

THE DIALECTICS OF PLASTICITY: A LUPASCIAN ANALYSIS

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Abstract: The concept of plasticity as proposed by Marc-Williams Debono is a major new development in the on-going search for sound principles linking science and art, physical systems and subjective meaning in an appropriate transdisciplinary manner. The plasticity of the human brain is a well-established principle in neuroscience. In this paper, I show that a strong ally for this objective is "logic in reality" (LIR), a recent extension of the logical system of Stéphane Lupasco, upon which Debono's system in part depends. I outline my approach that shows that the LIR dialectical logic and categorial ontology apply to the characteristics of plasticity both as a new epistemological paradigm and metaphysical principle. LIR makes possible a reconciliation of the irreducible epistemic aspects of plasticity and the contradictorial dynamics of emergent structures, where these are also viewed as complex evolving processes.

1. INTRODUCTION AND OBJECTIVE

The current glut of information of all kinds, due to the proliferation of the media and the Internet, is an everyday experience. The effects of this glut, negative as well as positive, have hardly begun to be analyzed, let alone understood. The appearance of valid general approaches to knowledge and the relations between the major branches of knowledge, especially, scientific and esthetic is more necessary than ever and should be welcomed and supported where possible.

The concept of plasticity, developed by M.W. Debono¹, is the basis for one such approach. Plasticity in Debono's acceptance is both a profound physical characteristic of the physical constitution of our world and an active process that, above all, links forms and content in relation to their apprehension by the human subject. Plasticity is not itself a system, but it is an essential part of the epistemology of all real systems. This paper will attempt to disentangle the logical, ontological and epistemological aspects of plasticity in the interest not only of its comprehension, but for its relevance to action in the moral domain.

My analysis of the characteristics of plasticity will be made with reference to the logical framework originally developed by S. Lupasco (Bucharest, 1900 - Paris, 1988) and used extensively by Debono, and to my up-dating and extension of this framework, which I call "logic in reality" (LIR). My book (2008)² takes into account recent developments in fundamental physics and cosmology, as well as in neuroscience. Plasticity is closely allied to transdisciplinarity in the acceptance of Basarab Nicolescu, and Lupasco logic has been called the "logic of transdisciplinarity", one of its "pillars".

¹ Debono, Marc-Williams. 2007. *Le concept de plasticité: un nouveau paradigme épistémologique* in DOGMA, February issue.

² Brenner, Joseph. 2008. *Logic in Reality*. Dordrecht: Springer.

More than simple concepts, plasticity and logic in reality are frameworks for analysis of a wide range of phenomena, processes and relations. The principles used are grounded in the best fundamental physics in order to reflect complex realities as closely as possible, and far more correctly than any system that includes, implicitly or explicitly, the principles of bivalent propositional logic and its modal variants. Among other things, my logic points toward a naturalization of both philosophy and metaphysics.

The objective of this paper is thus to make a contribution to the conceptualization and re-conceptualization of plasticity as they have been undertaken by M.W. Debono. As noted above, my approach to issues in plasticity will be based both on the original logical system of Lupasco and my version of it, but it also includes a critique of Lupasco's views in certain areas. I have tried, of course, to make this critique in a Lupascian spirit of constructive opposition! Plasticity will be familiar to readers of *PLASTIR*, but less so to others. I will attempt to show that this logical analysis can be useful to people interested in plasticity, in its search for a common language for science and art, and in transdisciplinarity, which aims at a principled unification of knowledge. My hope is that by establishing the relation between plasticity, transdisciplinarity and logic in reality, the concept of plasticity will become not only accessible to a broader audience, but a tool that can be used more frequently and effectively by its authors.

In constructing this paper for *PLASTIR*, my references are to books and articles that are in general readily accessible, but are primarily in English. Some but not all of the original books of Lupasco in French are in print. I conclude this Introduction by mentioning briefly my credentials, which are essentially those of experience and study, not of academic practice. I am a scientist, an organic chemist by training, who made a plunge into philosophy and logic after my retirement from gainful activity in the chemical industry. Poetry, in this case, the writing of poems, has been my companion *en route*, albeit a very inconstant one, with only occasional bursts of activity, such as the set of poems written for the combined *catalogue raisonné* and biography of my father, the American sculptor Michael Brenner (Lithuania, 1985 – Paris, 1969).

Gaston Bachelard, Jorge Luis Borges and Robert Blyth, who has written so knowledgably about Zen and haiku have been my mentors in poetics. In addition to Lupasco and Nicolescu, the paraconsistent logicians Graham Priest and Jean-Yves Béziau have been my mentors in logic, and in philosophy, Whitehead, Derrida, Sartre and Heidegger as well as Lupasco.

1.1 WHAT IS AT STAKE

Many people, even if they have a sense of the social and moral values of religious belief and practice, do not necessarily literally accept the dogmas of the supernatural and of eternal life or reincarnation that often accompany them. Nevertheless, they will hold, perhaps largely unconsciously, to such beliefs for strong emotional reasons, and because were they to refuse the existence some kind of sacredness in nature, even only as an appearance, they would have no justification for moral behavior. They would see no source for other non-physical values, in particular those of poetry and art.

The scientist, of course, is in a more favorable position since he does not need either the reality or the appearance of another world to carry out his or her work. Those scientists who are also believers have been able, by and large, to compartmentalize their religious beliefs and their sense of art and beauty such that they do not interfere with their research, although they may enhance its meaning.

At a point in the history of the world, however, where the mental stability of ordinary citizens is coming under increasing pressure from economic, political and environmental sources, the tendency to seek comfort in the most irrational aspects of thought and behavior is all too obvious. Many examples can be described as regressive, people seeking truth in both lost cults and new sects of one sort or another that are more or less invasive or totalitarian. The economic crisis of 2008-2009 has led to a boom in one business, that of "psychics" offering, at best, some distraction from overwhelming

material problems. We experience on a daily basis the degradation of culture, language and the capacity of people for simple reasoning.

Nicolescu suggests (2002)³ that what is sacred in the world is what is irreducibly real, but unfortunately, there is no general agreement on what constitutes the real. In fact, a clear division can be seen: some of the individuals characterized in the first paragraph above believe that what we see is an illusion or appearance, and that there is hidden non-physical world underlying it that is the true reality, and those in the second who believe the opposite, or both. As a moral and ethical imperative or strategy, it would be counterproductive to try to change people's belief in the supernatural to some kind of neo-rationalism or neo-materialism as it would be to try to convince realists that *their* beliefs were misguided.

Under these circumstances of a general incapacity for balanced thought, it is difficult to explain to people in what the value of a poem might consist, and what a work of art might be apart from the colors and figures of the physical image, virtual or real. Further, it is difficult to explain to both scientists and non-scientists, in the absence of a common language or guiding principle, what the logical values of the scientist and ethical and esthetic values have to do with one another, although vague intuitions are often to be found on both sides.

The introduction of the principle of plasticity by Debono⁴ is thus a major event in attempts to bridge this gap. Plasticity can be considered as both a physical property and an onto-epistemic process which looks at the real but non-obvious or non-actual aspects of both physical and cognitive phenomena. I believe it is an important step in the direction of a more widespread recognition of the congruence and convergence of science and poetry, and of scientists and poets. Debono has analyzed in detail what the potential social

³ Nicolescu, Basarab. 2002. *Manifesto of Transdisciplinarity*. Albany, N.Y.: State University of New York Press.

⁴ Debono, Marc-Williams. *L'ère des plasticiens*, Editions Aubin, 1996.

role of the poet could be, while avoiding any slippage toward the irrational that Nicolescu has warned against. In other words, as Nicolescu stated as early as 1985 (2002a)⁵, science does not have to *be* a religion, nor *vice versa* provided there is a framework for acceptance of the subjective objectivity of science and the objective subjectivity of religious and artistic tradition.

The task I have set for myself in this paper, in supporting the concept of plasticity, is thus a difficult one: I wish to show that all the non-material and emotional values of art, as well as the insights of science – Nicolescu has shown that the creativity involved is the same – can be described in a rigorous logical system such as LIR that is neither materialist or reductionist, nor the expression of (and this is the easier part) idealism or some form of *transcendental*/realism that leaves no room for the irrationality and inconsistency, not to say the contradictions, of real life.

I should emphasize that I am by no means saying that the great visionary poets and musicians such as Gerard Manley Hopkins or Bach were somehow misguided or wrong in their celebration of a “deity that does not exist”. I am saying that independent of their subject, which in any case existed in their imagination, their *poetry* is not transcendental, but is an integral part of our world as is science and the haiku poetry of Issa, who wrote about the fleas and lice that plagued him, and the rain that came through the cracks in the roof of his hut. As we will see, however, plasticity is in part a way of going beyond contradictions in an epistemological sense. The tension between plasticity, LIR and transdisciplinarity in this regard can lead, in my opinion, to further insights about all of them.

⁵ Nicolescu, Basarab. 2002a. *Nous, la particule et le monde*. Paris: Editions du Rocher. (Originally published by Éditions Le Mail, Paris, 1985).

1.2 THE NEED FOR A NEW DIALECTICS OF REALITY

Dialectics is not some dry method taught in musty schools of logic or promulgated as the dogma of a failed totalitarian ideology. It is an experiential methodology that can help deal with the problems associated with unfamiliar ideas and ways of reasoning. The linked ideas that will be discussed in this paper are 1) plasticity, as defined by Debono; 2) transdisciplinarity and 3) aspects of the logic of and in reality that apply to them both.

In his discussion of plasticity, Debono wishes to retain significant *transcendental perspective*⁶, in which it is understood that this is a form of reasoning (if it is, as it must be, totally honest), that describes phenomena *as if* some of their relations were non-physical, without falling into an idealist trap. This objective is fraught with difficulties and the possibilities of semantic drift, in which the entities involved may "take on", as it were, an ontological aspect to which they have no right. The problem is then to ascribe sufficient rigor to such concepts to avoid overstating the case. The function of dialectics of reality, then, is to accommodate the need for appearance of transcendence with physical immanence. In this article, I will show how the unfamiliar concepts of a non-standard, non-propositional logic and plasticity can be used in a transdisciplinary manner to achieve a further understanding of the relations involved in these areas.

With these thoughts in mind, I will proceed to develop my view of the complex dialectics of plasticity, which refers to two major aspects: 1) in what way plasticity is both a process and a fundamental structure of the world; and 2) how it develops in concert with the processes that instantiate dynamic opposition or antagonism at biological, cognitive and social levels of reality that also have their origin in the fundamental physical structure of the world.

⁶ Husserl's phenomenology and the Kantian conditions of knowledge of objects or conditions of possibility involve directly the knowing subject and not only ethics. Along these lines, Debono formalizes the essential plastic complexes that link the form or the experience to the evolving process of knowing (*évolution connaisante*) of the subject.

2. LOGIC IN REALITY (LIR)

LIR is a new kind of logic (Brenner 2008), based on the original work of Lupasco based in turn on the quantum mechanics of Planck, Pauli and Heisenberg, and subsequent developments of 20th century quantum field theory. Its axioms and rules provide a framework for analyzing and explaining real world entities and processes. The term “Logic in Reality” (LIR) is intended to imply both 1) that the principle of change according to which reality operates is a *logic* embedded in it, *the* logic in reality; and 2) that what logic really *is* or should be involves this same real physical-metaphysical but also logical principle.

2.1 COMPONENTS, AXIOMS, CALCULUS AND SEMANTICS

The major components of this logic are the following:

- The foundation in the physical and metaphysical dualities of nature
- Its axioms and calculus intended to reflect real change
- The categorial structure of its related ontology
- A two-level framework of relational analysis

LIR states that the characteristics of energy – extensive and intensive; continuous and discontinuous; entropic (tendency toward identity or homogeneity – 2nd Law of Thermodynamics) and negentropic (tendency toward diversity or heterogeneity – Pauli Exclusion Principle) – can be formalized as a structural logical principle of dynamic opposition, an antagonistic duality inherent in the nature of energy (or its effective quantum field equivalent) and accordingly of all real physical and non-physical phenomena – processes, events, theories, etc. (Lupasco 1987⁷). The overall theory is thus a metaphysics of energy and LIR is the formal, logical part of that metaphysical theory. LIR

⁷ Lupasco, Stéphane. 1987. *Le principe d'antagonisme et la logique de l'énergie*. Paris: Editions du Rocher. (Originally published by editions Hermann, Paris, 1951)

is a non-arbitrary method for including contradictory elements in theories or models whose acceptance would otherwise be considered as invalidating them entirely. It is a way to "manage" real contradiction, in a manner different from that of paraconsistent, inconsistency-adaptive and ampliative-adaptive logics, which deal with formal contradiction alone.

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

- LIR1:** *(Physical) Non-Identity:* There is no A at a given time that is identical to A at another time.
- LIR2:** *Conditional Contradiction:* A and $\text{non-}A$ both exist at the same time, but only in the sense that when A is actual, $\text{non-}A$ is potential, reciprocally and alternatively.
- LIR3:** *Included (Emergent) Middle:* An included or additional third element or T-state (T for "*tiers inclus*", included third term) emerges from the point of maximum contradiction at which A and $\text{non-}A$ are equally actualized and

potentialized, but at a higher level of reality or complexity, at which the contradiction is resolved.

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

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

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

The real-world elements involved are commonly termed 'facts' or extra-linguistic entities or processes in standard conceptions of reality. In the LIR calculus, developed by Lupasco and as far as I know used only by him, the reciprocally determined 'reality' values of the degree of actualization A , potentialization P and T-state T replace the truth values in standard truth tables. These values have properties similar to non-standard probabilities. When there is actualization and potentialization of logical elements, their non-contradiction is always partial. Contradiction, however, cannot take place between two classical terms that are rigorously or totally actualized or absolute, that is, where the axiom of non-contradiction holds absolutely. The consequence is that no real element or event can be rigorously non-contradictory; it always contains an irreducible quantity of contradiction.

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

2.2 ONTOLOGY

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

CATEGORIES OF LIR

Material

Energy/Quantum Field

Formal

Process

- Emergence, Closure and Downward Causation

Dynamic Opposition

- Separability and Non-Separability

Subject, Object and Subject-Object

T-state

In this ontology, the sole material category is Energy, and the most important formal category is Dynamic Opposition. From the LIR metaphysical standpoint, the elements of real systems, phenomena or processes in which real dualities are instantiated are *not* separated or separable! Real complex phenomena display a contradictory relation to or interaction between themselves and their opposites or contradictions. On the other hand, there are many phenomena in which such interactions are not present, and they, and the simple changes in which they are involved, can be described by classical, binary logic or its modern versions. The most useful categorial division that can be made is exactly this: 1) phenomena that show non-separability of the terms of the dualities as an essential aspect of their existence, at their level of reality; and 2) those that instantiate separability.

LIR thus approaches in a new way the inevitable problems resulting from the classical philosophical dichotomies, appearance and reality, as well as the concepts of space,

time and causality as categories with *separable categorial features*, including, for example, final and effective cause. Non-separability underlies the other metaphysical and phenomenal dualities of reality, such as determinism and indeterminism (see below), subject and object, continuity and discontinuity, and so on. This is a 'vital' concept: to consider process elements that are contradictorily linked as separable is a form of category error. I thus claim that non-separability at the macroscopic level, like that being explored at the quantum level, provides a principle of organization or structure in macroscopic phenomena that has been neglected in science and philosophy.

Stable macrophysical objects and simple situations, which can be discussed within binary logic, are the result of processes of processes going in the direction of non-contradiction. Thus, LIR should be seen as a logic applying to processes, to trends and tendencies, rather than to "objects" or the steps in a state-transition picture of change (Brenner 2005)⁸.

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

⁸ Brenner, Joseph E. 2005. Process in Reality; A Logical Offering. In *Logic and Logical Philosophy* 14: 165-202.

LIR thus applies to all real dualities, between either classes of entities or two individual elements. Inter and intra –level examples are theories and the data of theories, or facts and meaning, syntax and semantics. Others are interactive relations between elements, relations between sets or classes of elements, events, etc. and the descriptions or explanations of those elements or events. To repeat, LIR does not replace classical binary or multi-valued logics, including non-monotonic versions, but reduces to them for simple systems. These include chaotic systems which are not mathematically incomprehensible but also computational or algorithmic, as their elements are *not* in an adequately contradictory interactive relationship. Such relationships are characteristic of entities with some form of internal representation, biological or cognitive.

Philosophers critical of Lupasco, and accordingly of LIR, have questioned whether the alternating actualization and potentialization of a phenomenon and its antagonist or contradiction is part of reality or of subjective conceptualization. Given the grounding in physics that is available today, I believe we have a still better basis than Lupasco had for saying “both”. Real entities – objects, processes, and relations – are in this sense both objective and subjective, not devoid of an aspect of unreality, but one aspect will predominate at a given time over the other.

3. THE DEBONO CONCEPT OF PLASTICITY

The concept of plasticity, as developed by Debono, describes the properties of real systems at the basic inorganic material, biological, neurophysiological, cognitive and social levels. The term is a familiar one in various disciplines, including literature and art history, as well the science of materials. The extraordinary plasticity of the human brain is a major subject of current study. As Debono has pointed out, however, the term plasticity is polysemic and is often used in a loose or metaphoric manner, with little attention paid to the processes underlying it and their rich metaphysics. The papers referred to above⁹ show

⁹ Debono, Dogma 2007; Cosmopolis 2008/2: see next reference.

that plasticity itself is process that accompanies phenomena rather than another one of their emergent properties.

This process can link both irreversible forms and expressions, thus operating at both the ontological and epistemological levels of reality, going beyond their dualities. Debono has recently introduced the concept of “plastic complexes” (cf. footnote, page 6), whose, “auto-modeling” is an essential human activity. This constitutes a recent evolution of the theory, switching from the concept to the complex of plasticity and involving a direct binding or complexification at crucial levels (2008)¹⁰. Debono describes these complexes at the level of the matter (form-unformed-plasticity: FUP), of the mind: (neural-mental-plasticity: NMP), of the determination of systems (determined-undetermined-plasticity: CDVP) or at the level of the subject (alter-ego-plasticity: AEP), all being aggregated by plasticity or including plasticity as a binding or a chiasmatic point, a basic mechanism permitting physical complexification¹¹. In every cases, systems – not necessarily duals – are neither formed nor unformed, neither fruit of the chance nor of the necessity¹², but plastic. Plasticity is thus able to co-express or co-signify them, conferring stability on them and complexifying them into an irreversible shape.

Process and an interface ? How can something be both a process and an interface and what are the properties of the entities between which it is that interface? What does it mean for a concept or a complex to act as a link? These are all questions to which my logic of/in reality (LIR) offers the outline (*ébauche*, to use a “term of art”) of an answer.

Concepts in philosophy, “objects” of art and discoveries in science, including their epistemological aspects, are all emergent phenomena that would be conceivable without the multi-functionality of their respective substrates. This absence of a fixed set of forms or properties is what Debono attempts to capture with the term plasticity. A stem cell, for

¹⁰ « The complex of plasticity », Cosmopolis, Review of Cosmopolitic of the encyclopaedia Agora, 2008/2. See also Ref. 1 in DOGMA.

¹¹ Term not used in the meaning of complexity but to signify that plasticity is forming complexes.

¹² For living systems.

example, can be considered to have a high "*co-efficient*" of plasticity given its potential for developing into a large number of different types of an organism's cells.

In my interpretation, the Debono definition of plasticity, involving the absence of direct emerging properties *qua* epistemology, is not in conflict with LIR as a logic of ontological emergence. It is another perspective on reality, in which the emphasis is placed on the poetic dimension of existence, tying back to Lupasco's "poetic prehension of the universe". The perspectives of plasticity and LIR can be seen, also as being in a dialectical relation. I will return to the relation between Lupasco and LIR in Section 5 below. Before this, I will go briefly into the scientific foundation of plasticity which is equally essential for an understanding of its functionality.

3.1 ELASTICITY AND PLASTICITY

A key consideration for any discussion of the characteristics of plasticity, also for non-scientists, is its definition in physics, and this requires understanding the difference between plasticity and elasticity of physical materials. Elasticity is the property of a material to return reversibly to its original shape after application of a stress (to all intents and purposes, ignoring the microscopic changes that are inevitable in any real process). The elastic limit of a material is a threshold. Any further applied force causes a catastrophic transition to plastic flow, and the resulting deformation (strain) is permanent, up to and including total rupture. In my logical system, the new shape is an emergent phenomenon.

The value of these terms will depend on both their metaphysical and physical content, and I claim these cannot be separated. As I discuss further in Section 4.6, the application of these terms at higher levels of reality is non-metaphorical, describing changes in the real configurations in phase space of complex processes.

3.2 TRANSDISCIPLINARITY

Transdisciplinarity, in the definition of Nicolescu (2002) concerns that which is at the same time between, through and beyond all individual disciplines, the things they have in common. Its objective is the comprehension of the current world, of which one of the imperative necessities is a unity of knowledge. It is a theory that places the human being at the center of its preoccupations, and, in my opinion, this view has the greatest generality and is the one most suitable to discussing issues in science and philosophy as well as the social sciences and humanities, education, ethics and other aspects of social theory. A key event in the application of transdisciplinarity in education was the International Congress in Lugarno in 1997: "What University for Tomorrow? Towards a Transdisciplinary Evolution of the University." This event was sponsored by UNESCO and The International Center for Transdisciplinary Research in Paris.

The three conceptual "*pillars*" of transdisciplinarity in the Nicolescu acceptance are 1) levels of reality; 2) complexity; and 3); a logic of the *included* middle, from which, as noted above, LIR has been derived. The key relation between disciplinarity and transdisciplinarity is that disciplinary research tends to involve just one level of reality, while transdisciplinarity is concerned with the dynamics resulting from the interaction of several levels of reality or complexity at the same time.

Most people do not live, nor live by, the principle of transdisciplinarity as such in their daily lives. Thus, as complex a philosophical structure as that of transdisciplinarity will already be beyond the capability of most people to integrate into their understanding of what might or should be changed in their views of science and art. In addition, the philosophical system of Lupasco, in which both transdisciplinarity and plasticity find theoretical support, includes, in its discussion of affect, a dimension of "otherworldliness" upon which it is a complicated exercise to set proper boundaries. There is a risk of confusion with the least desirable components of received theological wisdom.

I have accordingly based the remainder of paper on the following main assumptions: 1) the concept of plasticity, as stated by Debono and as described further below, is “absolutely” essential to improving social and political dialogue; 2) an accessible and usable foundation of plasticity can be achieved by incorporating the basic insights of the Lupasco logic and the “logic of and in reality” that I have developed from it *without* reference to any a-rational aspects of the former; 3) a methodology of transdisciplinarity can be used that does not require reference to its most complex concepts, *e.g.*, the ontological and hidden included middle, zones of non-resistance to the flow of information and the *transdisciplinary* Subject-Object.

One model available for such an approach might be that of Zen practices, which depend almost entirely on the universal characteristics of the embodied human being, to use the term of George Lakoff, and his language, without the need for cultural or religious components. Another key reference is the work of the Nobel-prize winning chemist Roald Hoffman, who is also a prolific poet. In his book, *The Same and Not the Same* (1995)¹³, this essential dialectic concept is available and accessible. Most people, confronted with such a concept, nod sagely and say “Yes, things can be the same and different at the same time” or some such phrase. The logic I have described not only supports this concept but demands that people ascribe real meaning to it. “If they are the same and different, *how* are they so and what real (plastic) changes in one’s outlook does this require?”

With these ideas in mind, I will now call attention to a number of issues and phenomena to which the concept of plasticity applies, especially from the standpoint of the logic in reality. I will ask both how plasticity should be represented in a logical fashion as well as presented to people with specialized interests in one or more of the indicated topics. I will also show the specificity of plasticity, its differences from both transdisciplinarity and LIR. As the reader may guess, however, no absolute separation between presentation and representation is either necessary or desirable.

¹³ Hofmann, Roald. 1995. *The Same and not the Same*. New York: Columbia University Press.

4. THE RE-PRESENTATION OF PLASTICITY

4.1 THE PLASTICITY OF MANNER AND MEANING

It is well recognized that the standard concept of information is inadequate to capture its complex non-binary (non-Shannon) aspects that carry meaning, where meaning can be biological or cognitive. Levels of information correspond to levels of meaning, which, in LIR, are dialectically connected. Higher levels of meaning that are extracted from situations or artistic creations are clearly not fixed or static, but capable of undergoing changes of cognitive "shape". Plasticity thus provides a language for public referral to intellectual, emotional and artistic experiences and the changes they undergo. When one says that a task, for example, is carried out in a certain way or manner, there should be no barrier to assigning an appropriate form to this dynamic description.

We are at first sight far from science, at this point, but perhaps not from a "naturalized phenomenology" that attributes *some* regular structure to ideas such as manner or "spirit". If the *Zeitgeist* is indeed an entity emerging from the resolution of conflicting world-views (according to our preferred logical approach), then it can be assumed to display a certain variable form (according to our preferred plastic approach). Is the *Zeitgeist* nothing but an arbitrary metaphor for the feeling of a few individuals, an abstraction that is no more than a philosophical fiction?

The entities of fiction and imagination *qua* their non-existence have by now been well differentiated by Priest and others. They undergo no energetic change, are not causally efficacious and so on. They are in my terms *non*-processes. These properties by no means exhaust the possibilities of non-physical entities that exist in a physical context with which they interact and evolve. They are, in the dialectics of LIR, real and non-real and which aspect predominates will depend on the perspective chosen.

4.2. A FRAMEWORK FOR PLASTIC REASONING

The difficulties of disciplinary thinking and standard philosophical analysis suffer from the same kind of difficulties, including an adversary relation to competing or antagonistic theories or forms of thought. This rigidity, which in my view has nothing to do with the necessary scientific rigor¹⁴, is the opposite of what is needed for development from an ethical and intellectual standpoint. In other words, if one admits that one cannot “change the world”, what is the next best thing one can do, in the spirit of the Introduction?

From this standpoint, plasticity is a meta-model that refers to both plastic processes and thinking about such processes. The dialectics of Lupasco’s logic of the included middle and the logic in reality and categorial ontology that is derived from it authorize the existence of relations between epistemological, as well as physical levels, where the “lower” shares properties of the “higher” or more complex.

A possible task, then, for the reader, is for him or her to seek applications for the concept of plasticity and introduce them into common discourse and dialogue about issues in art, philosophy and science *in an appropriate context with appropriate interlocutors*. There is an enormous opportunity, if one is at all realistic, for loss of time and energy where there is no prior *terrain* for the acceptance of any of the basic ideas of plasticity, transdisciplinarity or LIR.

In a similar vein, Lucas (1990)¹⁵ stated something confirmed by my experience, namely, that the validity of LIR cannot be proved to any mechanist intent on rejecting it. But LIR can be seen as an addition to the armentarium of mentalists and realists for talking to any non-hide bound mechanist and reaching a Peircean consensus. LIR supports the

¹⁴ Rigor means to me avoiding anything that is arbitrary, gratuitous and/or merely metaphorical. Such statements leave LIR open to attack by my Aristotelian friends (I still have some).

¹⁵ Lucas, J.R.. 1990. Paper read to the Brighton Turing Conference, April 6, 1990, in Brighton, England. <http://users.ox.ac.uk/~jrlucas/Godel/brighton.html>

inherent irrationality of argument; the mind is, functionally, consistent and inconsistent, rational *and* irrational. But LIR is a way of avoiding the nihilism resulting from the apparent necessity of inherent contradictions in reason. Hope of rational discourse about such things as plasticity, transdisciplinarity and logic need not be abandoned, provided there is some minimum common ground, formal and/or informal. In my view, parts of sound arguments may always be informal in the sense of being valid but not capable of capture by any formalization.

4.3 MODEL-BASED REASONING

Magnani and Nersessian (2002)¹⁶ have recently developed a concept of “model-based” reasoning as a reaction to the obvious failure of descriptions of reasoning incorporating concepts of standard bivalent logic and its modal varieties. The target systems or processes of the models may be largely phenomena in which bivalent logic applies correctly, such as digital computation, but these authors correctly show that the reasoning about them cannot itself be entirely bivalent. The entity, constituted by a reasoning process and the model that describes it constitute, in my view, a further example of plasticity. Here, the constituents and their relations “move” with respect to one another and undergo changes in conceptual form.

As an epistemological process, reasoning involving the use of logic in reality is not science, which has its own methods and primary objects. The “output” of the reasoning process will not or not only be hard facts and firm conclusions, whatever they are, but also processes, trends and patterns of change, that is, embodiments of plasticity. In contrast to standard views, however, the behavior and properties of such systems do not have to be considered as *anti*-scientific or anti-realist, as they have, according to the postulates of LIR, an irreducible component of physical reality.

¹⁶ Magnani, Lorenzo and Nersessian, Nancy J. 2002. *Model-Based Reasoning*. Dordrecht: Kluwer Academic.

4.4 ON STRUCTURE AND FORM

As discussed in more detail in my book, standard views tend to reify structure and form and fail to provide adequate explanations of their evolution, seeing them as static entities. In addition, form is associated with a model of the universe in which geometry, or space, even in a relativistic sense, is considered primitive and energy and matter in their particle and field descriptions as derivative, with an inferior ontological status.

In the non-naïve dualism of LIR, energy and position are both fundamental and in a dialectic relationship *vis à vis* the constituents of the universe. Complex macroscopic entities cannot be separated from their forms, and both structures and forms are also processes, as Lupasco wrote in his 1967 monograph¹⁷. There is thus a close relation between the process view of structure and form and plasticity, which is another expression of the general dynamics of process phenomena and their forms.

It might be objected that one then would have to “see” ordinary objects in “constant” movement, which would be an obviously a mechanism of low survival value from an evolutionary standpoint. LIR thus does not go against common sense and common observation in providing for a “frozen” dialectic, in which the movement toward further actualization or potentialization is temporarily interrupted. Over a long enough time scale, of course, the most solid rock, and its form, can be viewed as a process. A plastic perspective is closely related to a general openness and avoidance of reification of complex processes, concepts or beliefs. It is a further basis for the tolerance of other and opposing views that is at the heart of the transdisciplinary attitude (Nicolescu, 2002).

¹⁷ Lupasco, Stéphane. 1967. *Qu'est-ce qu'une structure?* Paris: Christian Bourgois.

4.5 PLASTICITY "VS." TRANSDISCIPLINARITY AND LIR

Let me return to the definition of transdisciplinarity for a moment:

- Transdisciplinarity refers to what lies between, through and beyond individual disciplines.

Then, as far as plasticity is concerned:

- Plasticity refers to what between, through and beyond individual forms.

The logic that applies to both is the logic of the included middle, or LIR. The major difference between plasticity on the one hand, and transdisciplinarity and LIR on the other, is the following: the principle of dynamic opposition (PDO) as expressed in the Axioms of LIR (cf. Section 2.) describes *how* systems of real energetic entities, for example a cell and its environment, or two opposing theories, interact, evolve and can result in the emergence of new ones. This principle applies to all systems involving thermodynamic change, which are, of course, constituted by quantum particles and fields which are "*outside*" standard space-time and have the additional property of self-duality.

Plasticity, on the other hand, is a perfectly real, metaphysical property of the universe that "insures" that one can go from an original duality, say Being and non-Being, to our ordinary reality. Plasticity is thus in Debono's conception both an interface between energy and form (shape) and their metaphysical principle of co-existence (PCE) or co-signification (PCS) when the process is actualized. Plasticity focuses on the dualities of subject and object, "mind " and matter, innate and acquired and its description of the changes that take place are similar to that of LIR, in what Debono calls "restricted" or "reciprocal" plasticity. The component of plasticity that goes beyond these contradictory dualities is a *meta-plasticity* that focuses on the epistemology, that is, primarily the "processing" of the dualities by the human subject, such that the term co-signification for plasticity is also justified.

For me, the world exists as it does as a consequence of both plasticity and the LIR logic, both the PDO and the PCE or PCS. Both are fundamental, coming “just after”, ontologically speaking, the fact that anything exists at all, which is due to the co-existence of Being and non-Being. This might be an argument for making co-existence a more fundamental principle than dynamic opposition, but in LIR terms, if not others, such debate is otiose. I prefer to see the two principles and perspectives as of equivalent value and priority, dialectically connected, as are, in the same way, plasticity and meta-plasticity. Neither concept is totally devoid of aspects of its “partner”. The mind moves between the two as Lupasco originally described (1935)¹⁸ as it does between knowledge and knowledge of knowledge, knowledge as such and intuition, and knowledge and ignorance (non-knowledge).

4.6 THE PROBLEM OF METAPHOR

In my experience, statements about complex processes, *e.g.*, involving plasticity, are categorized as metaphors by critics with the specific (if often unconscious) intent of rejecting their real, dialectic content. As an example that should be easily grasped by readers familiar with plasticity, I might mention the American expression “bent out of shape” to describe a person who has been caused to be both very angry and very upset. It is easy to read this as a simple metaphor of his state, but I claim there are (at least) two important non-metaphorical meanings to this expression. One is that the person or a part of him, perhaps his back or hands, may well be significantly “*bent*”. In his “*body language*”, bent is thus an accurate non-metaphorical term for a change in shape that reflects the real tensions of the individual. The second is based on the concept of plastic, irreversible change in the form of the person’s personality, where the personality should be seen as a complex process in a space of high-dimensionality. Whatever the form of this personality prior to the event, it should be obvious that that form has changed plastically after it. This

¹⁸ Lupasco, Stéphane. 1935. *Du devenir logique et de l'affectivité* ; Vol. 1 : *Le dualisme antagoniste* ; Vol. 2 : *Essai d'une nouvelle théorie de la connaissance*. Paris: Vrin; 2nd edition 1973.

could readily be observed by noting aspects of behavior, availability for dialogue, reaction time and so on.

By remaining at the linguistic level of metaphor, it is easy for the critic to take, again literally and non-metaphorically, a separation or distance from the dynamics of the contradictory situation, in which, however, he is likely to be actually or potentially involved. In extreme cases, the attribution of metaphor can completely block a dialogue: one says that "grasped" or even "*dialectics*" are also metaphors, and further discussion or argument in good faith becomes impossible. One has reached, in the human sphere, a degree of absence of interaction that corresponds to the absolute *non*-contradictions of classical logic, the abstract limits that Lupasco showed could never be reached *provided* the situation was adequately contradictory or dialectically interactive.

The attribution of metaphor, therefore serves as a mechanism to avoid the dialectics, that is, any personal involvement or responsibility for the outcome. The lack of communication between individuals is thus not only a matter of not speaking the same language, but a rejection of the reality of non-absolute opinions, positions, etc. Seeing the other's point of view and behaving accordingly, in LIR, is logically and metaphysically as well as humanly necessary.

Metaphors, accordingly, belong in the domain of discourse about literary entities. A legitimate use of metaphor is described in a paper by Anthony Judge that, further, is in relation to transdisciplinarity¹⁹. However, metaphors have no useful role to play in philosophical discussions of real phenomena. In my view, it will be generally incorrect to consider that a description of a plastic process is *only* a metaphor; it should rather be stated, as it could be in my example, that the expression is *also* a metaphor.

¹⁹ Judge, Anthony. 1991. Metaphors as Transdisciplinary Vehicles of the Future. In *Congrès Science et Tradition: perspectives transdisciplinaires, ouvertures vers le XXIème siècle*. Paris: UNESCO. <http://www.laetusinpraesens.org/docs/transveh.php>

It is fair to ask, however, in view of the overall objective of a view of plasticity that is also *scientific*, what could be the non-metaphorical picture of the deformations involved at the cognitive level corresponding to those of plastic, elastic and visco-elastic materials (cf. Section 3. above)? It part of common discourse to say of someone that she is "flexible" or "resilient" in her response to "pressure", and in my view these are not metaphorical expressions at all. It is rather a task, that Debono has set for us, to better define some measure for both the stress experienced and the corresponding linear or non-linear strain and the "material" that undergo them. Of course, there should be no implication that people who follow Hooke's Law are in some way inferior to those who do not! The difficulty comes from the inability, in the overwhelming context provided by binary logic, to see behavior non-metaphorically as a real entity undergoing plastic or elastic deformation. This tendency is due, again, to seeing the individual and his behavior as two separable entities, rather than, following LIR, as process elements that interact dialectically.

In LIR terms, the individual *is* his behavior and the complex that these constitute reacts to external and internal flows of energy. The details of those reactions, as for any scientific context, cannot be determined by the *logic* of the situation alone, but the situation is different from the inability of logic to provide the basis for epistemic choice in an inconsistent linguistic context, as Rescher points out (2009)²⁰.

The situation seems less absolute and easier to comprehend in French than in English. One may understand a term either literally (*sens propre*) or non-literally (*sens figuré*). However, the latter is not totally devoid of dynamic content. In other words, *sens propre* and *sens figuré* are dialectically connected. Together, they better express the energetic phenomenon of deformation of the subject that is the plastic domain and the domain of plasticity.

²⁰ Rescher, Nicholas. 2009. *Aporetics. Rational Deliberation in the Face of Inconsistency*. Pittsburgh: University of Pittsburgh Press.

I will now turn to an aspect of the system of Lupasco, formulated over his entire working life, from the publication of his State Thesis in 1935 until his last book on ethics published in 1984. It refers to his conception of affect, or affectivity, and the related ontology with which, unfortunately, I fundamentally disagree.

5. LUPASCO AND THE "THIRD" STATE

In an interesting monograph²¹, Debono calls attention to a *general* need for a Lupascian feeling for an included third state in phenomena, especially at the cognitive – artistic and social – levels of reality. This third state – Lupasco's included middle – arises at the point of equilibrium of semi-actualization and semi-potentialization of contradictory states, and in going beyond the contradictions, it can be the origin of emergent entities at a higher level of reality or complexity.

To avoid misunderstanding, however, it is necessary to point out that there is a different part of Lupasco's overall theory that I believe is inapplicable to reality and its plasticity, and that is his conception of affect or affectivity. As described also by Debono, Lupasco considered the existence of human affect as something extra-logical, that is, not subject to his logic of the included middle, in fact a-logical, purely ontological, in fact the only ontological feature of the world, the only "*being*". All energetic phenomena, in this conception, were logical but part of "*non-being*". The only bridge between the two was designated as a logico-affective relation that despite my obvious bias in favor of the Lupasco approach, I find unacceptable. Not only does it violate his own precept of non-separability (functional association of opposites or contradictories), but there is no way in which a relation that carries information of any kind can be considered, without substantial anti-realism, as non-energetic.

²¹ Debono, Marc-Williams. 1996. *Lupasco et le Tiers-Etat*. In « *La plastique et le sens* ». Chap. 1. from *L'Ere des Plasticiens*, Aubin Editeur, St Etienne.

Lupasco was baffled by the "sudden" appearance - interference (*ingérance*, similar to the Whiteheadian term "*concrecence*") of affect or emotion in the world. However, his transcendental view of it seems untenable, especially since the work of Damasio and others on the feedback between mental perceived states of pleasure or pain and the rest of the body. It is accordingly counterproductive, in my view, to attempt to found morality and apply ethical principles on such an abstract base. The case for ethical behavior has been made by both Debono and myself on the Lupascian principles that focus on the logical (in our expanded sense) and interactive relation between people and between individuals and the society.

These relations, as I have discussed in a recent paper (2009)²², follow the pattern of alternating actualization and potentialization, and emergence of T-states, as laid down by Lupasco. Free will, on this basis, is an appearance (albeit a very powerful one) that is in a dialectical relationship with an opposite which is the reality of a deterministic universe. The burden of proof lies on anti-realists to demonstrate the existence of ontological indeterminacy²³ outside the realm of radioactive quantum decay.

Lupasco's tendency toward dogmatic application of his own logical theory (who of us is not inconsistent?) outside a scientifically acceptable domain led him to postulate entire universes that were the "antagonists" of ours, in which "third" T-states existed to the exclusion of others. Such concepts, taken at face value, lead to a kind of science-fiction which is not devoid of valid intuitions, but they should not be taken literally. Negative energy has been recently shown to be increasing at the expense of ordinary "bright" matter/energy and postulated "dark" matter as the driving force for the current expansion phase of our universe.

²² Brenner, Joseph E. 2009. Prolegomenon to a Logic of the Information Society. In *triple-C Cognition, Communication, Cooperation. Open-Access Journal for a global sustainable Information Society.* <http://triple-C.at>.

²³ Epistemological indeterminacy, the difficulty of prediction in the absence of complete knowledge of a system's parameters, is not a problem for LIR.

The two may be in fact in some kind of dialectical relationship, and cyclic models of the universe postulate a return to states in which the converse is true. However, further speculation or attempts to relate such phenomena to the insights of, say, Eastern religions are neither necessary nor desirable, since it is well-known that the precepts of the latter are not to be taken literally either. My realist but non-materialist position was expressed much more poetically than I could by the great American novelist Joseph Conrad (1986)²⁴ in response to the proposal that the events he recounted were "supernatural":

"The world of the living contains enough marvels and mysteries as it is – marvels and mysteries acting upon our emotions and intelligence in ways so inexplicable that it would almost justify the conception of life as an enchanted state. No, I am too firm in my consciousness of the marvelous to be ever fascinated by the mere supernatural, which (take it any way you like) is but a manufactured article, the fabrication of minds insensitive to the intimate delicacies of our relation to the dead and to the living, in their countless multitudes; a desecration of our tenderest memories; an outrage on our dignity."

It is thus for what Debono calls Lupasco's "*implacable logic*" that my entire thesis is nothing more, for me, than a tribute and an attempt at the *valorisation* of what I truly believe is the essential basis that Lupasco provided for a change in paradigm for the 21st Century. Let me turn, then, to the final topic in this overview, which is the direct dialectical relation between plasticity and poetry, one that is in addition to that between poetry and science, and to which the logic of Lupasco is abundantly applicable. All of the insights of plasticity, and its ability to deal, like LIR, with all levels of organization, interaction and reality, are valid without any absolute transcendental component, and without reduction to naïve materialism. Form and content, exactly as foreseen by Lupasco, cooperate within the dynamics of their common foundation.

²⁴ Conrad, Joseph. 1986. *The Shadow-Line*. London: Penguin Books. (Originally published in 1917)

6. THE POETRY OF PLASTICITY; THE PLASTICITY OF POETRY

If the principle of dynamic opposition and its application in the cognitive domain has the scientific and logical scope I would like to ascribe to it, dialectic relations between high-level conceptual generalizations about reality and specific examples of artistic creations as part of reality should be the rule. For comparison, I note that Lupasco's dictum that "experience is logic and logic is experience", does not of course mean that they are, or have to be identical, but that they stand in the contradictorial relation that his logic and LIR describe.

In the same sense, plasticity and poetry are not identical, but they should be seen, also, as a pair of complex entities that are, not "*antagonistic*", but in a relation of ontological non-separability. When Debono establishes the *presence* in our world of such a complex carrier of value and meaning as plasticity, this is to me also a poetic creation. It is a form of poetry, a poetry of form, that simply does not require the usual components of meter and rhyme. It is not necessary to establish any frontiers of exclusion between, for example, the didactic paragraphs of Attar and the poems with which they alternate. Even in complex prose composition, plasticity and poetry occasionally are contrasted and related in the interaction of the characters (2005, p. 347).²⁵

The experience of poetry, or indeed of any art, involves many interacting emotional, physical and intellectual components as realities, logical processes in LIR and Lupasco dialectic terms. The plasticity of poetry, accordingly, can be seen to refer to this irreversibly changing epistemological and ontological "*mind-scape*", giving form to the complex multi-dimensional spaces involved in the creation and re-creation of poetry. The principles of plasticity give necessary meaning to the intuition, expressed recently by Nicolescu referring to a paper by Henry Bauchau that "*poetry is a form of thought*".

²⁵ James, Henry. 2005. *The Wings of the Dove*. New York: Barnes & Noble Classics. (Originally published in 1902).

At this point, I wish to assure the reader that the attribution of a logical structure to plasticity and poetry in no way constitutes as reduction of their esthetic and emotional contents. Reductionist and mechanist positions can and will always be taken by some people, as noted above, but there is no necessary relation of exclusion between science and wonder at the world. They too are different ways of looking at things at different times, and when one is in the foreground, the other is in the background in the manner I have explained.

I cannot do full justice here to the many poetic passages in Debono's major early study²⁶, but his overall message, which is similar to that in Nicolescu's discussions of transdisciplinarity, is clear. Its call for the reconciliation of art and science through plasticity is not as some kind of pastime for self-indulging intellectuals. It is part of the necessary transdisciplinary changes that society must begin to implement if it is to be globally sustainable. The scientific basis for such changes will include new views of systems, complexity and symmetry. All of these will in some way involve dialectics and, accordingly, a non-standard logic that cannot be of a bivalent or multi-valent linguistic form.

7. CONCLUSION AND CONTINUATION

It is in a sense contrary to the spirit of plasticity to establish a set or sub-set of the principles of Debono, Lupasco or Nicolescu as a "conclusion", unless it is with the specific understanding that it is an emergent entity that immediately enters into further dialectic, contradictory relationships, in ones own mind and that of others. Plasticity expresses this openness in its emphasis on the interactions between forms at the level of subject, object and subject-object, to use the LIR categories.

²⁶ Ibid ref. 18

Directions for further theoretical and practical development of plasticity are suggested in the work of Debono, as well as in some exchanges that the author has been privileged to have with him. One such direction would be to establish an understanding of the distinction between the absolute, static duality of bivalent logic and forms of thought dependent on it, and the "living" active duality implicit in all complex systems and relations. It is in this sense, I believe, that Debono's view of the plastic dynamics of complex phenomenological couples at the same or different levels of reality such as space and time, innate and acquired characteristics or neurological and mental entities should be taken. The interactions involved, which follow the logic I have described as "logic in reality" are necessary and sufficient to permit a plastic "co-signification" that can lead to a "state of mind" or understanding in which all dependence on abstract duality is excluded.

The resulting dialectical plastic complexes and reciprocal plasticity are thus subjects for further investigation and for transdisciplinary education, in which the key categorial feature of non-separability is accepted as a matter of course, in a new energy-space of thought. Finally to those people, perhaps inspired by Bachelard, who might say that emphasis on the logical (hence scientific) side of art would detract from or dilute its emotional artistic dimensions, I suggest that this is not inevitable; the best of both worlds is possible, just only not all at the same time !

TABLE OF CONTENTS

1. INTRODUCTION AND OBJECTIVE
 - 1.1 What is at Stake
 - 1.2 The Need for a New Dialectics of Reality
2. LOGIC IN REALITY (LIR)
 - 2.1 Components, Axioms, Calculus and Semantics
 - 2.2 Ontology
3. THE DEBONO CONCEPT OF PLASTICITY
 - 3.1 Elasticity and Plasticity
 - 3.2 Transdisciplinarity
4. THE RE-PRESENTATION OF PLASTICITY
 - 4.1 The Plasticity of Manner and Meaning
 - 4.2 A Framework for Plastic Reasoning
 - 4.3 Model-based Reasoning
 - 4.4 On Structure and Form
 - 4.5 Plasticity "vs." Transdisciplinarity and LIR
 - 4.6 The Problem of Metaphor
5. LUPASCO AND THE "THIRD" STATE
6. THE POETRY OF PLASTICITY; THE PLASTICITY OF POETRY
7. CONCLUSION AND CONTINUATION