

## Transdisciplinarity, Yesterday and Today<sup>1</sup>

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### Abstract

In the first part, this paper intends to show some reasons for the advent of transdisciplinarity as a strategy of knowledge in the 21st century. In the second part, it develops the basis for a transdisciplinary attitude required to solve complex and contemporary problems, and to promote a new articulation among science, art, technology, and culture.

### 1. Symptoms and Causes of Transdisciplinarity

Knowledge production, especially since the emergence of universities at the end of the Middle Ages (Bologna, Oxford, Paris), is characterized by a pendulum movement: on the one hand, establishing and developing specialized and deepened disciplines and knowledge, and on the other, gathering those disciplines and knowledge in the same place and unifying their diverse and fragmented nature. It is a production that is created by systole and diastole, amplification and narrowing of knowledge. Modernity could not escape these movements: while knowledge was made vertical, amplifying specialization, it also drew them closer. This can be proven by countless examples: the intercommunication between art, science, and techniques in Leonardo da Vinci and Vesalio, in the 15th and 16th centuries; the 17th-century physicists and mathematicians (Galileo and Newton); the physician Galvani, who revolutionized electromagnetism by observing frogs; Darwin, a lover of coleopterons, who elaborated the Theory of Evolution even though he was not an expert in the field; the meteorologist Wagner, who in 1912 while looking at a world-map, “had the impression that Africa and America once formed a single continent,” and because of that was initially rejected by geographers; the physicist Schrödinger, who in the 1950s projected onto the biological organism the problem of physical organization and promoted cellular biology; the notions of “information” and “code,” proceeding from social praxis and juridical language, which migrated to biology to establish the notion of “genetic code;” the idea of “structure” that Jakobson elaborated for linguistics and that was helpful for Lévi-Strauss as he developed his structural anthropology; “cybernetics,” which results from the union of technical research meant to create auto-controlled machines with mathematical work inaugurated

by Church and Turing; 20th-century psychoanalysis, biochemistry, and anthropology; and information theory conceived by Shannon and Weaver at Bell Laboratories.

As Thomas Khun demonstrates in *The Structure of Scientific Revolutions*, it is that approximation and reorganization of the principles of knowledge, rather than their accumulation, that produced the development of science, culture, and society. And this approximation and reorganization owe less to discoveries and inventions than to new ways of looking at already existing content and knowledge. This view conveys different cognitive schematics, which pass through disciplines “with such virulence as to put them in a trance.”<sup>2</sup>

This virulence, “trance,” and shock, which pass through knowledge pushed by something beyond and below those disciplines, are symptoms of transdisciplinarity. Other symptoms are the tensions between disciplines and what lies outside them, as in nonsystematic knowledge, between the “expert” and the “generalist,” between longing for deeper knowledge while at the same time giving it unity to prevent it from pulverization; between “method” and “exploration.” Transdisciplinarity is not in one of those poles but the space between them, in the oscillation from one to another, and in its interchange and contagion. Contagions result in profound modifications to the structure of knowledge, and to methods and principles of disciplines, which are not often found in multi- and interdisciplinary approaches. Transdisciplinarity transfigures disciplines internally to bring them closer – not to destroy or deny them, as would pseudo-scientific holism, but to face complex contextualized problems and objects, like the ones that proliferate in the 21st century. But before delimiting what distinguishes transdisciplinarity, the repercussions and functions presently attributed to it, we need to point out some of its more recent causes, for they are forging new meanings for it, for the world and its new problems, for production and diffusion of knowledge required by the 21st century, and for ourselves.

The main reasons for the existence of transdisciplinarity today are the characteristics and sheer size of the challenges that we face in the new century. They are complex and radical problems that emerge and proliferate as much in the academy as outside it. Problems such as diversion of rivers to satisfy an increasing demand for energy; the violence of the metropolis and its expanded urbanization toward the country-

side; genetic manipulation; the cultural and economic effects of globalization; the environmental crisis; the overabundance of often conflicting information, approaches, and technologies (resulting in mechatronics, biochemistry, psycholinguistics, geo-processing, and bioinformatics); the changing nature of warfare since the First and Second World Wars; construction of ever more-technological artifacts, from armaments to surgical tools (namely missiles, magnetic resonance appliances, maritime oil platforms, robots, huge telescopes, satellites, and spaceships); increasingly powerful communication devices; increased verisimilitude of prototypes and simulation in computer games (as in the movements of dinosaurs in "Jurassic Park" and simulated conditions of "exploration" on Mars); and replacement of substantive human connection, freedom, and autonomy with transitory pleasures such as inflatable sex partners.

A second reason refers to the development and deepening of knowledge in several niche areas where it was fragmented, especially since the 18th century. Hyper specialization of knowledge culminates in the loss of its own object, as is the case in medicine where isolated studies of areas of the body led to a lack of understanding of the body as a total organism. Because of this problem, Oriental medicine found a place in the West's healthcare system. The desire to reunify knowledge, like the reconfiguration of the body as a totality, is symmetrically the opposite of the fragmentation of modern knowledge.

In its vertical dimension, hyper specialization stretches the limits of specialized knowledge, creating new communication channels, transferring methods from one discipline to another (as in physics-mathematics), creating new professionals and disciplines (such as mechatronics and biochemistry, videographers, cinéastes, astrophysicists, or geneticists). In this unexplored territory, we find transitory human, social, and natural phenomena of different dimensions and layers that are impossible to split or separate, reminding us, as did Gestalt in Bachelardian epistemology, or the corporal schematic of Merleau-Ponty, to stick to the problem of perception and the relationship between human beings and the world that surrounds them. Advanced study of a field (say, of perception) reaches the borders of another field to recover the notion that the whole prevails over the parts. Another example of the limits of hyper-specialization can be seen in the general theory of systems, in Maturana and Varela's autopoiesis theory, or in the theory of complexity, all of which are situated at the extremes of scientific and specialized knowledge and forced to interact with, and allow themselves to be contaminated by, realms outside their original systems. In summary, modernity dethroned theology, metaphysics, their sub- and supra-lunar hierarchic worlds, and the Aristotelian and medieval worlds, as sovereign forms of knowledge. Modernity replaces this knowledge with physics and its homogeneous, sensible, laboratorial, one-dimensional, and macrophysical universe. In reaching

microphysical and subatomic levels and further exploring the astrophysical universe, science was forced to break away from modern reductionism and determinism, opening itself to other disciplines and non-disciplinary knowledge; this was accentuated by pressures imposed by technology and its practical applications. However, although the deepening of knowledge creates disciplinary islands that lead to the transdisciplinary sea between them, it does not mean that we should suppress the islands. The transdisciplinary must live with the disciplinary, since they are interdependent, just as the life that circulates in the islands is crucial to the exploration and vitality of the sea between them.

A fourth reason for the current condition of transdisciplinarity is the recognition that it is essential for universities to interact with, and let themselves be contaminated by, their surroundings, to renovate their own objects of study more appropriately. What is at stake here, as Boaventura puts it in *Pela Mão de Alice (By Alice's Hand)*, is the acknowledgement that the university has lost its hegemonic position in knowledge production, since knowledge is produced, in large part (as in the case of art and technology), outside its walls. It is now up to the university to absorb new knowledge and promote a contagious relationship between academic and scientific thought.

Further reason for the need for transdisciplinarity is the shift of paradigms that has taken place inside the sciences, such as the crisis in classical physics, modern science, Cartesian epistemology and its basilar paradigms and procedures like reductionism, causality, simplicity (clear and distinct ideas and rules), and determinism. Quantum physics, for example, discovered gaps between several physical states and spaces, rather than continuity: the logic of the third included (where a third term is at the same time A and non-A) wave and particle, like the quantum; art and technique as the architecture,<sup>3</sup> the inseparability between subject and object, non-determinism, and rejection of a single level of reality thought to be always ruled by the same laws (as in the separation of the sub-atomic and supra-atomic reality). Biology, as Jacques Monod suggests in *Chance and Necessity*, promises to be the new knowledge base in Western thought, replacing physics, wherein chance, the imponderable, wholeness, complexity, and indeterminism are not only more accepted, but also allowed greater interaction with other scientific and extra-scientific fields. That indeterminism, full of disorder, is what is within our genome.

Until the early 1970s, the model we had for the human genome was of a well organized place, more or less static, where each gene had its right place, pre-assigned by its function. [But now] our genome resembles more of a storage room than a library, untidy, with no clear evidence of organization, full of accumulated stuff (the non-coding DNA), since almost nothing is thrown away, even if it has no use. Besides that, the human genome is dynamic, its pieces are shuffled, and change positions frequently, without any reason or rhyme.<sup>4</sup>

To the paradigm shift of the so-called hard sciences, we add the several levels of subjectivity and the fragmentation of modern man, cited by Freud and explored in psychoanalysis and philosophy, and by language, which is equally relativised, contextualized, and fragmented.

The takeover of science by technology and techno-science, which corresponds to the victory of the creature over its creator, displaced the privileged position of reason and Cartesian scientific methodologies, leading them to failure, making room for doubt of general and abstract logics, rationalities, and methodologies. Out of those doubts came reasons for devising new strategies to approach the real, including those not properly technological or pragmatic.

In addition to that failure, causes of transdisciplinarity are found in the swift obsolescence of tools of specialized knowledge, like those created by technology, techno-science, techno-culture, and pragmatism. On the one hand, transdisciplinarity produces instability and insecurity in the content of teaching and professional knowledge. On the other hand, it provokes pressure for acquiring extensive knowledge that is able to build a more enduring intellectual citizenship.

With that opening, we can perceive that there is not one truth but several, whether in the fields of science, nature, and life or in the humanities, art, and culture. The cultural and social cosmopolitanism of the early 21st century allows for approximation of different traditions and epistemological and social praxis, even antagonistic ones, and of conceptions of the world that exceed Western hermeneutics, Eurocentric rationality, the big theories, the scientific, artistic, moral, ethical, and religious systems. This broad diversity of social experiences can not be explained by a monolithic and universal theory, but only by a work of "translation" and transdisciplinarity that is able to create a mutual intelligibility between possible experiences, praxis, theories, and systems, without destroying individual identities. Without mutual translation and intelligibility, we are bound to maintain social and epistemological fragmentation and atomization and fall into post-modern relativism, which breaks new ground for imposition of heteronomous synthesis and systems, colonizers and destroyers of identity, and disciplinary and cultural differences.

From cosmopolitanism and multiculturalism arises the need to give meaning to modern knowledge and the world, leaving behind illusory certainty of the indelible march of progress and development of civilization. There is, therefore, under the tag of transdisciplinarity, an appeal to new meanings that lead it not only to design a "true description" of the world and technical progress, but also to bring science and the world of thought closer to wisdom, praxis, and action. Breaking disciplinary insularity also means to breach the boundary of opposite poles: the insularity of technique and science, on the one hand, and the insulation of philosophy and art, on the other. This implies, among other things, ethical and moral regulation. This appeal is subjacent to the appeal for

transdisciplinarity.

We point out here one last reason for transdisciplinarity nowadays: the evidence of savagery, the contra-appeal against the civilized ideal that mixes with ideas of progress, progress that never reaches most parts of the world. The presence of destruction, misery, and the total hecatomb of culture and the environment is more evident now, especially in the periphery and marginal regions of the Occident.<sup>5</sup>

## 2. Transdisciplinarity, University, and Culture

The transdisciplinary attitude is not new. It can be found in the Renaissance and Romanticism, in Leonardo da Vinci, Alberti, and Goethe. The term "transdisciplinarity," however, is recent and was coined by Jean Piaget in the First International Seminar on Pluridisciplinarity and Interdisciplinarity held at the University of Nice in 1970. At this conference, Piaget proposed the transdisciplinary model, which could go beyond interdisciplinary relations being discussed at the time. Not satisfied with "finding interactions or reciprocities between specialized researches, [Piaget] would place those connections within a total system, with no stable frontier between those disciplines." In 2000, Patrick Paul added to this total, global, hierarchical system of no stable frontiers between disciplines the concepts of order and disorder, the known and the unknown, rationality and imagination, conscious and unconscious, and formal and informal.

For Piaget, the focus is the interaction between the formal disciplinary sciences; to Jantsch and Boaventura Santos, the focus is interaction between those sciences, the human and the social, and on opening disciplinary knowledge to non-disciplinary knowledge, most notably in the fields of art and culture, which the academy absorbs only partially and with great strain. The relationship between academic-scientific knowledge and extra-academic and cultural knowledge is also problematic:

Well, the values associated with the scientific fields are exactly the ones with which the heavily bureaucratic structure of the university can assimilate, with inevitable losses for the arts and the cultural themes within the university. Therefore, the agenda that organizes the daily academic life of the university tends, more and more, to reinforce the imbroglia that can already be seen: whether the field of culture bends to the present rules in the management of knowledge and, consequently, whether it loses its identity, or whether it will be more and more pushed toward the periphery of the institution.<sup>6</sup>

Bringing transdisciplinarity to the university implies, therefore, reviewing its structure so as to create the conditions for assimilation of external culture and knowledge, and allowing itself to be contaminated by them.

In the Science and Tradition Congress (UNESCO, Paris,

1991), transdisciplinarity recognized the value of specialization but proposed surpassing it in such a way as to reassemble the unity of culture and find the inherent meaning of life. In 1994, in the First World Congress of Transdisciplinarity, held in Arrábida, Portugal, "transdisciplinarity acknowledges different levels of reality, ruled by different logics and laws." This attitude does not try to dominate the several other disciplines, but to open them all to what passes through and surpasses them, and reunite the exact sciences with humanities, arts, literature, poetry, and spiritual experience. It is transcultural in the sense that there is no privileged place from which to judge the other cultures. The bases for that "transdisciplinary attitude" are three: rigor (against possible detours), opening (for acceptance of the unknown, unexpected, and unpredictable), and tolerance (to the ideas and truths contrary to ours and to our discipline). Differing from interdisciplinarity and the "weak transdisciplinarity" proposed by Piaget, "strong transdisciplinarity" asserts itself by carrying on a dialog with areas of non-scientific knowledge, toward what is beyond those disciplines, non-disciplined knowledge, and other knowledge. It would imply, for example, the "ecology of knowledge," our "inverted extension," proposed by Boaventura Santos for these new-millennium universities.

To prevent turning transdisciplinarity into omniscient, divine, globalizing, holistic, generalizing, and superficial knowledge, we have to keep in sight which specializations to explore, the islands within which to navigate, the discourses and languages of disciplinary relevance, how to proceed with the exercise of translation, and where to build the reciprocal intelligibility between them, the third language, the meta-language, the concepts and the semantic or even metaphoric operation without which the work of the "translator" is impossible. This reciprocal, mutual intelligibility between the disciplines is needed to evaluate the interactive potential, defining possible alliances and hermeneutic operations between them, the possibilities for articulation and aggregation without which the "trans" is not achieved. Since it is not a method or a general theory *a priori*, but a procedure or attitude, we should always consider transdisciplinarity as a work of inter lingual or inter semiotic translation, of migration, of navigation and transport, of commerce, dialogue, change and interchange, between the visible and the invisible, art and science, tradition and the new emergent proprieties.

The premise and reason for the transdisciplinary work of translation is the transcultural consensus on the theory of the impossibility of a general theory. The multiplicity and diversity of the levels of reality, disciplines, and social-cultural practices prevent them from receiving broad translations that could entirely recover them. Not everything is inherently translatable, although there are lacunae, silences, and neglected spaces in those disciplines and practices that we are bound to make recognizable. What is possible to translate is that which each discipline, culture, and practice selects to expose to the "con-

tact zone" with other disciplines, cultures, and practice, which are not necessarily the most relevant and central elements of each area. Only the deepening of the work of translation and migration can bring out to the zone what is central and relevant, and what each experience and field of knowledge, at first, won't risk and give away. Without this interchange, we relapse into hegemonic, one-dimensional, totalitarian, and colonialist culture. Transdisciplinary work is, therefore, patient, respectful, and humble, starting peripherally at the borders of specific, local, and disciplinary knowledge. Each disciplinary and cultural practice must then decide what aspects, concepts, methods, and practices to make available to translation, to collective operation, to transdisciplinary and transcultural confrontation, and to help build with them the topoi and hermeneutic operators with which to populate the contact zones. Finally, those aspects, concepts, methods, and practices must be open, porous, and permeable to a functional, operative, and semantic pluri-dimensionality.

Finally, the translator should be a good representative of the disciplinary field or of the cultural group (that is, he must have good competence in his specific disciplines, move freely in its several levels, be strongly rooted in the practices and knowledge he represents, comprehend them deeply and critically in such a way as to find and to recognize their often hidden deficiencies, to cultivate the feeling of incompleteness and the motivation to search for other disciplines, knowledge, and cultural and social practices whose responses cannot be found within the field of specialization). Again, the "trans" requires disciplinary skill.

In addition to the already mentioned attitudes of vigor, openness, tolerance, and prudence, it is essential to cultivate the ability to listen, to benefit from errors and detours, to grasp concepts, and search for connections between one field and another (that is, a receptivity to the trans-exercise and an openness to concepts that allows them to be transported and inflected within a certain margin). The discourse that donates itself and that means to be transdisciplinary must do so keeping in sight a possible "translatability," and even motivating it.

The two fields between the translation can be seen, firstly, as the "source" or "destination." But as the interaction process begins, they both lose their positions and begin to act like two fields in unceasing dialogue and interaction, without original or final terms, endlessly talking to each other, as if at a café table, where a muthos is established, a plot, a net, albeit an intriguing one. And that café table, or the environment where the interlocution between the fields and its subjects is developed, configures itself as fluid, plasma, which is progressively created, molded, and cultivated by the interlocutors and by the changes and reciprocal contribution. We need to not only be attentive to fields that polarize changes but, above all, to caring about facilitating, to functioning as a battery between the diverse voltages of disciplines. For at a café table there is always room for one more, provided he comes to add to the

polyhedron of talking and to the plasma of liquids that convey it.

The disciplinary view leans forward rather than to the original disciplinary field, intending to identify the common point from which to give itself to the encounter with the other. *Intendere*, "stretch toward", is the proper attitude for the trans-, to agitate and challenge knowledge that is satisfied to rely on disciplinary safety. It is necessary to risk going across the desert, and as Brazilian writer Guimarães Rosa suggests in the "liso suçuarão," what anchors us in that departure time is where we want to arrive, more than the starting point. The fundamentals of transdisciplinary action lie more in the "guessed" horizon of a common arrival point than in the port from where the ship of individual disciplinary knowledge begins.

The "capacity to fecundate and mold knowledge" is the quality that must be pursued in the concepts and the discourses resulting from the transdisciplinary exercise. They must, while trans-, "go beyond" to mold the specific concepts from which they stem to unveil other truths, meanings, latitudes, and horizons, within which new meanings, concepts, and discourse can come to life. In the Greek sense of *aletheia*, concepts following this function produce truths, as they present emergent worlds and visions that were kept latent and inoperative. They indicate and point out, more than describe, contrary to the truth understood as adaequatio between representation and reality. Creating a new problem or a new approach to old problems enriches the concept of trans-view. And that novelty does not lie in the advent of new technologies or instruments, like those that succeed with the advent and successive progress of informatics, but, above all, freshness is to be found in a new view applied to the same objects and the arsenal of the past.

In addition to its fecundity, the properties and concepts generated in the transdisciplinary field must be open and porous to being contaminated, redone, and interacting with each other in such a way as to acquire new complexions and metaphors, losing the basilar, atomic, and indivisible units to form molecules and nets within which to acquire new meanings and functions. From the wandering, equivocations, and ambiguity of the discourse emerge the contagious and creative translation of a transdisciplinary environment that always involves, in my opinion, a detour. That ambiguity or opening of discourse to other interpretations and unexpected derivatives seems to me an essential property of transdisciplinarity. It moves away from the extremely disciplinary, hermetic, and specialized discourse that searches for rigor at any cost, drawing close to the notion of error as an "un-rooting" to be applied to concepts and disciplinary properties, and making them migrate, wander a little without direction.

There is not a general methodology, but one that is found in the given transdisciplinary problem. Transdisciplinarity involves a permanent heuristic and invention, and "rebels against" automatic transference of models or previous experi-

ences. There is a specific problem and context on which to build a bridge with available material and direct the resolution of the problem and knowledge in the agenda. Finally, we consider it an economic net that conforms to the object from the sea between the disciplines, and not a general net that is apt to solve any given problem.

#### Footnotes

- 1 This essay is part of our work in the research project Architecture, Humanism and Republic, developed in partnership with CNPQ/ Brazil. The author is director/president of the Instituto de Estudos Avançados Transdisciplinares da Universidade Federal de Minas Gerais, Belo Horizonte and teaches history, art, and architecture theory.
2. See Morin, Edgar. Educação e complexidade: os sete saberes e outros ensaios. São Paulo: Cortez, 2002, 49.
3. Working on that logic in architecture and conceiving it as "a dobradiça de um biombo;" see Brandão, Carlos Antônio Leite. Teoria Eletrônica. In: Interpretar Arquitetura: [www.arq.ufmg.br/ia](http://www.arq.ufmg.br/ia)
4. Pena, Sérgio. 2006. O genoma humano, Jorge Luís Borges e a Biblioteca de Babel: [cienciahoje.uol.com.br/48486](http://cienciahoje.uol.com.br/48486)
5. Those reasons were exposed, in an oral and summarized session, in the 3rd Week of Architecture in UFMG "Architecture: arc of knowledge", 29 May 2006, promoted by the Academic Directory of the School of Architecture of UFMG.
6. Fenati, Ricardo. 2006. Cultura e Universidade: [www.ufmg.br/dac](http://www.ufmg.br/dac)