a published text, poetry or prose, are not the words; words represent only one of the means undertaken by human beings until now in order, at the same time, to translate, express, keep, interpret, form, and develop this embryo made of perceptions, which is the root of all forms of language. [...] Any word, all by itself, is an accomplished literary text which can be published. It is you, the embryo of the text, and you try hard, as many others did, do and will do, to transform this embryo into words, to define, by means of words, everything that this embryo represents before words, without words; fortunately, you are an embryo among other embryos, there is an infinity of embryos, there isn't an infinity of words [7].

A study of the Eastern European discourse in the novel in general, Romanian in particular, underlines the mechanisms of the crossing of languages and cultures which are very different from the ones which characterize the African literature of French expression, for example. It does not have, for example, the inferiority complex of the dominated as, far from being the language of the colonizers, the French language represents (or, at least, it represented) an elitist aesthetic choice, a royal road to "play in the backyard of the powerful". However, there is still ambivalence, fueled by the strangeness felt in the in-between of the two languages, two cultures. In other words, the imaginary and the expression of these writers are marked at the same time by the desire of opening to the world and by the growing of roots in the original cultural territory. It is not always comfortable to become a moving root and this causes a permanent conflict between authenticity and readability. This struggle manifests itself, on the one side, by a kind of systematic breaking-in which consists of subverting the French language so as to make it short of breath and the odor of hay and dung, this wild malleability of the Romanian language, on the other side, by a paradoxical disarray, formulated by Panait Istrati in the following manner: "I have come to the French literature with a Romanian soul, but I had to lend it a French mask. When I tried to give back to this soul its Romanian face, I was no longer able to do that; it had distanced itself because of the foreign face" [8].

In addition, the original language revenges like an abandoned mistress and rejects the body which has become estranged. This has been the emblematic case of Istrati, warmly welcomed by the French, while the attitude adopted by the Romanian critics before and after the war proved to be extremely divergent, depending on the socio-cultural horizon of expectation. Essentially, the

attacks against the writings of Istrati are based upon the idea of the mystification of the Romanian realities, which this writer accomplished in another language than his own, a reason for which, according to great critics such as Nicolae Iorga or George Călinescu, he cannot be considered a Romanian writer, in spite of the literary qualities that everybody agrees that he possesses.

Envisaging a field of study for the novel largely opened to the relations between cultural products coming from different civilizations, Semunjanga [9] introduces new operative concepts which he names *transculturality* and*transgenerity*, with the purpose of studying the transversal relationship negotiated between different cultural products in a novel, the manner in which an artistic work unveils the culture of the Self and of the Other.

It has been obvious for a very long time – even before the concept of *intertextuality* was coined – that every artistic work is influenced by its relations with other works, on the formal plan as well as on the thematic plan. Based upon this postulate, many researchers contemplate the study of the francophone discourse in the novel as a transcultural object which is formed in the margin of the French language and culture. It is obviously true for the francophone African literatures, but it is not the case of Romanian francophone writers, who do not bear upon their shoulders the weight of a traumatizing history with the French language and do not conceive, when leaving, any need of a revengeful *alteration* of the vocabulary, only the pleasure of *variations, rephrasing*, and *word plays* [10] with, in the writing of the text, an easiness of increasing and intertwining several types of discourse and several enunciating instances.

Marius Daniel Popescu told us that he had often been asked, in Switzerland, why he inserted poems or word plays based on sounds in his writings. The interviewers thumbed their noses at the beginning, as if it had been a lack of taste or clumsiness resulted from his insufficient familiarity with the uses and the habits of the space of francophone literature. But the author has always answered, with the most matter-of-fact air in the world, that it was in this manner that he felt and that he was perfectly free to follow his inspiration, even if it meant offending "the orthodox" of the novelistic style. It is *his own style*:

This girl had back shoes, the sidewalk was asphalted, it had been raining for half an hour, she was walking between the road and the high barrier of a private propriety, you believe that one word contains all the other words, you tell yourself that all the words can be concentrated in only one word, any word, you take the word girl, this girl you have just seen, she must have a mother and a father, somebody who waits for her at home, home is an apartment, in this apartment she has her own room, she walks with her pink schoolbag held above her head toward the entrance of the building where she lives with her parents or only with her mother, or only with her father prose – "1. Ordinary form of spoken or written language, which does not submit itself to the rules of rhythm and musicality specific to poetry. 2. Manner of writing which is specific to somebody, a school, etc. – Fam. Spoken or written words, no

matter which." – who is there with you and this little girl who has finished her second-grade classes today, she went out of her class then out of her school then she lifted her arm holding the schoolbag, she protects herself from the rain as she can, you keep looking at her in some area of your memory these words and their syllables and their letters, you say "g from girl who has left school, the rain is not a fool, g from greed of the soil for water, the rain on the schoolbag: g g g g g g gleaming g g g giddy g g g g great g generations g g g g g g g g g g g girl" who doesn't care at all about poetry and prose and she doesn't care about these literary genres, she goes home in this rain, she hasn't been educated indoctrinated emancipated manipulated lead into this labyrinth without exit which offers along its way the walls poetry and prose [11].

Conformism amuses him, as he does not feel any false modesty in front of a "major" language. He uses it as he pleases, he feels at ease inside this new mental and linguistic space he has created, but he does not see any chain and he could not bear any hindrance in the crystallization of his creative drive. The tension center-periphery as regards the languages, he does not know it. Certainly, he is a minor writer, but there is no trace of pejorative connotation in this epithet, on the contrary, as in the case of music, the presence of a semi-tone in a major, Olympian structure, which risks becoming tedious, introduces this original and disquieting note which, far from breaking the harmony of the whole, elevates it. After a breaking wave of words which swirl and gush from everywhere, he thrusts phrases like: "The most disagreeable thing is that we have to use words in order to prove the uselessness of words" [12]. Or, if he is ever pompously asked about "the truth of words," he has a staggering answer: "My words, all the words, shouldn't exist!" [13]. Which does not prevent him from speaking during the same interview about the "vibration" of words and about the fact that they are "always signifying" for him, who has chosen to "move away from their non-sense, their absurdity" [14].

It is the case of an ethnical contamination of the French imaginary by the imaginary of the Romanian language. In the former, it is practically unthinkable to mock the aesthetic force of the word which creates a stable universe, according to the Aristotelian law of the excluded third. For the Romanian, the actual and the virtual of the words' connotations, fixed by speech, have an equal force and the same ontological value, as they do not act separately or in an opposing manner. Essentially, the absurd does not exist in the Romanian vision of the world, as nothing could contradict a logic which allows (without naming it thus) the included third and several levels of reality, which maintains, consequently, an organic relation with time, non-linear, of a natural come-and-go between conventional delineations. Popescu's narratives are confusing to an occidental reader, as he uses with ease and at every moment these temporal shifts, without any warning, following the functioning of his associative thinking, without caring to know whether "it is done" or not. The *forma mentis* of his texts is circular, but not of that circular symmetry of the circle which turns on itself, it would rather be the open one of the spiral.

A kind of "endless colum" by Brancusi. In addition, Marius Popescu drops apparently at random, at the end of a phrase, that: "The word 'end' should not exist" [15]. Another one. But the wave of words nonetheless submerges us in his texts. He is another paradox.

13.3 Literary Francophonie under the Sign of Freedom

The notion of francophone literature(s) has been much discussed, as in spite of its singularity, it corresponds to a vast heterogenic body which resists any simplifying grid. It is the world-wide case of young literatures, and their writers find themselves at the "crossroads of languages" [16] and in cases of "culture contact" [17]. It is however difficult to define this phenomenon, to which Michel Beniamino attaches three main factors, i.e. space, history, and language. We cannot speak about literary Francophonie as a space, the institutional borders being questioned and having little in common with the open dialogue of cultures at this time of globalization. As to history, it is not a better criterion, as even the title of francophone studies sends in the subtext to a relation of dominating/dominated, centre/periphery. Incidentally, all the literature written in French should be integrated in the category of French literature. And wouldn't it be easier to speak about French literature simply, in the sense used by Salman Rushdie for the English literature ("which I have always understood to mean simply literature written in English") [18]?

The recent theories concerning language as a common denominator for the francophone writers, especially the ones of Lise Gauvin, talk about a certain paradigm of the ratio of foreignness to the language. This is certainly true for this category of "minor" writers, but is it not an emblematic case for any authentic writer? Wherever they come from, they have an exacerbated and fertile relationship of love-hate with the common language, that they cultivate incessantly, that they re-invent, in order to come – to use Gilles Delueze's words – to "make the language itself shout, stammer, stutter, murmur." [19] The writer who expresses himself in another language than his native one has a unique experience of interiority-exteriority, which is unknown to the native speaker, for obvious reasons. The foreigner is "condemned" to think the language, actually the languages, as any linguistic questioning arisen from the intimate contact with another universe sends him back in a loop to his own language, of which he acquires an extended vision. We believe that the linguistic over-awareness mentioned by researchers does not apply only to the new field of expression – with this area of creative casualness and of not knowing innate taboos –, but also to the old sphere, of which the weaknesses and the incredible resources become evident to the one who has detached himself from it.

In this respect we partly disagree with authors such as Michel Beniamino, who defines literary Francophonie as:

> The modern form of a set of phenomena related to seeking the perspective of the Other – of whom we can question the historic origins (perhaps the Renaissance) – but whose specificity – that which marks its break with previous issues – would be to link the perspective of otherness to the issue of language in the socio-symbolic and socio-linguistic sense in a perspective of domination [20].

Thus considered, francophone literature is not the spearhead of a cultural dialogue, based upon the use of the same idiom, which would transcend national forms of expression, historically determined, but a sly, perverse way of dominating by means of what we call the "cultural influence". Or, as we have already seen, there are thousands of nuances other than the ones with a colonial stench in the choice (voluntary or imposed) of the French language by foreign writers, including in the former colonies, where the new generations do not hold the same grudge, the more so in the countries which have never regarded the French language as an instrument of the oppressor, but as the means to obtain access to universality. Certainly, it is difficult to escape from the historical context, and in this sense, the term of "francophone literature" seems to be tainted by the imperialist seal, bearing heavy misunderstandings, this is the reason for which an important group of writers writing in French, having as promoters Michel le Bris and Jean Rouaud, launched in 2007, during the Festival "Etonnants Voyageurs" in Saint-Malo, the concept of "world-literature," which led to the writing of a book [21]. We do not insist on the force and the real interest of this phrase, which produced as many enthusiastic followers as hostile reservations. The fact is that in discarding the direct reference to the French language, it creates another ambiguity and a conceptual vague which eventually complicates things even more.

Theoreticians have built arguments which are valid on paper, but which do not hold in front of the dynamic of the writer's own discourse, as our epoch forces us to change the mental coordinates. See, for example, the words of Nimrod, writer, essayist, and poet from Chad:

> We are hybrids; it is no use trying at all costs to track down the African in us. On the contrary, let us use this great probes which, following the comma and the phrase, inform us about the acclimatization of Rimbaud and of Claudel, of Chateaubriand and of Proust under the tropics. (...) This literature named African owes everything to the French literature. In any case, it owes it the beginning of a modern tradition [22].

This new understanding of literature implies the abandoning of the dialectics centre/periphery, and of entering in the era (or area) of the literature written in French (or other literature, opened to the world, but also aware of the diversity of its influences, and which aspires to move elsewhere and in other ways than the frame which has been traced for it for a too long, even if it

is a prestigious one. The result is a process of rewriting the traditional genres from it, a cross-genre outburst and especially an understanding of the novel in terms of *diffraction*; it is at the level of the fracture in the discourse, of this impossibility to inhabit completely the French that we may notice the unique adventure of francophone writings, a literature of cultural, linguistic, and ontological crossroads, an interbreeding which does not lead to an impasse, but to an infinitely flexible and malleable space.

When the French, as a literary language, does not correspond to the native language of the author or if the language of writing and the first language do not coincide, there will be of necessity a discrepancy to the widely acknowledged norm. A new type of novel tends to emerge on the margins of canons established by the French literary tradition, between the classical perfection, heir of the *Belles Lettres*, and the creative tension marked by diffuse non-native elements. The consequence is a different treatment of space, time, characters, actions, and especially of the words which designate them.

The emergence of the ethno-linguistic substratum in the narrative fabric produces complex works, which belong to the tradition of dialogism characteristic for the discourse in the novel developed by Bakhtin [23], for whom "the novel is the social diversity of speech types or the specific social dialogue of speech types." In other words, discourse in the novel is the place where living and various genres meet and interact, the result of which is that "the novel as a whole is a pluristylistic, plurilingual, plurivocal phenomenon" [24]. It is a widespread phenomenon of dialogism, which is designated by Bakhtin by the concept of heteroglossia, stating that the power of the novel originates in the coexistence of and from the conflict between different types of speech: the speech of characters, the speech of the narrator and even the speech of the author. He defines heteroglossia as "another's speech in another's language, serving to express authorial intentions but in a refracted way" [25]. It is exactly what we discover in the two novels of Marius Daniel Popecu (*La Symphonie du loup- The Symphony of the Wolf and Les Couleurs de l'hirondelle - The Colours of the Swallow*), the speech types which form its heteroglossia comprising voices of the past and of the present, as well as voices coming from different, meaning divergent, cultural environments.

A writer can always assimilate a literary genre from the world to which he adheres, as was the case of, for example, Hélène Vacaresco and her poetry with heavy Parnassian influences, or for Cioran and the borrowing of short, aphoristic forms, or for Eliade and his Gidean existentialist narratives. But in our days the writing of novels falls more and more in the line of what we already designate as the "francophone tradition," which allows us to speak about a hybrid production of novels, bringing together different symbolic universes, aspiring to a synthesis which guarantees the richness of culture interactions.

Thus, the ethnic stereotypes from the two sides overlap in order to contribute to the building of one world, autonomous, representative for a no man's land and of a no man's language which come into being and state their different but recognizable status. Here are, in the form of a summary which

is both ironic and tender, which says much about contemporary mentalities and realities in Romania, some of the 19 reasons identified by Marius Daniel Popescu for staying in the "country of there," as he calls it:

1. Because you can always leave the country, no matter when... Nobody forces you to stay in the country.
2. Because in the country everybody is ready to share with you everything they have: the stupid songs played at maximum volume in their cars, flu in public transportation, their women who stay at home [...]
3. Because only in our country there are more Jeeps than millionaires and more millionaires than firms.
4. Because only in our country it seems normal to receive without giving anything in exchange.
5. Because our country is the only country where if you do nothing more than look at those who work, you receive a spectator's bonus called "supervising allowance". [...]
6. Because we are the only people in the world for which "thief!" is an endearing word. [...]
7. Because only our country can organize the World Championship of 3000 km slalom with having as obstacles: carts, hen-nests, hungry stray dogs, drunkards.
8. Because in our country snow is considered to be a saint only because it falls from the sky; once it falls on the roads, nobody dares to touch it.
9. Because in our country the working day begins with a break. [...]
10. Because when all the places in Hell are taken, our country will become a destination to replace Hell; those who will remain in our country won't have to pay transportation expenses to Hell" [26].

The other world – France, in this case – is well oiled and functional, only that people, even in couples, even in groups, feel lonelier than ever and a discreet indifference reigns in their hearts:

> People who sit at their table at the terrace do not mind the man who is alone in the street, passers-by do not look at him, cars slow down and overtake him, he makes pirouettes, he kneels, he gets up, he jumps in the air. It is the first time that I see such a scene in Paris, I have the feeling that this man wants to revenge himself on the entire planet, I see him making signs to passers-by, I drink coffee and I think about the miseries of the human race [27].

The assumption that we defend is that the space- at the same time confined and unlimited-offered by the French language to foreigners leads to original

modes of writing, to the use of figures of speech such as the mix of genres and speech types, producing eventually a renewing of the depth of the novel. The polyphony is articulated around memories – conscious or involuntary – of the socio-cultural and linguistic universe of the "country from there." The link is never completely broken, on the one hand the root is never deeply fixed, and on the other hand, we are dealing rather with a rhizome-like structure, to recall the epistemological model defined by Deleuze and Guattari [28]. Any element can influence another element and vice-versa, without having hierarchical presuppositions and without the suffocating co-existence of the specificity of the one or the other. The image of Marius Popescu's library appears to us as an edifying metaphor in this regards (our underlining):

> I arrange my books, my library, it feels as if I'm moving away. There are several hundreds of books in Romanian and maybe two thousands in French. *I will make separate book-shelves for the Romanian books, they will be together and they will touch the books in French only through the wooden wall of the bookcase.* I take these bilingual books in my hands and I shake with my hands the dust which has covered them. I had mixed the books in Romanian with the books in French [...]. I will translate for you the titles of books in Romanian and I translate from Romanian to French. Here is another title that I have just translated: "Treatise on the Blind Blind". As I have many books in French, I quote for you the title of a book in French: "Poems of Youth" [29].

13.4 The Francophone Audacities of Marius Daniel Popescu

He writes novels as he used to glue posters in the beginning, after his arrival in the "country from here," Switzerland. He writes juxtaposing episodes which flow all along the temporal spiral, in all directions, trying very hard the attention and the judiciousness of the reader, loosening Ariadne's thread in order to prompt him to find the exit from the labyrinth all by himself.

In *La Symphonie du loup and Les Couleurs de l'hirondelle*, Marius Daniel Popescu offers unusual autobiographic narratives, actually deconstructing them – in comparison with the traditional image that we have of them – and giving them back in the form of a puzzle. A little in the manner of Julio Cortazar, or of Jean Genet, he creates a kind of textual hopscotch, disdaining the chronological order of events, jumping from one subject to another, at the mercy of fanciful associations of ideas or even sounds. The two books begin with dramatic moments: the death of the father, in *La Symphonie*, the death of the mother, in *Les Couleurs*, the two texts end with the beginning of a new game. Between death and life, under the sign of the ludic, unrolls the entanglement of thousands of scenes which tell, bit by bit, with a seriousness never exempt

of irony, about life during the communist regime, the liberty regained, love, family, children, in the "country from here." From the one to the other, he traces a path that we could call, to paraphrase Lise Gauvin, a road of the "unrest," [30] with the difference that he does not distance himself from the French language in particular, but from any language, the literary field appears to be a place where an affirmation of identity and a type of liberation express themselves at the same time. The setting free of the word by the word, as suggested by the last metaphor used at the end of *La Symphonie*, the one of the schoolbag made of white iron that his daughter is supposed to show to her classmates and "if they ask her why she has a schoolbag made of white iron, she will answer them, as you taught her, that it is because words shouldn't exist" [31].

With Popescu, we have the feeling that the word is a mental construct we can do without, in the same manner as the francophone space is a mental construct of France, as Orientalism was invented by the Occident. It remains however dependent and fascinated, following the example of any other writer, and he yearns for, paradoxically, silence, by increasing the power of the words, by breaking up any daily gesture into thousands of verbal sparks, like the labels of Swiss products, all of them written in three languages. Certainly, his writings remind us inevitably of the New Novel, of Le Clezion making the inventory of Monoprix in his *The Interrogation*, and nonetheless, in this "sacralisation of the commonplace," [32] it is not the accumulation of things which hails the author, but the accumulation of words which chase the concrete which, in its turn, eludes us. And this experience is completely personal, man is confronted with things in his quality of "enunciating instance," individually, every verbal person being a specter of virtual values which is activated in a particular context, but this referential oscillation is not at all collective.

In the polyphonic narratives that he offers, there is no sign of the *doxa*, there is never *one* (and even the *we* and the *you* which designate the plural are rather rare). The existential adventure and the bookish adventure are experienced with all the suffering and the passion of a bodily being which gives itself in the flesh of the words, proving that literature does not force us to associate it with a principle of territoriality, opening on the contrary on a great area of contact, of the *in-between*, where the imaginary of the languages makes the law. The texts of Marius Daniel Popescu are inhabited by plurilinguism in a subterranean manner and by dialogism in an obvious manner, in the constant symbolic journeys between "the country from over-there" and "the country from here," the temporal serpent which often uses the written word as a vehicle:

> This book, I no longer remember when and where I bought it. It is old and worn like one of my great-grandfather's belts, its pages are yellow and fragile on the last page which contains where the literary text is printed "231" then there are seven more pages of which the seventh is "PRINTED ON THE TWENTYETH OF MARCH NINETEEN SIXTY SEVEN IN THE PRINTING PRESS OF H.

> MESSEILER IN NEUCHZTEL." I was almost four years old and my mother and all the other members of my family didn't think and couldn't even dream that one day the kid that I was then was to see another country and in a more conclusive manner than as a tourist or a student [...] I read in the language which is not my mother tongue but which has become my language. I always read very well in the language I have learned since my childhood but for the past twelve years I have been reading mostly in French. [...] I do not search pleasure in words. [...] Loving books does not mean taking pleasure in words. [...] There is no layout for words or a page layout that could allow me to feel pleasure [33].

Marius Daniel Popescu presents us this French language in which he has plunged body and soul, moving in a kind of linguistic Moebius band, having a view at the same time exterior- neuter, impartial – and an axial view, which goes to the root of words and searches for the reason of their existence. Neither a straight jacket, nor an object of silent dull adoration, the French language is for him a here-elsewhere, a nice comfortable jacket, the fundamental usefulness of which remains questionable, as with any language. He does not suffer because of this any more than it makes him happy. His heteroglossia is pronominal, the latent tensions of his personality, the aspects of his relation with the world and with language are translated in this unpredictable shifts of *I*, *you, he*...Multiple points of view, certainly, but no clear sign of shifting from one instance of discourse to another, this constant game builds a masterly composition, to take one's breath away, from lack of stable landmarks. There is no use in trying to see in the distancing due to the use of *you* or *he* a wish to distinguish between the I of the present and hypostasis of the past, or vice-versa, as Popescu cheats all the time: *I* is now the omniscient narrator, now the voice of the grandfather, now in a kind of *mise en abyme*, the narrator of another text; *you* is either the narrator, or the natural person addressed in speech, with the difference that the real dialogue hardly exists; *he* is now the narrator, now a non-person exterior to the conversation talk but enjoying a surplus of referential determinants. Here are several examples:

> He sent me a text typed at the writing machine, he would like me to publish his text in the literary journal "le persil," he wrote to me several words on a postcard, he is a writer, he has published several texts, he tells me "it is a fragment from my next novel," I read: "I began my days looking at the objects placed on the bedside table. [...]" (CH, 171)

> I'm telling you, son, that neither objects nor beings are responsible for the miseries in the world. The only misery in the world comes from words. (SL, 127)

> You are in the street with your two girls, at your right you hold

> the older one by hand, and the younger one has her arm around your neck [...] (SL, 367)

> He reads sever newspapers a days, some of them he buys in kiosks, others he receives in his mailbox, by subscription. He reads them from one end to the other, he spends around two hours to read them. The titles and the subtitles of every heading, he pronounces them in a loud voice, until he finds for them a linguistic charm or a deontological flaw. (CL, 34)

The polyphonic mosaic which results from this produces an impression of multiplication of "corporal" characters, this various connotations coming from areas so different the one from the other from every point of view, creating an atmosphere which mixes casualness and dreams, the funny and the absurd, smiling lucidity and heavy anxiety. This pronominal linguistic dissipation is a proof of a need of equal recognition of multiple points of view, not necessarily opposing which reflects a personal, poetical approach of the world across a multiple I which refuses to surrender in front of the request of the unique option. The internal coherence of the universe of Marius Daniel Popescu is not at all affected.

13.5 Conclusions

The literary francophone space is a good opportunity. The opportunity of a meeting between two cultures, two ways of thinking, two (or more) languages. The opportunity of transcending them towards a new horizon. Words are there in order to express perceptions, not to impose them, and it that is exactly what it is about: becoming aware of what life is, in its unity and diversity, in its mental, affective, physical manifestations. It is made of these little and great realities which man perceives in his conscience and in his unconscious, in the memory of his spirit and body, which travel like a bird which is given the colors of time. Facts and objects. It is in them, by them, with them, apparently given in a raw state, in reality divided with minuteness like notes on a musical sheet, that emotion is created, by the intervention of numberless words populating the phrases of a narrative which are forever extended by memory.

Taking into consideration the multiple debates and nuances evoked, we believe that the francophone space is a "free zone," beyond a concrete spatiality and geo-historical temporality, a complex area in which the writer who plunges inside lives a major experience: the dismay in front of the strangeness of the language and the pleasure of creating a new one.

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