



Transdisciplinarity - Past, Present and Future

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1 - The war of definitions

a. How transdisciplinarity was born

Transdisciplinarity is a relatively young approach in the history of human knowledge: it emerged seven centuries later than disciplinarity, due to the genius of the Swiss philosopher and psychologist Jean Piaget (1896-1980).

The word itself first appeared in France, in 1970, in the talks of Jean Piaget, Erich Jantsch and André Lichnerowicz, at the international workshop "Interdisciplinarity - Teaching and Research Problems in Universities", organized by the Organization for Economic Co-operation and Development (OECD), in collaboration with the French Ministry of National Education and University of Nice.

In his contribution, Piaget gives the following description of transdisciplinarity: "Finally, we hope to see succeeding to the stage of interdisciplinary relations a superior stage, which should be "transdisciplinary", i.e. which will not be limited to recognize the interactions and or reciprocities between the specialized researches, but which will locate these links inside a total system without stable boundaries between the disciplines". This description is vague, but has the merit of pointing to a new space of knowledge "without stable boundaries between the disciplines". However, the idea of a "total system" opens the trap of transforming transdisciplinarity in a super- or hyperdiscipline, a kind of "science of sciences". In other words the description of Piaget leads to a closed system, in contradiction with his own requirement of the instability of boundaries between disciplines. The key-point here is the fact that Piaget retained only the meanings "across" and "between" of the Latin prefix *trans*, eliminating the meaning "beyond". In such a way, transdisciplinarity is just a new, but "superior" stage, of interdisciplinarity. I think that Piaget was fully conscious of this alteration of transdisciplinarity, but the intellectual climate was not yet prepared for receiving the shock of contemplating the possibility of a space of knowledge *beyond* the disciplines. The proof is that, in his introduction to the Proceedings of the workshop, Pierre Duguet honestly recognizes that some experts wanted, in preliminary meetings, to see the word "transdisciplinarity" in the title of the workshop, but authorities of the OECD refused to do so, because they were afraid to confuse some representatives of the member countries. I had the chance to meet and to speak with Guy Michaud, one of the organizers of the meeting, who confirmed to me that it is Piaget who wanted to see "transdisciplinarity" in the title of the workshop. Guy Michaud was, in fact, the person who indicated to me, in 1986, that Piaget was the first to specifically use the word "transdisciplinarity", at the time of the Nice meeting. This fact is not widely known. Even today, of the 220000 entries "Jean Piaget" on Google, only 69 contain the word "transdisciplinarity", half of them being, in fact, quotations from my own work. It is possible

that some people used this word before Piaget, as equivalent to multidisciplinary or interdisciplinarity. However it is certainly Piaget who recognized the necessity of considering a new field of knowledge, distinct from multidisciplinary and interdisciplinarity as defined till 1970.

In his contributions, Erich Jantsch, an Austrian thinker living in California, falls in the trap of defining transdisciplinarity as a hyperdiscipline. He writes that transdisciplinarity is "the coordination of all disciplines and interdisciplines of the teaching system and the innovation on the basis of a general axiomatic approach". He clearly situates transdisciplinarity in the disciplinary framework. However, the historical merit of Jantsch was to underline the necessity of inventing an axiomatic approach for transdisciplinarity and also of introducing values in this field of knowledge.

Finally, the approach of André Lichnerowicz, a known French mathematician, is radically mathematical. He sees transdisciplinarity as a transversal play, in order to describe "the homogeneity of the theoretical activity in different sciences and techniques, independently of the field where this activity is effectuated". And, of course, this theoretical activity can be formulated, he thinks, only in mathematical language. Lichnerowicz writes: "The Being is put between parentheses and it is precisely this non-ontological character which confers to mathematics its power, its fidelity and its polyvalence." The interest of Lichnerowicz for transdisciplinarity was accidental, but his remark about the non-ontological character of mathematics has to be remembered. Lichnerowicz was disappointed that his mathematical program in transdisciplinarity was not fulfilled, a fact that he confirmed to myself in 1992 at the Plenary Session of the Pontifical Academy of Sciences at Vatican.

I described in some detail the three different positions of Piaget, Jantsch and Lichnerowicz concerning transdisciplinarity, because they can be found again, a quarter of a century later, in what I call "the war of definitions". The word "war" does not belong to the transdisciplinary vocabulary. But I use it on purpose, because it appeared in the issue "Guerre et paix entre les sciences: disciplinarité et transdisciplinarité / War and Peace Between Sciences: Disciplinarity and Transdisciplinarity" of a French magazine. In this issue, one of the authors asked for the interdiction of the word "transdisciplinarity". His desire was obviously not satisfied.

I would like to add, in this discussion about the incipient phase of transdisciplinarity, the name of Edgar Morin. A short time after the Nice meeting, Morin begins to use the word "transdisciplinarity" and he even leads a transdisciplinary laboratory in human sciences, in the framework of a prestigious French research institution. It is true that Morin did not give a definition of transdisciplinarity. For him, transdisciplinarity was, in that period, a kind of messenger of the freedom of thinking, a go-between discipline. We met a quarter of a century ago and we agreed on the complementarity between transdisciplinarity and complexity. From then, we go hand in hand on the same way - that of the freedom of thinking.

b. Beyond disciplines

I proposed the inclusion of the meaning "beyond disciplines" in 1985 and I developed this idea over the years in my articles and books and also in different official international documents. Many other researchers over the world contributed to this development of transdisciplinarity. A key-date in this development is 1994, when the Charter of Transdisciplinarity was adopted by the participants at the First World Congress of Transdisciplinarity (Convento da Arrábida, Portugal).

This idea did not come from heaven or just from the pleasure of respecting the etymology of the word *trans*, but from my long practice of quantum physics. For an outsider, it might seem paradoxical that it is from the very core of exact sciences that we arrive at the idea of limits of disciplinary knowledge. But from inside, it provides evidence of the fact that, after a very long period, disciplinary knowledge has reached its own limitations with far reaching consequences not only for science, but also for culture and social life.

The crucial point here is the status of the Subject.

Modern science was born through a violent break with the ancient vision of the world. It was founded on the idea - surprising and revolutionary for that era - of a total separation between the knowing subject and Reality, which was assumed to be completely independent from the subject who observed it. This break allowed science to develop independently of theology, philosophy and culture. It was a positive act of freedom. But today, the extreme consequences of this break, incarnated by the ideology of scientism, become a potential danger of self-destruction of our species.

On the spiritual level, the consequences of scientism have been considerable: the only knowledge worthy of its name must therefore be scientific, objective; the only reality worthy of this name must be, of course, objective reality, ruled by objective laws. All knowledge other than scientific knowledge is thus cast into the inferno of subjectivity, tolerated at most as a meaningless embellishment or rejected with contempt as a fantasy, an illusion, a regression, or a product of the imagination. Even the word "spirituality" has become suspect and its use has been practically abandoned.

Objectivity, set up as the supreme criterion of Truth, has one inevitable consequence: the transformation of the Subject into an Object. The death of the Subject is the price we pay for objective knowledge. The human being became an object - an object of the exploitation of man by man, an object of the experiments of ideologies which are proclaimed scientific, an object of scientific studies to be dissected, formalized, and manipulated. The Man-God has become a Man-Object, of which the only result can be self-destruction. The two world massacres of this century, not to mention the multiple local wars and terrorism - are only the prelude to self-destruction on a global scale.

In fact, with very few exceptions - Husserl, Heidegger or Cassirer - modern and post-modern thinkers gradually transformed the Subject in a grammatical subject. The Subject is today just a word in a phrase.

The quantum revolution radically changed this situation. The new scientific and philosophical notions it introduced - the principle of superposition of quantum "yes" and "no" states, discontinuity, non-separability, global causality, quantum indeterminism - necessarily led the founders of quantum mechanics to rethink the problem of the complete Object / Subject separation. For example, Werner Heisenberg, Nobel Prize of Physics, thought that one must suppress any rigid distinction between the Subject and Object, between objective reality and subjective reality. "The concept of "objective" and "subjective" - writes Heisenberg - designate [...] two different aspects of one reality; however we would make a very crude simplification if we want to divide the world in one objective reality and one subjective reality. Many rigidities of the philosophy of the last centuries are born by this black and white view of the world." He also asserts that we have to renounce the privileged reference to the exteriority of the material world. "The too strong insistence on the difference between scientific knowledge and artistic knowledge - writes Heisenberg - comes from the wrong idea that concepts describe perfectly the "real things" [...] All true philosophy is situated on the threshold between science and poetry."

My line of thinking is in perfect agreement with that of Heisenberg. For me, "beyond disciplines" precisely signifies the Subject, more precisely the Subject-Object interaction. The transcendence, inherent in transdisciplinarity, is the transcendence of the Subject. The Subject can not be captured in a disciplinary camp.

The meaning "beyond disciplines" leads us to a fabulous space of new knowledge. The main outcome was the formulation of the methodology of transdisciplinarity, which I will analyze in the next section. It allows us also to clearly distinguish between multidisciplinary, interdisciplinarity and transdisciplinarity.

Multidisciplinarity concerns itself with studying a research topic in not just one discipline only, but in several at the same time. Any topic in question will ultimately be enriched by incorporating the perspectives of several disciplines. Multidisciplinarity brings a plus to the

discipline in question, but this "plus" is always in the exclusive service of the home discipline. In other words, the multidisciplinary approach overflows disciplinary boundaries while its goal remains limited to the framework of disciplinary research.

Interdisciplinarity has a different goal than multidisciplinary. It concerns the transfer of methods from one discipline to another. Like multidisciplinary, interdisciplinarity overflows the disciplines, but its goal still remains within the framework of disciplinary research. Interdisciplinarity has even the capacity of generating new disciplines, like quantum cosmology and chaos theory.

Transdisciplinarity concerns that which is at once *between* the disciplines, *across* the different disciplines, and *beyond* all discipline. Its goal is the understanding of the present world, of which one of the imperatives is the unity of knowledge.

As one can see, there is no opposition between disciplinarity (including multidisciplinary and interdisciplinarity) and transdisciplinarity, but a fertile complementarity. In fact, there is no transdisciplinarity without disciplinarity. In spite of this fact, the above considerations provoked, around 1990, a more or less violent war of definitions. This war is not yet finished.

I will not make here detailed considerations about the sociological and psychological motivation of such a non-transdisciplinary attitude - like the fear of the unknown, the ideological rejection of spirituality, the will to power or the wish of academic honorability, understood as disciplinary honorability. That would generate endless polemics which are, in my opinion, a waste of time. I prefer to try to understand the unconscious motivation of such views. When the unconscious motivation goes to the surface of consciousness and it is put in words, a true dialogue can begin.

I have in mind a specific different approach of transdisciplinarity, characterized by the refusal of formulating any methodology and by its exclusive concentration on joint problem-solving of problems pertaining to the science-technology-society triad. This approach is represented by figures like Michael Gibbons and Helga Nowotny. The point of view of this transdisciplinary current was largely expressed at the Zürich Congress, held in the year 2000.

This version of transdisciplinarity does not exclude the meaning "beyond disciplines" but reduces it to the interaction of disciplines with social constraints. The social field necessarily introduces a dimension "beyond disciplines", but the individual human being is conceived of as part of a social system only.

It is difficult for us to understand why "joint problem solving" must be the unique aim of transdisciplinarity. It is certainly one of the aims but not the only aim. The use of singular seems to us dangerous, as in religion, as allowing unnecessary wars and unproductive dogmatism. Is transdisciplinarity concerning only society, as a uniform whole, or, in the first place, the human being which is (or has to be) in the center of any civilized society? Are we allowed to identify *knowledge* with *production of knowledge*? Why the potential of transdisciplinarity has to be reduced to produce "better science"? Why transdisciplinarity has to be reduced to "hard science"? In other words, the Subject - Object interaction seems to us to be at the very core of transdisciplinarity and not the Object alone.

I think that the unconscious barrier to a true dialogue comes from the inability of certain transdisciplinary researchers to think the discontinuity. I will give an image in order to express what I have in mind. For them, the boundaries between disciplines are like boundaries between countries, continents and oceans on the surface of the Earth. These boundaries are fluctuating in time but a fact remains unchanged: the continuity between territories. We have a different approach of the boundaries between disciplines. For us, they are like the separation between galaxies, solar systems, stars and planets. It is the movement itself which generates the fluctuation of boundaries. This does not mean that a galaxy intersects another galaxy. When we cross the boundaries we meet the interplanetary and intergalactic vacuum. This vacuum is far from being empty: it is full of

invisible matter and energy. It introduces a clear discontinuity between territories of galaxies, solar systems, stars and planets. Without the interplanetary and intergalactic vacuum there is no Universe.

It is my deep 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. Much confusion arises by not recognizing that there are a *theoretical transdisciplinarity*, a *phenomenological transdisciplinarity* and an *experimental transdisciplinarity*.

The word *theory* implies a general definition of transdisciplinarity and a well-defined methodology (which has to be distinguished from "methods": a single methodology corresponds to a great number of different methods). The word *phenomenology* implies building models connecting the theoretical principles with the already observed experimental data, in order to predict further results. The word *experimental* implies performing experiments following a well-defined procedure allowing any researcher to get the same results when performing the same experiments.

I classify the work done by Michael Gibbons and Helga Nowotny as phenomenological transdisciplinarity, while my own work, as well as the one of Jean Piaget and Edgar Morin, as theoretical transdisciplinarity. In its turn, experimental transdisciplinarity concerns a big number of experimental data already collected not only in the framework of knowledge production but also in many fields like education, psychoanalysis, the treatment of pain in terminal diseases, drug addiction, art, literature, history of religions, etc. The reduction of transdisciplinarity to only one of its aspects is very dangerous because it will transform transdisciplinarity into a temporary fashion, which I predict will disappear soon as many other fashions in the field of culture and knowledge have indeed vanished. The huge potential of transdisciplinarity will never be accomplished if we do not accept the simultaneous and rigorous consideration of the three aspects of transdisciplinarity. This simultaneous consideration of theoretical, phenomenological and experimental transdisciplinarity will allow both a unified and non-dogmatic treatment of the transdisciplinary theory and practice, coexisting with a plurality of transdisciplinary models.

2 - Formulation of the methodology of transdisciplinarity

a. The axiomatic character of the methodology of transdisciplinarity

The most important achievement of transdisciplinarity in present times is, of course, the formulation of the methodology of transdisciplinarity, accepted and applied by an important number of researchers in many countries of the world. Transdisciplinarity, in the absence of a methodology, would be just talking, an empty discourse and therefore a short-term living fashion.

The axiomatic character of the methodology of transdisciplinarity is an important aspect. This means that he 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, have to be rejected.

This fact is not new. It already happened when disciplinary knowledge acquired its scientific character, due the three axioms formulated by Galileo Galilei in *Dialogue on the Great World Systems*:

1. *There are universal laws, of a mathematical character.*
2. *These laws can be discovered by scientific experiment.*
3. *Such experiments can be perfectly replicated.*

It should be obvious that if we try to build a mathematical bridge between science and ontology, we will necessarily fail. Galileo himself makes the distinction between human mathematics and divine mathematics. Human mathematics constitutes, he says (through

Salvati), the common language of human beings and God, while divine mathematics is connected with the direct perception of the totality of all existing laws and phenomena. Transdisciplinarity tries to seriously take this distinction into account. A bridge can be built between science and ontology only by taking into account the totality of human knowledge. This requires a symbolic language, different from mathematical language and enriched by specific new notions. Mathematics is able to describe repetition of facts due to scientific laws, but transdisciplinarity is about the singularity of the human being and human life. The key-point here is, once again, the irreducible presence of the Subject, which explains why transdisciplinarity can not be described by a mathematical formalism. The dream of the mathematical formalization of transdisciplinarity is just a phantasm, the phantasm induced by centuries of disciplinary knowledge.

After many years of research, we have arrived at the following three axioms of the methodology of transdisciplinarity:

- i. **The ontological axiom:** *There are, in Nature and in our knowledge of Nature, different levels of Reality and, correspondingly, different levels of perception.*
- ii. **The logical axiom:** *The passage from one level of Reality to another is insured by the logic of the included middle.*
- iii. **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 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 from the beginning of historical times.

Axioms can not be demonstrated: they are not theorems. They have their roots in experimental data and theoretical approaches and their validity is judged by the results of their applications. If the results are in contradiction with experimental facts, they have to be modified or replaced.

Let me note that, in spite of an almost infinite diversity of methods, theories, and models which run throughout the history of different scientific disciplines, the three methodological postulates of modern science have remained unchanged from Galileo until our day. Let us hope that the same will prove to be true for transdisciplinarity and that a large number of transdisciplinary methods, theories and models will appear in the future.

Let me also note that only one science has entirely and integrally satisfied the three Galilean postulates: physics. The other scientific disciplines only partially satisfy the three methodological postulates of modern science. However, the absence of rigorous mathematical formulation in psychology, psychoanalysis, history of religions, law theory and a multitude of other disciplines did not lead to the elimination of these disciplines from the field of science. At least for the moment, not even an exact science like molecular biology can claim a mathematical formulation as rigorous as that of physics. In other words, there are *degrees of disciplinarity* which can respectively take into account more or less completely the three methodological postulates of modern science. Likewise, the process of more or less taking completely into account the three methodological pillars of transdisciplinary research will generate different *degrees of transdisciplinarity*. Large avenues are open for a rich and diverse transdisciplinary research.

The above three axioms give a precise and rigorous *definition of transdisciplinarity*. This definition is in agreement with the one sketched by Jean Piaget.

Let me now describe the essentials of these three transdisciplinary axioms.

b. The ontological axiom: levels of Reality and levels of perception

The key concept of the transdisciplinary approach to Nature and knowledge is the concept of *levels of Reality*.

Here the meaning we give to the word "Reality" is pragmatic and ontological at the same time.

By "Reality" we intend first of all to designate that which *resists* our experiences, representations, descriptions, images, or even mathematical formulations.

In so far as Nature participates in the being of the world, one has to assign also an ontological dimension to the concept of Reality. Reality is not merely a social construction, the consensus of a collectivity, or some inter-subjective agreement. It also has a trans-subjective dimension: for example, experimental data can ruin the most beautiful scientific theory.

Of course, one has to distinguish the words "Real" and "Reality". *Real* designates that which *is*, while *Reality* is connected to resistance in our human experience. The "Real" is, by definition, veiled for ever, while "Reality" is accessible to our knowledge.

By "level of Reality", I designate a set of systems which are invariant under certain laws: for example, quantum entities are subordinate to quantum laws, which depart radically from the laws of the macrophysical world. That is to say that two levels of Reality are different if, while passing from one to the other, there is a break in the applicable laws and a break in fundamental concepts (like, for example, causality). Therefore there is a *discontinuity* in the structure of levels of Reality, similar to the discontinuity reigning over the quantum world.

Every level of Reality has its associated space-time, different from one level to the other. For example, the classical realism is associated with the 4-dimensional space-time (three dimensions of space and one dimension of time), while the quantum realism is associated with a space-time whose number of dimensions is bigger than four. The introduction of the levels of Reality induces a multidimensional and multireferential structure of Reality.

A new *Principle of Relativity* emerges from the coexistence between complex plurality and open unity in our approach: *no level of Reality constitutes a privileged place from which one is able to understand all the other levels of Reality*. A level of Reality is what it is because all the other levels exist at the same time. This Principle of Relativity is what originates a new perspective on religion, politics, art, education, and social life. And when our perspective on the world changes, the world changes. The great Brazilian educator Paulo Freire asserts, in his *Pedagogy of the Oppressed*, that saying a true word is equivalent to the transformation of the world.

In other words, our approach is not hierarchical. There is no fundamental level. But its absence does not mean an anarchical dynamics, but a coherent one, of all levels of Reality, already discovered or which will be discovered in the future.

Every level is characterized by its *incompleteness*: the laws governing this level are just a part of the totality of laws governing all levels. And even the totality of laws does not exhaust the entire Reality: we have also to consider the Subject and its interaction with the Object.

The zone between two different levels and beyond all levels is a zone of non-resistance to our experiences, representations, descriptions, images, and mathematical formulations. Quite simply, the transparency of this zone is due to the limitations of our bodies and of our sense organs - limitations which apply regardless of what measuring tools are used to extend these sense organs. We therefore have to conclude that the topological distance between levels is finite. However this finite distance does not mean a finite knowledge. Take, as an image, a segment of a straight line - it contains an infinite number of points. In a similar manner, a finite topological distance could contain an infinite number of levels of Reality. We have work to do till the end of times.

This open structure of the unity of levels of Reality is in accord with one of the most important scientific results of the twentieth century concerning arithmetic, the theorem of Kurt Gödel, which states that a sufficiently rich system of axioms inevitably leads to results which are either undecidable or contradictory. The implications of Gödel's theorem have considerable importance for all modern theories of knowledge, primarily because it concerns not just the field of arithmetic, but all of mathematics which include arithmetic. The Gödelian structure of levels of Reality implies the impossibility of a self-enclosed complete theory. Knowledge is forever open.

The zone of non-resistance corresponds to the sacred - to that which does not submit to any rationalization. Proclaiming that there is a single level of Reality eliminates the sacred, and self-destruction is generated.

The unity of levels of Reality and its complementary zone of non-resistance constitutes what we call the transdisciplinary Object.

Inspired by the phenomenology of Edmund Husserl, I assert that the different levels of Reality are accessible to our knowledge thanks to the different levels of perception which are potentially present in our being. These levels of perception permit an increasingly general, unifying, encompassing vision of Reality, without ever entirely exhausting it.

As in the case of levels of Reality, the coherence of levels of perception presupposes a zone of non-resistance to perception.

The unity of levels of perception and this complementary zone of non-resistance constitutes what we call the *transdisciplinary Subject*.

In a rigorous way, we see that "levels of perception" are, in fact, *levels of Reality of the Subject*, while "levels of Reality" are, in fact, *levels of Reality of the Object*. Both types of levels imply resistance.

The two zones of non-resistance of transdisciplinary Object and Subject must be identical for the transdisciplinary Subject to communicate with the transdisciplinary Object. A flow of consciousness that coherently cuts across different levels of perception must correspond to the flow of information coherently cutting across different levels of Reality. The two flows are interrelated because they share the same zone of non-resistance.

Knowledge is neither exterior nor interior: it is simultaneously exterior and interior. The studies of the universe and of the human being sustain one another.

The zone of non-resistance plays the role of a *third* between the Subject and the Object, an Interaction term, which acts like a secretly included middle which allows the unification of the transdisciplinary Subject and the transdisciplinary Object while preserving their difference. In the following I will call this Interaction term the Hidden Third.

Our ternary partition { Subject, Object, Hidden Third } is, of course, different from the binary partition { Subject vs. Object } of classical realism.

The emergence of at least three different levels of Reality in the study of natural systems - the macrophysical level, the microphysical level and cyber-space-time (to which one might add a fourth level - that of superstrings, unifying all physical interactions) - is a major event in the history of knowledge.

Based upon our definition of levels of Reality, we can identify other levels than the ones in natural systems. For example, in social systems, we can speak about the individual level, the geographical and historical community level (family, nation), the cyber-space-time community level and the planetary level.

Levels of Reality are radically different from levels of organization as these have been defined in systemic approaches. Levels of organization do not presuppose a discontinuity in the fundamental concepts: several levels of organization can appear at one and the same

level of Reality. The levels of organization correspond to different structures of the same fundamental laws.

The levels of Reality and the levels of organization offer the possibility of a new taxonomy of the more than 8000 academic disciplines existing today. Many disciplines coexist at one and the same level of Reality even if they correspond to different levels of organization. For example, Marxist economy and classical physics belong to one level of Reality, while quantum physics and psychoanalysis belong to another level of Reality.

The existence of different levels of Reality has been affirmed by different traditions and civilizations, but this affirmation was founded either on religious dogma or on the exploration of the interior universe only.

The transdisciplinary Object and its levels of Reality, the transdisciplinary Subject and its levels of perception and the Hidden Third define the transdisciplinary model of Reality. Based on this ternary structure of Reality, we can deduce other ternaries of levels which are extremely useful in the analysis of concrete situations:

- Levels of organization - Levels of structuring - Levels of integration
- Levels of confusion - Levels of language - Levels of interpretation
- Physical levels - Biological levels - Psychological levels
- Levels of ignorance - Levels of intelligence - Levels of contemplation
- Levels of objectivity - Levels of subjectivity - Levels of complexity
- Levels of knowledge - Levels of understanding - Levels of being
- Levels of materiality - Levels of spirituality - Levels of non-duality
- Allow me to make now some historical considerations concerning the idea of levels of reality

I formulated this idea already in 1976, during a post-doctoral stay at Lawrence Berkeley Laboratory, after stimulating discussions with Geoffrey Chew, the founder of the bootstrap theory and other colleagues. My main motivation was the fact that this idea offered a logical solution to the incompatibility between the theory of relativity and quantum mechanics. I interpreted this incompatibility as the necessity of enlarging the field of Reality, by abandoning the classical idea of a single level of Reality.

In 1981, I was interested by the idea of veiled reality of Bernard d'Espagnat, but I realized that his solution is not satisfactory and I therefore decided to publish my findings in an article published in 1982 and later, in an elaborated form, in 1985, in the first edition of my book *We, the particle and the world*.

In 1998, I had a big surprise to discover the idea of « levels of Reality », expressed in a different form, in a book by Werner Heisenberg, *Philosophy - The manuscript of 1942*. This book had a quite astonishing history: it was written in 1942 but it was published in German only in 1984. I read the French translation of the book in 1998. There is not yet, to my knowledge, an English translation of this book.

The philosophy of Heisenberg is based on two main ideas: the first is the notion of levels of Reality corresponding to different modes of embodying objectivity in terms of the respective process of knowledge and the second is the gradual erasing of the familiar concept of 3-dimensional space and 1-dimensional time.

For Heisenberg, reality is "the continuous fluctuation of the experience as captured by consciousness. In that sense, it can never be identified to a closed system [...]". By "experience", he understands not only scientific experiments but also the perception of the

movement of the soul or of the autonomous truth of symbols. For him, reality is a tissue of connections and of infinite abundance, without any ultimate founding ground.

"One can never reach an exact and complete portrait of reality" - writes Heisenberg.

The incompleteness of physical laws is therefore present in his philosophy, even if he makes no explicit reference to Gödel.

Heisenberg asserts many times, in agreement with Husserl, Heidegger and Cassirer (whom he knew personally), that one has to suppress any rigid distinction between the Subject and Object. He also writes that one has to renounce the privileged reference to the exteriority of the material world and that the only way to understand the nature of reality is to accept its division in regions and levels.

The similarity with my own definition of reality is striking, but the differences are also important.

By "region of reality" he understands a region characterized by a specific group of relations. His regions of reality are, in fact, strictly equivalent to the levels of organization of contemporary systemic thinking.

His motivation for distinguishing regions and levels of reality is identical to my own motivation: the break between classical and quantum mechanics.

Heisenberg classifies the numerous regions of reality in only three levels, in terms of the different proximity between the Object and the Subject. He deduces that the rigid distinction between exact and human sciences has to be abandoned, a fact which sounds very, very transdisciplinary.

Heisenberg's first level of reality corresponds to fields which embody objectivity in an independent way from the knowledge process. Classical physics, electromagnetism and the two theories of relativity of Einstein belong to this level.

The second level corresponds to fields inseparable from the knowledge process: quantum mechanics, biology, the sciences of consciousness (like psychoanalysis).

Finally, the third level corresponds to fields created in connection with the knowledge process. He situates there philosophy, art, politics, the metaphors concerning God, the religious experience and the artistic creative experience.

If the first two levels of Heisenberg totally correspond to my own definition, the third one mixes levels and non-levels (in other words, the zones of non-resistance). The religious experience and the artistic creative experience can not be assimilated to levels of Reality. They merely correspond to crossing levels in the zone of non-resistance. The absence of resistance and especially the absence of discontinuity in the philosophy of Heisenberg explain the difference between his approach and mine. A rigorous classification of regions in levels can not be obtained in the absence of discontinuity.

Heisenberg insists on the crucial role of intuition: "Only an intuitive thinking - writes Heisenberg - could bridge the abyss between old and new concepts; the formal deduction is impotent in realizing this bridge [...]". But Heisenberg did not draw the logical conclusion concerning this impotence of formal thinking: only the non-resistance to our experiences, representations, descriptions, images or mathematical formalisms can bridge the abyss between two levels. This non-resistance restores the continuity broken by levels.

c. The logical axiom: the included middle

The incompleteness of the general laws governing a given level of Reality signifies that, at a given moment of time, one necessarily discovers contradictions in the theory describing the respective level: one has to assert A and non-A at the same time. This Gödelian feature of the transdisciplinary model of Reality is verified by all the history of science: a theory leads

to contradictions and one has to invent a new theory solving these contradictions. It is precisely the way in which we went from classical physics to quantum physics.

However, our habits of mind, scientific or not, are still governed by the classical logic, which does not tolerate contradictions. The classical logic is founded on three axioms:

1. *The axiom of identity:* A is A.
2. *The axiom of non-contradiction:* A is not non-A.
3. *The axiom of the excluded middle:* There exists no third term T ("T" from "third") which is at the same time A and non-A

Knowledge of the coexistence of the quantum world and the macrophysical world and the development of quantum physics have led, on the level of theory and scientific experiment, to pairs of mutually exclusive contradictories (A and non-A): wave and corpuscle, continuity and discontinuity, separability and non-separability, local causality and global causality, symmetry and breaking of symmetry, reversibility and irreversibility of time, and so forth.

The intellectual scandal provoked by quantum mechanics precisely consists in the fact that the pairs of contradictories that it generates are actually mutually exclusive when they are analyzed through the interpretive filter of classical logic.

However, the solution is relatively simple: one has to abandon the third axiom of the classical logic, imposing the exclusion of the third, the included middle T.

History will credit Stéphane Lupasco (1900-1988) with having shown that the logic of the included middle is a true logic, mathematically formalized, multivalent (with three values: A, non-A, and T) and non-contradictory.

In fact, the logic of the included middle is the very heart of quantum mechanics: it allows us to understand the basic principle of the superposition of "yes" and "no" quantum states.

Heisenberg was fully conscious of the necessity of adopting the logic of the included middle. "There is - writes Heisenberg - a fundamental principle of classical logic which seems to need to be modified: in classical logic, if one assertion has a meaning, one supposes that either this assertion or its negation has to be true. Only one of the sentences "There is a table here" and "There is no table here" is true: *tertium non datur*, i.e. there is not a third possibility and this is the principle of the excluded middle. [...] In quantum theory, one has to modify this law of the excluded middle. If one protests again any modification of this basic principle, one can immediately argue that this principle is implicated in the ordinary language [...]. Consequently, the description in ordinary language of a logical reasoning which does not apply to this language would mean simply a self-contradiction."

Our understanding of the axiom of the included middle - there exists a third term T which is at the same time A and non-A - is completely clarified once the notion of "levels of Reality", not existing in the works of Lupasco, is introduced.

In order to obtain a clear image of the meaning of the included middle, let us represent the three terms of the new logic - A, non-A, and T - and the dynamics associated with them by a triangle in which one of the vertices is situated at one level of Reality and the two other vertices at another level of Reality. The included middle is in fact an *included third*. 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. It is inherently self-destructive if it is completely separated from all the other levels of Reality. A third term which is situated at the same

level of Reality as that of the opposites A and non-A, cannot accomplish their reconciliation. Of course, this conciliation is only temporary. We necessarily discover contradictions in the theory of the new level when this theory confronts new experimental facts. In other words, the action of the logic of the included middle on the different levels of Reality induces an open structure of the unity of levels of Reality. This structure has considerable consequences for the theory of knowledge because it implies the impossibility of a self-enclosed complete theory. Knowledge is forever *open*.

The logic of the included middle does not abolish the logic of the excluded middle: it only constrains its sphere of validity. The logic of the excluded middle is certainly valid for relatively simple situations, for example, driving a car on a highway: no one would dream of introducing an included middle in regard to what is permitted and what is prohibited in such circumstances. On the contrary, the logic of the excluded middle is harmful in complex cases, for example, within the economical, social, cultural, religious or political spheres. In such cases it operates like a genuine logic of exclusion: good or evil, right or left, heaven or hell, alive or dead, women or men, rich or poor, whites or blacks. It would be revealing to undertake an analysis of xenophobia, racism, apartheid, anti-semitism, or nationalism in the light of the logic of the excluded middle. It would also be very instructive to examine the speeches of politicians through the filter of that logic.

There is certainly coherence among different levels of Reality, at least in the natural world. In fact, an immense self-consistency - a cosmic bootstrap - seems to govern the evolution of the universe, from the infinitely small to the infinitely large, from the infinitely brief to the infinitely long. A flow of information is transmitted in a coherent manner from one level of Reality to another in our physical universe.

The included middle logic is a tool for an integrative process: it allows us to cross two different levels of Reality or of perception and to effectively integrate, not only in thinking but also in our own being, the coherence of the Universe. The use of the included third is a transformative process. But, at that moment, the included third ceases to be an abstract, logical tool: it becomes a living reality touching all the dimensions of our being. This fact is particularly important in education and learning.

It is important to note that the combined action of the ontological and logical axioms engender the notion of *paradox*. The paradox is the suspension of the contradictories (A, non-A) in the space between two levels of Reality. Therefore, there is no need to introduce paradox as a 4th axiom of transdisciplinarity.

Recent findings in the physiology of the brain give a particularly deep understanding of the action of the included middle. High technology tools, like the single photon emission computed tomography, allow to rigorously visualizing the blood flow patterns in the brain during so different activities like solving a mathematical problem or Zen meditation. Different specialized zones of the brain are now identified. Of course, the notion itself of "reality" is empty without the brain participation. This does not necessarily mean that the brain creates reality. Merely we can say that we have inside ourselves an apt apparatus of perceiving reality.

Based on these neurophysiological discoveries, Andrew Newberg and Eugene d'Aquili introduced a series of *cognitive operators*, which describe the general functions of the human mind. Between them, of particular interest for us are the binary operator and the holistic operator.

The binary operator means the "human brain's ability to reduce the most complicated relationships of space and time to simple pairs of opposites - above and below, in and out, left and right, before and after, and so on" and it "gives the mind a powerful method of analyzing external reality". The brain constructs in such a way, during the evolutionary process, a binary representation of the world, very useful for survival in a hostile environment. However, culture extended this binary representation, in terms of exclusive contradictories, to ethical, mythological and metaphysical representations, like good and evil, the space-time background of such representations being erased. The binary operator

describe, in fact, the neurological operations of the inferior parietal lobe. The classical logic is a product of the inferior parietal lobe.

In its turn, the *holistic operator* "allows us to see the world as a whole. [...] The holistic operator most likely rises from the activity of the parietal lobe in the brain's right hemisphere." The holistic view is also a product of the evolutionary process. When our ancestors were confronted with a wild animal, the binary representations were not sufficient for survival. If our ancestors spent their time in analyzing the different parts of the wild animal and the associated pairs of the mutually exclusive contradictories, they would be simply killed and we would not be here to think about excluded or included middle. The holistic operator erases contradictories and therefore is connected with the action of the included middle.

We can today seriously, scientifically speak about a "neurology of transcendence" and a new discipline is now built - the "neurotheology". I had the opportunity to meet one of the founders of these new approaches, Andrew Newberg, and I can testify that the respective researchers are far from being adepts of reductionism. They do not try to reduce transcendence or religion to neurophysiology, but they offer a scientific framework for discussing so subtle matters and performing useful transdisciplinary links between science, religion, art, mythology and philosophy. Notions like "levels of Reality" or "included middle" could very much help them to perform new discoveries.

d. The complexity axiom: the universal interdependence

There are several theories of complexity. Some of them, like the one practiced at the Santa Fe Institute, with the general guidance of Murray Gell-Mann, Nobel Prize of Physics, are mathematically formalized, while others, like the one of Edgar Morin, widely known in Latin America, are not.

In the context of our discussion, what is important to be understood is that the existing theories of complexity do not include either the notion of levels of Reality nor the notion of zones of non-resistance. However, some of them, like the one of Edgar Morin, are compatible with these notions. It is therefore useful to distinguish between the *horizontal complexity*, which refers to a single level of reality and *vertical complexity*, which refers to several levels of Reality. It is also important to note that *transversal complexity* is different from the vertical, transdisciplinary complexity. Transversal complexity refers to crossing different levels of organization at a single level of Reality.

In a paradoxical way, in fundamental physics, complexity is embedded in the very heart of simplicity. Indeed, popular works state that contemporary physics is a physics where a wonderful simplicity rules (in fact, more rigorously said, *simplicity* rules), through fundamental "building-blocks" - quarks, leptons, and messengers of the physical interactions. But for physicists working inside physics, the situation appears as infinitely more complex.

For example, according to the superstring theory in particle physics, physical interactions appear to be very simple, unified, and subordinate to general principles if they are traced within a multidimensional, 11-dimensional space-time (10 dimensions of space and 1 dimension of time) and involve an incredible energy, corresponding to Planck's mass. But complexity appears at the moment of describing our familiar world, which is characterized by four dimensions and by low energies. Unified theories are at their strongest at the level of general principles, but they are very poor at describing the complexity on our own level of reality. It is interesting to note in passing that the superstring theory has emerged thanks to string theory, which in turn emerged from the *bootstrap theory*, which embodies a particular form of the old principle of universal interdependence. Bootstrap describes not only the interdependence of all existing particles, but also of the general laws of physics.

From a transdisciplinary point of view, complexity is a modern form of the very ancient principle of universal interdependence. This recognition allows us to avoid the current confusion between complexity and complication. The principle of universal interdependence

entails the maximum possible simplicity that the human mind could imagine, the simplicity of the interaction of all levels of reality. This simplicity can not be captured by mathematical language, but only by symbolic language. The mathematical language addresses exclusively to the analytical mind, while symbolic language addresses to the totality of the human being, with its thoughts, feelings and body.

It is interesting to note that the combined action of the ontological, logical and complexity axiom engenders values. Therefore, there is no need to introduce values as a 4th axiom. The transdisciplinary values are neither objective nor subjective. They result from the Hidden Third, which signifies the interaction of the subjective objectivity of the transdisciplinary Object and the objective subjectivity of the transdisciplinary Subject.

3 - Paths of the Future

Nobody can predict the future. In the transdisciplinary approach, our linear time "past-present-future" is an anthropomorphic construction, a crude approximation of the *living time*. The living time is linked to the intersection of the space-times associated with all the levels of Reality. We can decipher the traces of the future in the sand of the present moment if we decide to open our eyes. In that sense I speak about "paths of the future" and not "paths for the future". Everything exists in the present moment, and the past and the future.

After a long hibernation of a quarter of century after Piaget, transdisciplinarity is experiencing an accelerated movement in the 90's. Today, transdisciplinary activities are flourishing in many parts of the world. Transdisciplinary institutes, associations and networks are being created in Brazil, in France, in Italy, in Canada, in Romania, in South Africa, in Switzerland. Important international conferences dedicate entire sessions on transdisciplinarity, in Russia, in Turkey, in Canada, in Austria, in USA, in Holland and in other countries. Transdisciplinary magazines are published one after another in several countries and on the Web. A surprisingly big number of transdisciplinary books were published in the last few years, covering an amazingly diverse range of subjects, such as education, "science and religion" studies, economics, management, therapy, geography and landscape studies, post-colonialism, nursing, health social science, storybook activities for children or even studies of the work of Jacques Derrida from transdisciplinary point of view. Two editing houses in France and one in Brazil founded "Transdisciplinarity" series. A quite new phenomenon, transdisciplinary lectures are given in several universities in USA, in Spain, in Romania, in France, in Brazil and even transdisciplinary chairs are created.

We live now in a new period of the advancement of transdisciplinarity.

The theory of transdisciplinarity is fully developed. Now the time for action has arrived. In the past, our actions were concentrated in the field of education, a fact which is natural because of the central role of education in individual and social life. But now we have the ethical obligation to extend our activities in the scientific, social, political and spiritual sectors. Our individual and collective responsibility, of all of us, is therefore big.

Let me describe, in few words, what kind of actions are, in my opinion, of an urgent nature.

a. Development of transdisciplinary higher education

The transdisciplinary education, founded on the transdisciplinary methodology, allows us to establish links between persons, facts, images, representations, fields of knowledge and action and to discover the Eros of learning during our entire life. The creativity of the human being is conditioned by permanent questioning and permanent integration.

The epistemological aspects of transdisciplinarity presented above were studied, on a practical level, in 1997, at the International Congress held in Locarno "What University for Tomorrow? Towards the Transdisciplinary Evolution of Education", organized under the sponsoring of UNESCO, CIRET and the Government of Ticino. The Locarno Congress was based on the CIRET-UNESCO project on transdisciplinary education and on the Delors

Report. The participants adopted the Declaration of Locarno. Experiments conforming to the recommendations of the Locarno Congress were already made in different countries: Brazil, Canada, France, Romania, USA, Switzerland, Argentina and Spain. The Locarno Congress stimulated also a rich theoretical reflection, in particular on the invention of new methods of education in relation with the new technologies. En entire recent issue of the E-zine "Transdisciplinary Encounters" was dedicated to experiences in transdisciplinary education. Similar experiments were done, independently of the Locarno Congress, in different countries.

One of the important points is that we accumulated a lot of useful data from practical work, justifying one of the basic assumptions of the transdisciplinary education. In transdisciplinarity, we always talked about three types of intelligences: the analytical intelligence, the feeling's intelligence and the intelligence of the body. This idea is similar to the idea of multiple intelligences developed by Howard Gardner. The difference with the theory of Gardner is that we speak, in fact, about a new type of intelligence, founded upon the equilibrium between mind, body and feelings. The transdisciplinary education is an *integral education*. The person is therefore not confined to choose a job connected with his own type of intelligence, but he or she is able to perform his or her freedom of choice, through the internal flexibility between the three types of intelligence which, in fact, anybody possesses.

At the beginning, our claims sounded exotic, like a new utopia. It is very encouraging that recent scientific works in biology, as the one of Antonio Damasio, demonstrate the cognitive dimension of feelings and emotions. Also, in a very stimulating book, Jean-Louis Revardel showed the extraordinary pertinence of the axioms of transdisciplinarity in studying the universe of affectivity.

Another significant point is that important work on the formation of transdisciplinary educators was already performed, for example in Brazil, through the persistent and rigorous actions of CETRANS and several other Brazilian organizations and universities, in Romania and in France, due to the academic work performed at the University of Tours' and in other French universities.

In fact, networks of transdisciplinary educators are now present in different countries. They allow us to think of three new stages in transdisciplinary education.

First of all, it is important to introduce in as many as possible universities courses on transdisciplinarity. Of course, transdisciplinary courses are not very rare, but we know about only one example of course *on* transdisciplinarity, i.e. about the epistemological foundations and practical applications of transdisciplinarity. The Claremont Graduate University (CGU), one of the highest rated universities in United States, recently instituted a new transdisciplinary course requirement for all doctoral students. The mission of CGU is to prepare a diverse group of outstanding individuals to assume leadership roles in the worldwide community through teaching, research and practice in selected fields. At Claremont, all PhD students must now take a "T course" ("T" for "transdisciplinary") sometime in the first two years of their program. CGU already has a rich tradition of transdisciplinary activities. There are already two transdisciplinary chairs at CGU. The example of CGU can be followed by many other universities, of course by adaptation to the local conditions.

A second important development would be the creation of a PhD in transdisciplinary studies. There are several examples of transdisciplinary PhD thesis, but they are all performed in a given discipline. There is even a PhD thesis in philosophy, on the foundations of transdisciplinarity. However, the time has now arrived to create a specific PhD, in transdisciplinary studies. It will create the appropriate space for academic studies and also for social action in the field of transdisciplinarity. It will also allow students with transdisciplinary interests to find an appropriate place to accomplish their research. The very prestigious Stellenbosch University in South Africa is at an advanced stage of creating such a PhD. We have the pleasure of having an important delegation from South Africa

present at this Congress and we will be happy to hear their thoughts on such an important initiative.

A third important development would be the creation of a Virtual Global Transdisciplinary University. This can be realized, due to the existence of transdisciplinary networks in several countries and due to extraordinary advancement of informatics today.

But about all these aspects on the development of transdisciplinary higher education we will hear more in the following days of the Congress, and especially on September 11th.

b. Towards a human model of health

In many contemporary societies, the human being is more and more a collection of numbers, codes and electronic files. The physical body itself is seen as a juxtaposition of genes, cells, neurons and internal organs, each organ and part of this organ being under the control of super-specialists who do not communicate between them. Of course, high technology treats these organs, prolonging our life, and nobody can complain about this positive fact. However, no high technology can treat the entirety of the human being.

In this context, transdisciplinarity can contribute to the emergence of a new health system. One might think that this is again a utopia, an unnecessary luxury. However, empirical data accumulated show that transdisciplinary teams, acting in the field of health, can bring about a better quality health care system - a system which succeeds in simultaneously satisfying our bodily, mental and psychical needs whilst, at the same time, reducing the costs of having to treat all the different maladies and disorders.

Very interesting transdisciplinary experiences were performed in Québec, in Canada, where the Institute for Health Research of Canada (IRSC) is assisting such initiatives. Here I can mention the activities of the transdisciplinary team of Patrick Loisel, Professor of Medicine at the University of Sherbrooke, acting in the field of workplace handicaps, which affect more than one million of Canadians per year as well as the transdisciplinary team of Daniel Boisvert, Professor at the University of Québec at Trois Rivières, acting in the field of intellectual deficiencies, which affect more than one million persons in Québec and France. Interestingly enough, these experiences directly show the pertinence, on a very concrete level, of the three pillars of transdisciplinarity. We will hear more about such important experiences during this congress.

Let me also say that almost everywhere we are witnessing an institutional attack against psychiatry and psychoanalysis. The predominant opinion is that psychical disorders are the result of the body's secretions and of the bad functioning of neurotransmitters and therefore psychiatry and psychoanalysis could be, at best, a branch of neurophysiology. This is a clear demonstration of mechanistic thinking and of reductionism. In accord with its notions of levels of Reality and included middle, transdisciplinarity can change this dangerous situation. The psychical level is, from a transdisciplinary point of view, a different level from the one of organic cells. The couple of contradictories (depressed, non-depressed) is unified by the included middle, acting at the level of the human person, accepting, as a stage of the interior development of the being, his or her moral suffering.

c. Scientific studies on consciousness

"Consciousness" was, a few years ago, a forbidden word in scientific research, as a kind of magic reminiscence. However, scientists began slowly to recognize that there is a missing link between neurons and the human being. John Eccles, Nobel Prize of Physiology and Medicine, is amongst the pioneers in this regard. I had the opportunity to exchange views with him at the Vatican in 1992, when we participated together at the plenary session of the Pontifical Academy of Sciences dedicated to the emergence of complexity in mathematics, physics, chemistry and biology. We discussed an interesting paper he had just published in collaboration with a quantum physicist and in which he tried to show that quantum processes are certainly important in the functioning of the brain. From that time, other researchers in neurophysiology and quantum physics followed this path.

Like quantum mechanics, the scientific theory of consciousness will certainly be a collective creation. It is important to create transdisciplinary teams involving neurophysiologists, physicists and other disciplinary specialists of exact and human sciences, animated by a transdisciplinary attitude. Brain and mind, like anything in this world, involve different levels of Reality and perception. I am personally convinced that consciousness is the ultimate frontier of the science and of the philosophy of 21st century and that transdisciplinarity has very much to contribute to this advancement of science.

d. Dialogue between science and religion

The transdisciplinary model of Reality allows us to define three types of meaning:

1. *Horizontal meaning* - i.e. interconnections at one single level of Reality. This is what most of the academic disciplines do.
2. *Vertical meaning* - i.e. interconnections involving several levels of Reality. This is what poetry, art or quantum physics do.
3. *Meaning of meaning* - i.e. interconnections involving all of Reality - the Subject, the Object and the Hidden Third. This is the ultimate aim of transdisciplinary research: the dialogue between science and spirituality is its main axis.

It may seem paradoxical to speak about cultures and religions in transdisciplinarity, which seem to refer, by the word itself, to academic disciplines. However, the presence of the Hidden Third explains this fake paradox.

The crucial difference between academic disciplines on one side and cultures and religions on the other side can be easily understood in our approach. Cultures and religions are not concerned, as academic disciplines are, with fragments of levels of Reality only: they simultaneously involve one or several levels of Reality, one or several levels of perception *and* the non-resistance zone of the Hidden Third.

Technoscience is entirely situated in the zone of the Object, while cultures and religions cross all the three terms: the Object, the Subject and the Hidden Third. This asymmetry demonstrates the difficulty of their dialogue: this dialogue can occur only when there is a *conversion* of technoscience towards values, i.e. when the techno-scientific culture becomes a true culture. It is precisely this conversion that transdisciplinarity is able to perform. This dialogue is methodologically possible, because the Hidden Third crosses all levels of Reality.

Technoscience has a quite paradoxical situation. In itself, is blind to values. However, when it enters in dialogue with cultures and religions, it becomes the best mediator of the reconciliation of different cultures and different religions.

In this context, the dialogue between science and religion is particularly important. Many steps in this direction were performed in the last years, for example by the actions initiated by the Templeton Foundation, which involve very prestigious scientists.

This dialogue does not mean that science will become religious or that religion will become scientific. In transdisciplinarity, the *otherness* is a great source of deepening its own identity. By respecting the values of science, religion will become more tolerant and more open to the modern world and science will become more responsible for the destiny of the human being.

e. Creation of networks of networks

The existence of transdisciplinary networks is today a fact of life. Of course, this process will continue in the future.

The very existence of these networks signifies that the number of transdisciplinary experts is continuously increasing. These researchers are certainly not "experts" in the usual meaning of this word: they are not ultra-specialists of a very narrow discipline. However

they are transdisciplinary experts, because they have knowledge of the methodology of transdisciplinarity, because they are involved in practical applications of transdisciplinarity and because they are socially attached to transdisciplinary values. These transdisciplinary experts constitute the seeds of transdisciplinary local networks. These networks have to link in order to form networks of networks, crucially important for actions at a national or regional level. In the not too distant future, these different networks of networks will join in order to form a planetary network of networks, which will be the seed of the transdisciplinary culture.

The transdisciplinary culture is a necessity of our time, due to two contradictory facts: on one side, the inner evolution of knowledge and, on the other side, the process of globalization.

The inner evolution of knowledge is marked by the already mentioned disciplinary big-bang. It is therefore more and more difficult to understand the complexity of our world today and to take appropriate decisions: an expert in one discipline is ignorant of thousands and thousands of other disciplines. The decision-makers are confronted with this fact.

From another angle, globalization is requiring, by its own dynamics, to built bridges and links between different areas of knowledge and between different views of the world. If globalization is to be reduced only to the economic dimension, it will inevitably lead to new exclusions and a new form of slavery. Globalization with a human face, serving the human being, requires a transdisciplinary culture, able to harmonize different fields of knowledge, different cultures and different views of the world.

f. Create living sustainability examples

For the first time in the 4.5 billion year history of the Earth is there one species - the human species - that is consuming (and wasting) natural resources at a rate faster than what can be handled by the earth's ecological systems. The most explicit and hard-hitting current example in this regard is the reality of 'peak oil production'. In short, this means that for the first time in history we have reached a point where we can not extract more oil than what is available and that, from this point onwards, the rate of demand is always going to be greater than the rate of supply. Most experts believe that if we have not already reached 'peak oil', we will do so very soon. The implications of this reality for all of us are extremely far reaching. It will not be possible to find an alternative source of oil that allows us to keep on living as we do, but powered via some other source of energy. Surely, alternatives exist - solar, wind, coal, ethanol, biodiesel, hydrogen (only as carrier) etc. - but none can do what oil can do. What will have to give is the way we live, how we travel, where we locate people in our towns and cities, what we eat and what we wear. In other words, 'peak oil' may very well be the start of the post-oil civilization and it is imperative on all of us to create real-life examples of sustainable living.

In April 2005, I had the privilege of visiting the Lynedoch EcoVillage Development just outside Stellenbosch in South Africa where I witnessed such an emerging example in sustainable living. Lynedoch EcoVillage Development is a very good working example of an *integrated sustainable development* approach where strategies and action plans are being consciously pursued and implemented to *connect* social, economic and ecological objectives whilst incorporating technologies that spans the energy, water, waste, and sanitation and building materials fields. Lynedoch is also a learning and educational hub. As a socially mixed community - kept apart by years of racist policies and practices - it is organized around not only a child-centered learning precinct, but it is also home to the *Sustainability Institute* which offers a MPhil degree in Sustainable Development where students from across the African continent can learn about sustainability in action.

Although my visit was a brief one, I was left with a deep sense of having encountered a real-life example of where the principle of the included middle is not just talked about in theoretical terms, but where it is being pursued in all sorts of creative and practical ways. What Professor Mark Swilling and his wife Eve Annecke have managed to achieve in a relatively short period of five years is worthy of being replicated on different scales and in

many parts of the world. From a transdisciplinary point of view, if our aim is to not only understand the world, but to also find solutions to the complex problems facing us all today, including having to change the systems of reference which produce these problems, then we simply have no choice but to act decisively in our search for alternative, sustainable modes of living. In the 'Planetary Era' there is no one single, big problem - only series of overlapping, interconnected problems - what Edgar Morin so aptly described as a 'polycrisis'. How we as the human species are going to respond to these over the next decade or two might very well be decisive for our peaceful and continued existence on the Earth. From a transdisciplinary point of view, it is our duty and responsibility to use all the means at our disposal - spiritual, theoretical and practical - to find sustainable solutions to problems which, if remain unresolved, will affect each one of us on this beautiful planet ours - rich and poor, young and old, Muslim and Christian, believer and non-believer, male and female, North and South, West and East.

g. Building a new spirituality

"Spirituality" is a completely devaluated word today, in spite of its etymological meaning as "respiration", in an act of communion between us and the cosmos. There is a big spiritual poverty present on our Earth. It manifests as fear, violence, hate and dogmatism. In a world with more than 10000 religions and religious movements and more than 6000 tongues, how can we dream about mutual understanding and peace? There is an obvious need for a new spirituality, conciliating technoscience and wisdom. Of course, there are already several spiritualities, present on our Earth from centuries and even millennia. One might ask: why is there a need for a new spirituality if we have them all, here and now?

Before answering to this question, we must face a preliminary question: is a Big Picture still possible in our post-modern times? Radical relativism answers in a negative way to this question. However its arguments are not solid and logical. They are in fact very poor and obviously linked to the totalitarian aspect of the political and philosophical correctness expressed by the slogan "anything goes". For radical relativists, after the death of God, the death of Man, the end of ideologies, the end of History (and, perhaps, tomorrow, the end of science and the end of religion) a Big Picture is no more possible. For transdisciplinarity, a Big Picture is not only possible but also vitally necessary, even if it will never be formulated as a closed theory. We are happy that the well-known art critic Suzi Gablik, in her book *Has Modernism Failed?*, joined recently our point of view. The last chapter of her book is entitled "Transdisciplinarity - Integralism and the New Ethics". For her, the essential intellectual change of the last two decades is precisely transdisciplinarity. This change was anticipated by the big quantum physicist Wolfgang Pauli (1900-1958), Nobel Prize of Physics, who wrote fifty years ago: "Facing the rigorous division, from the 17th century, of human spirit in isolated disciplines, I consider the aim of transgressing their opposition [...] as the explicit or implicit myth of our present times."

The first motivation for a new spirituality is technoscience, with its associated fabulous economic power, which is simply incompatible with present spiritualities. It drives a hugely irrational force of efficiency for efficiency sake: everything which can be done will be done, for the worst or the best. The second motivation for a new spirituality is the difficulty of the dialogue between different spiritualities, which often appear as antagonistic, as we can testify in our everyday life. The new phenomenon of a planetary terrorism is not foreign to these two problems.

In simple words, we need to find a spiritual dimension of democracy. Transdisciplinarity can help with this important advancement of democracy, through its basic notions of "transcultural" and "transreligious".

The *transcultural* designates the opening of all cultures to that which cuts across them and transcends them, while the *transreligious* designates the opening of all religions to that which cuts across them and transcends them. This does not mean the emergence of a unique planetary culture and of a unique planetary religion, but of a new *transcultural and transreligious attitude*. The old principle "unity in diversity and diversity from unity" is embodied in transdisciplinarity.

Through the transcultural, which leads to the transreligious, the spiritual poverty could be eradicated and therefore render the war of civilizations obsolete. The transcultural and transreligious attitude is not simply a utopian project - it is engraved in the very depths of our being.

4 - CONCLUSIONS

In conclusion, the way is open toward a practical, concrete foundation of transdisciplinarity and we are all happy that the basis of such a foundation will be formulated here, in Brazil, through the *Vitória Declaration*.

It is not a coincidence that the 1st World Congress of Transdisciplinarity was organized in Portugal by the big painter Lima de Freitas.

It is not a coincidence that, ten years later, the 2nd World Congress of Transdisciplinarity is organized in Brazil and that we start our work on Independence Day.

It is not a coincidence that the *Vitória Declaration* will be adopted on September 11th.

We can merely speak of "objective hazard", by using the famous expression of André Breton.

I wish to express all our gratitude to those who make this congress possible and especially to Maria de Mello, Vitória de Barros and Américo Sommerman. I know what incredible efforts they made for more than two years now. The "material question" is more acute than ever. Nevertheless, they created an opportunity and it is over to all of us, present here, to transform this opportunity in a wonderful act of transdisciplinary creativity.

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